TECHNO RAMA'24

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CATALOGUE

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TECHNORAMA is an innovation exhibition organized by Kaunas University of Technology (KTU) and its partners, bringing together innovation creators – students, researchers, and technology enthusiasts – for over two decades.

The mission of TECHNORAMA is to inspire and support technology creators by showcasing their achievements to the public, providing funding for product development, and connecting them with investors and industry professionals.

In 2024, with the slogan 'Let's make it!', TECHNORAMA called on all innovators, creators, and tech enthusiasts to participate in the event and transform their ideas into reality.

THIS YEAR'S HIGHLIGHTS INCLUDE:

PROJECTS:	**70 innovative projects presented at the exhibition.**
PARTICIPANTS:	**Over 300 innovators showcasing groundbreaking projects.**
VISITORS:	**An enthusiastic audience of more than 1,500 attendees, including industry professionals and investors.**
PRIZE FUND:	**A prize pool of more than €15,000, dedicated to fostering innovation and supporting future development.**

PUBLIC VOTE:

PARTNERS:	**14 key partners collaborating to make the event a success.**
PUBLIC VOTING:	**Up to 15,000 votes for the best innovation from public voting.**
PITCH BATTLE:	**25 teams presented their ideas on the *Pitch Battle* stage.**

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CONTENT
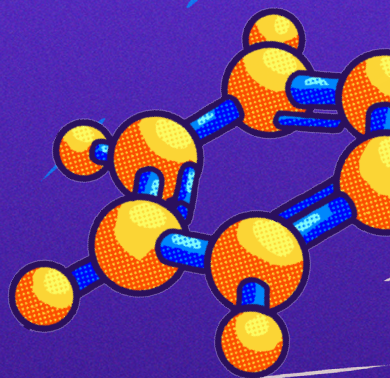
CHEMICAL TECHNOLOGIES

SMART PLANT-DERIVED VITRIMERS WITH REPROCESSABILITY, SHAPE-MEMORY, AND SELF-WELDING PROPERTIES FOR ANTIMICROBIAL APPLICATIONS

Brigita Kazlauskaitė
Sigita Grauželienė
Danguolė Bridžiuvienė
Vita Raudonienė
Mentor: **Dr. Jolita Ostrauskaitė**

Kaunas University of Technology

Field of science │ Chemical Technologies

Description of the work

Several efforts had Only 7% of plastic waste is recycled, and the majority of this waste enters the environment due to the growth of consumerism. Scientists are exploring innovative plant-derived materials, such as vitrimers, polymers with reversible bonds, for shape-memory and self-welding properties promising an extended lifespan. Incorporation of antimicrobial properties could provide benefits to healthcare as well as economics. This work aims to develop smart antimicrobial vitrimers from plant-derived materials by combining green engineering and green chemistry concepts with the objective to reduce environmental and human health impacts. Vanillin- and glycerol-based vitrimers have been developed, and their properties

have been compared with petroleum-based vitrimers. The shape-memory behavior showed ability to retain a temporary shape and return from it to the permanent shape under temperature changes, which makes them promising candidates for biomedicine, electronics, and robotics. Mechanical properties were retained after 3 reprocessing cycles, thus highlighting sustainability together with self-welding. Additionally, the antimicrobial activity of vitrimers showed higher efficacy, thereby emphasizing their potential in antimicrobial applications and sustainable alternatives to petroleum-based vitrimers.

Technical or other problems that are solved with the work

This product solves the problem of the negative effects of plastic waste on the environment and human health caused by consumerism. The proposed solution involves developing smart antimicrobial vitrimers from plant-derived materials. These vitrimers possess shape-memory and self-welding properties, which allows them to have an extended lifespan compared to the traditional plastics. The target market for this product includes industries involved in robotics, healthcare, and any sectors reliant on plastic materials. Robotic systems could benefit from the shape-memory behavior of these vitrimers. Healthcare industries could adapt their antimicrobial properties for various applications, potentially reducing the spread of infections and improving the overall hygiene. The size of the market for this product can be substantial considering the widespread use of plastics in various industries. As environmental concerns continue to increase, and regulations on plastic usage are becoming stricter, the demand for sustainable alternatives, such as smart antimicrobial vitrimers, is set to increase. Furthermore, the versatility of the product, including robotics and healthcare, presents opportunities for the expansion and further broadening of its market size.

Novelty of the work

The novelty of this work is the synthesis and investigation of smart antimicrobial vitrimers from new combinations of plant-derived monomers by a combination of green engineering and green chemistry principles. The activation of bond exchange reactions opens new possibilities in the practical applications of vitrimer features, such as self-welding, reprocessability, and

reshaping. This work represents the development of sustainable and func-
tional materials offering a solution to the challenges posed by plastic waste
and the demand for environmentally friendly alternatives.

The benefits and value to the potential users

The development of smart antimicrobial vitrimers from plant-derived mate-
rials offers significant value to potential users by addressing environmen-
tal concerns, providing healthcare benefits, offering economic advantages,
driving innovation, and promoting sustainable green engineering and green
chemistry practices for long-term sustainability by fostering environmental-
ly friendly manufacturing processes and material choices.
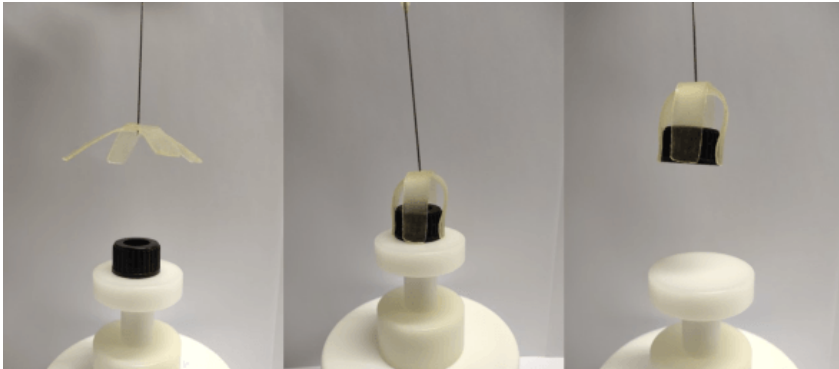
BACSTY – ELIMINATE BACTERIA, ENSURE SAFETY

Justinas Masionis
Erikas Lekerauskas
Gailė Pocevičiūtė
Tadas Prasauskas
Mentor: **Dr. Martynas Tichonovas**

Kaunas University of Technology

Field of science │ Interdisciplinary Work │ Chemical Technologies

Description of the work

Bipolar air ionizer for the reduction of microbiological indoor contamination in the food and healthcare sectors. The bipolar ionizer generates and releases both positively and negatively charged ions into the air. These ions remove or inactivate particles of the biological origin (bacteria, viruses) present in ambient air and on surfaces.

Technical or other problems that are solved with the work

Food industry needs to ensure hygiene and achieve as well as sustain a low microbiological contamination level in order to prevent food spoilage, losses and recalls from suppliers.
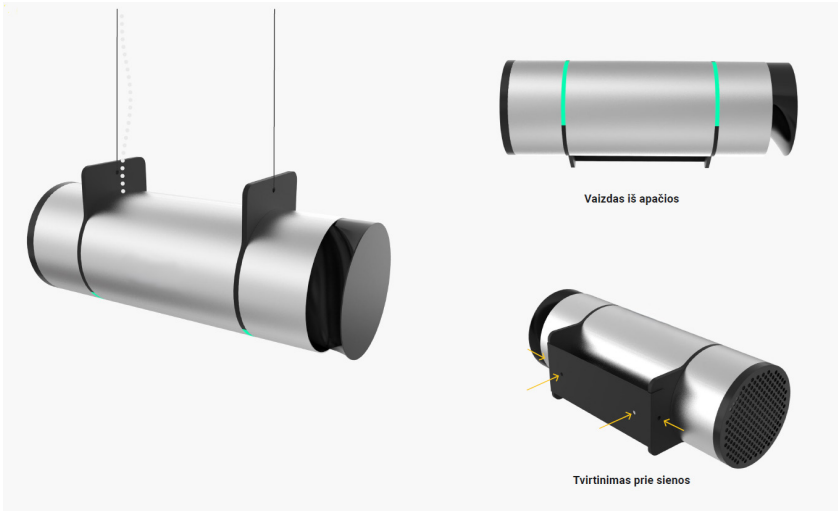
Novelty of the work

The developed technology is based on a novel air ionization system which generates active compounds, and eliminates bacteria and viruses.

The benefits and value to the potential users

BACSTY – disinfection equipment is created for companies representing the food industry. It constantly eliminates bacteria from air and surfaces.

Vaizdas iš apačios

Tvirtinimas prie sienos

HENDLEX GLASS XTREME FOR AUTOMOTIVE APPLICATIONS

Roberta Kybartaitė
Vytautas Švirinas
Mentor: **Dr. Vida Malinauskienė**

Kaunas University of Technology
UAB Baltic Nano Technologies

Field of science | Chemical Technologies

Description of the work

A highly effective automotive glass coating has been developed to withstand the test of time and adverse environmental conditions. It forms an extremely durable and resistant hydrophobic layer. The treated windows repel water, thus providing heightened visibility while driving in inclement weather. During rain, at speeds above 50 km/h, windshield wipers are not necessary as raindrops simply roll off. The coating prevents dust, dirt, bugs, and other contaminants from sticking to the glass, thereby ensuring effortless maintenance of the vehicle's windows. In winter time, this innovative coating repels ice and snow, thus making ice removal quick and easy.

Technical or other problems that are solved with the work

Long-term protection of automotive windows against dirt, limescale, water (rain) and other types of contamination is one of the most important tasks in the vehicle care sector. The main and essential feature of the product is its self-cleaning ability, which reduces the accumulation of dirt on the surface of the coating and provides an easy cleaning, while ensuring hydrophobic and,

at the same time, oleophobic properties. This product has been developed for everyone who owns a car and wants to reduce vehicle maintenance costs and time spent on maintenance. The geographical distribution of the target audience for the car care product is extremely wide – essentially, this includes all the countries of the world wherever motor vehicles are used.

Novelty of the work

This protective coating for glass is new at the global level, thanks to its unique combination of properties. In contrast to the short-term products presently available on the market, this coating remains effective on the surface for up to 12 months, protecting against rain, ice, insects as well as other types of dirt. The surface is sufficiently slippery for water drops to roll off at speeds exceeding 50 km/h. Moreover, snow or ice does not stick to the surface in winter time, and insects do not stick to it during summer.

The benefits and value to the potential users

Cleaning and maintenance of the coated glass surfaces becomes extremely easy, it lowers costs required for cleaning products and windshield wipers. In addition, due to the bonds formed between the coating and the glass surface, it becomes durable, as it remains on the surface for at least 12 months. The coating protects not only from dirt, but also from ice, rain, snow and insects. The combination of such properties ensures the conservation of human resources.
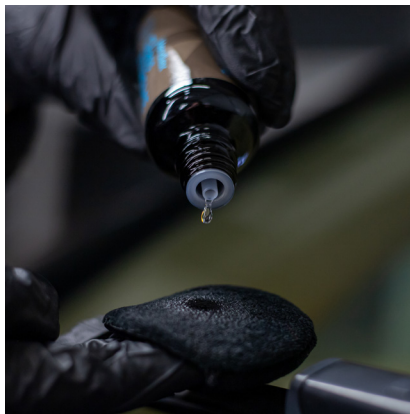
WHITE FUNCTIONAL CHOCOLATE *STRESS RELIEF:* PEACE IN EVERY PIECE, FOR STRESS RELEASE

Gabija Bagdanskytė
Toma Simanavičiūtė
Deimantė Meilutė-Ganusauskienė
Karolina Lutinskaitė
Mentors: **Dr. Loreta Bašinskienė, Dr. Aušra Rūtelionė**

Kaunas University of Technology

Field of science │ Chemical Technologies

Description of the work

A unique, innovative product was created during the work – a functional white chocolate *Stress Relief*. The developed product contains no added sugar, and has fewer calories (due to the fact that sweeteners are used). It is enriched with fiber and additives that help you stay calm in stress-ful situations: melatonin, ashwagandha, and lavender. In order to make the product suitable for a wider market, the only allergen used in its production is milk. This chocolate is suitable for people with special dietary needs: spe-cifically, it is suitable for vegetarians, gluten-intolerant people, and people on a ketogenic diet. This chocolate is recommended for those who want to reduce anxiety in a delicious way, improve the quality of sleep, and mitigate the effects of jet lag (i.e., suffering from time zones changing while traveling). When developing the product, the appropriate amount of melatonin and ashwagandha powder was selected to ensure the manifestation of the

functional properties of the chocolate. Additionally, lavender has been selected for the chocolate not only due to its soothing properties, but also for the exceptional taste and smell which it gives to the product. The impact of the amounts of these additives on the technological properties of the chocolate mass, as well as the quality and acceptability of the developed product have been evaluated. After the experiments, the quantitative composition of the composition of the functional additives was drawn up, thus ensuring excellent quality, appealing sensory properties, and the overall acceptability for consumers.

Technical or other problems that are solved with the work

Consumers continue to prioritize health and wellness, as they are looking for foods denoted by functional properties. The demand for natural, minimally processed foods with 'clean' labels, emphasizing ingredients that are considered nutritious and/or have additional health benefits, is likely to persist. Busy lifestyles, in many cases also including constant travel, have been driving the demand for convenient and functional food products. Snacks are no longer merely an indulgence; they are increasingly being seen as an opportunity to add functional ingredients and healthful nutrients to the diet. Consumers are looking for snacks that would offer a balance of taste, convenience and nutritional/functional value. The functional white chocolate *Stress Relief* has been designed to reduce anxiety, improve the quality of sleep, and reduce the effects of jet lag. This chocolate is made without the use of added sugar. It is enriched with fiber and additives that help you stay calm in stressful situations and improve the quality of sleep, notably, melatonin, ashwagandha, and lavender. On the grounds of the market analysis, after reviewing similar products on the market, it was determined that there is a need for the product we have created. Also, according to the conducted qualitative research and discussions developed in focus groups, it has been established that the product is particularly suitable and has a market demand.

Novelty of the work

The product is unique, as it has no analogues. No functional chocolate has been created on the Lithuanian market so far. The product can be used as an alternative to conventional food supplements. The desired functions of

the product are provided by the composition of selected additives: melatonin and ashwagandha powder. With its unique composition, the product performs the function of sleep adjustment and sustaining good mood, which is relevant for many people, and allows the target buyer to achieve calm in a 'delicious way' and without chewing. It will also facilitate falling asleep faster.

The benefits and value to the potential users

This is a functional chocolate for people who are leading a healthy lifestyle, who want to consume less sugar, as well as people whose lifestyle is intense, who tend to be stressed during the day, or have a tendency to worry. The selected additives of this white chocolate perform functions that help us feel better: melatonin is a hormone that is closely related to our sleep rhythm and good mood at all times of the year, and it also helps to reduce the subjective feeling of the difference in time zones and the length of time needed to fall asleep; ashwagandha is an evergreen plant, the root of which is used as a medicine to reduce stress and improve the quality of sleep, whereas lavender is a plant denoted by sedative properties, which improves the quality and duration of sleep while also reducing anxiety.

MICROFIBROUS BIOPOLYMER MATRICES FOR LIFE SCIENCE AND INDUSTRIAL APPLICATIONS

Goda Masionė
Aistė Pupiūtė
Ingrida Pauliukaitytė
Mentor: **Dr. Dainius Martuzevičius**

Kaunas University of Technology

Field of science │ Chemical Technologies

Description of the work

Our core technology integrates both solvent-free and solvent-based electrospinning processes with additive manufacturing (3D printing). This modification of the traditional 3D printing technique incorporates a high-voltage electrostatic field, transforming polymer materials into nano- and micro-sized fibers and pores. By utilizing this advanced technique, we produce innovative nonwoven materials from biopolymers, designed for multipurpose life sciences and industrial applications. The following products in life sciences sector have been pursued: micro- nano- fibrous biopolymer matrices for 3D cell culture scaffolds. These scaffolds provide a versatile framework that mimics the natural extracellular matrix, enhancing cell growth and differentiation, which is essential for tissue engineering and cultivating meat *in vitro*. We target a wide range of products in the chemical/environmental engineering sector: filter and catalyst support materials based on bio-based polymer nonwoven materials. These can be applied for

air filtration and purification systems, improvement of air quality and energy efficiency in buildings.

Technical or other problems that are solved with the work

Our technology addresses several critical challenges in both medical and environmental applications by enhancing the functional capabilities of materials while also prioritizing sustainability. Firstly, by utilizing biocompatible biopolymers, our innovative nonwoven materials significantly improve the biocompatibility of products. This is particularly crucial in medical applications such as tissue engineering, where enhanced compatibility with human tissue supports better cell growth and integration. Additionally, the unique morphology of our electrospun nonwoven materials increases the surface area, which directly enhances the functional efficiency. This improvement is vital in applications such as air filtration, where a larger surface area translates to higher filtration efficiency, effectively removing more contaminants from the air and reducing energy consumption due to lower pressure drops. Also, the advanced matrix morphology facilitates cellular cultivation by providing a stable platform for cell attachment, proliferation, and infiltration. As a result, this matrix fosters cellular proliferation and tissue genesis, establishing the foundation for artificial meat production. Finally, our use of bio-based polymers instead of the traditional fossil-based options addresses environmental concerns directly. By replacing non-renewable resources with sustainable alternatives, our technology reduces the overall environmental impact, thereby contributing to a greener and more sustainable future.

Novelty of the work

The novelty of our work lies in the integration of advanced electrospinning techniques with 3D printing technology to create multifunctional nonwoven materials. This unique combination allows for the production of bio-based polymers that are not only sustainable but adjusted for high performance in diverse applications. For air filtration, our materials provide superior efficiency with reduced energy costs due to their optimized morphology. In life sciences, we offer innovative solutions like ethical and sustainable meat alternatives that mimic the traditional meat along with advanced 3D scaffolds enhancing cell cultivation and tissue engineering. This innovation augments material performance across multiple industries while fundamentally

addressing environmental sustainability, ethical issues, and public health challenges.

The benefits and value to the potential users

3D scaffolds for cell cultivation facilitate advanced tissue engineering, by offering reliable and efficient platforms for research and therapeutic applications, thereby accelerating scientific advancements and medical treatments. Also, the technology provides a sustainable and ethical alternative to the traditional meat, by delivering products offering the taste and texture of animal-derived meat but without its environmental and ethical issues. For air filtration systems, the users shall benefit from high efficiency and easy handling, coupled with cost-effectiveness. Our filters also come with sustainability declarations, thus underscoring our commitment to environmental responsibility. The design allows for significant energy savings, while enhancing the overall sustainability, and reducing operational costs.
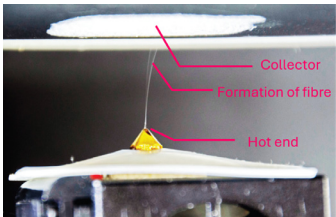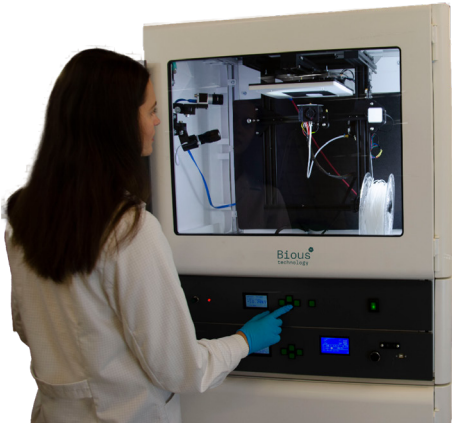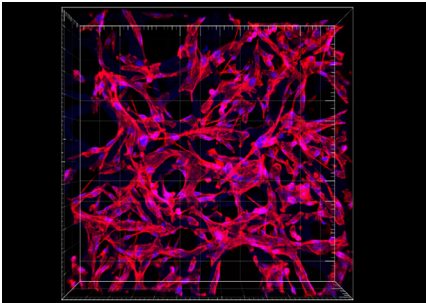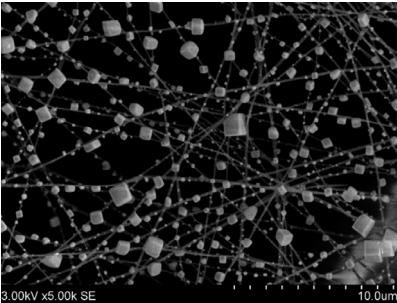
SMART SEMICONDUCTOR PANDI: FROM IDEA TO REALIZATION

Lauryna Monika Svirskaitė
Mantas Marcinskas
Ernestas Kasparavičius
Mentor: **Dr. Tadas Malinauskas**

Kaunas University of Technology

Field of science │ Chemical Technologies

Description of the work

Our research team, in collaboration with KAUST, has developed the organic electron transporting semiconductor PANDI which has already been used in the construction of perovskite solar cells. By using the innovative concept of self-assembly, the efficiency of PSC has been significantly improved. As a result, low-temperature processed PSCs with PANDI self-assembled monolayer as electron-selective contact has shown a maximum power conversion efficiency of 21.5%, thus representing the highest efficiency among the n-i-p architecture PSCs with organic electron transporting layers. Solar cells have achieved superior long-term stability under operating temperature conditions, compared to devices using SnO_2 as the n-type semiconductor. Currently, licensing negotiations with *Tokyo Chemical Industry Co. Ltd* and *American Perovskites LLC* are underway.

Technical or other problems that are solved with the work

Although the photovoltaic technology is constantly improving and the costs of devices have been decreasing, however, 4.5% of the total global electricity generation from solar cells is not sufficient To compete in the world markets, the photovoltaic technology needs to be further improved. Perovskite solar cells (PSCs) represent a technology which is currently being widely investigated and developed with the potential in the future to complement silicon-based devices Hence, it is not surprising that PSCs demonstrated one of the most significant progresses in efficiency, from 3.8% in 2009 to 26.1% in 2023. The novel concept of the self-assembling monolayer (SAM) transporting positive charges has had a significant impact on the improvement of PSCs [5]. Nevertheless, the efficiency of solar cells is also strongly dependent on the type of semiconductor selected for electron transport. There are not that many organic semiconductors which would be efficient at electron transport, and the field is dominated by expensive and not-so-easily producible fullerene; therefore, it is of importance to identify and apply less costly and more economical alternative for fullerene, and PSCs can perfectly fill this gap in the market

Novelty of the work

We have designed a material that can form a single-molecule-thick layer on a flexible, rough or uneven surface of a solar cell. The semiconductor can be coated on the surface from a dilute solution or by the spin-coating method at a low temperature, by using a small amount of material while coating a very large area of the surface. This type of material is very easy to work with and can be easily applied in industry where low-cost optimization of the production processes is fundamentally important.

The benefits and value to the potential users

Our semiconductor PANDI is cheaper, and its synthesis is simpler compared with fullerene and its derivatives, which are currently dominating in perovskite solar cells. As a result, PANDI will reduce the final production cost of commercialized perovskite solar cells due to the simple fabrication process and device architecture, while maximizing the power conversion efficiency. Considering the solar cell market, this innovation will allow perovskite solar cells to complement or compete with silicon solar cells. In a global

perspective, the further expansion of these solar cells will contribute to the development of the usage of renewable energy resources for the electricity production while providing support for reducing the climate change.

21.5%

Perovskitas

PANDI SAM

Funkcinė grupė

PANDI

„Inkarinė" grupė

ITO
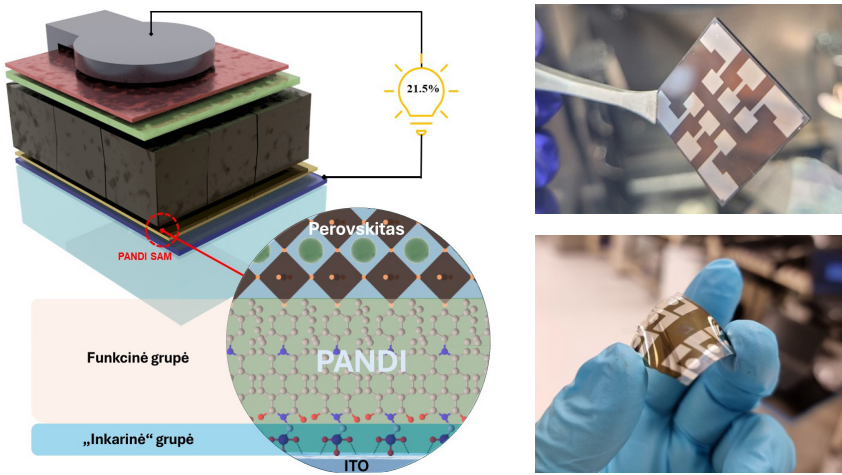
SUGAR-FREE WHITE CHOCOLATE INFUSED WITH MATCHA AND LUCUMA FIBERS – INNOVATING SWEETNESS FOR HEALTH

Estida Aleknavičienė
Vitalija Komarova
Joris Eric Pouzol
Mentor: **Dr. Loreta Bašinskienė**

Kaunas University of Technology

Field of science │ Chemical Technologies

Description of the work

At its core, the penchant for sweets is deeply rooted in human nature. White chocolate takes a special place among many consumers. Today, while people's dietary understanding has changed and they know more about the benefits and health risks related with different foods, the natural craving for sweetness persists, ingrained in the taste preferences and cultural traditions. Our project aims to increase the nutritional value of white chocolate by developing a sugar-free white chocolate infused with matcha (green tea, *Camellia sinensis*, powder) and lucuma fibers (*Pouteria lucuma*). This innovative product satisfies sweet cravings while being healthy, as it contains natural ingredients such as matcha green tea and lucuma fruit, known for their nutritional properties. With a focus on taste, texture, and health, our new creation chocolate has been designed for health-conscious consumers

who want to reap the benefits with every bite of the treat. When creating a new product, after conducting a market analysis, it was decided to test the possibilities of using matcha and lucuma in chocolate production. During the work, the influence of various quantities of these ingredients on the technological properties of the chocolate mass, along with the product's sensory properties were evaluated. Their qualitative and quantitative composition was selected in combination with other additives, thereby ensuring the best sensory properties of chocolate and acceptability for the consumers.

Technical or other problems that are solved with the work

The global white chocolate industry has been enjoying a yearly growth of 2.40%. As the trends of health and wellness continue to increase among consumers as well, producers are actively seeking inventive avenues to expand their product offerings, by aligning with the evolving needs of health-conscious individuals. Each year, the demand for natural, sugar-free, antioxidant-rich, and micronutrient-enriched functional foods sees a notable increase. However, in the traditional white chocolate, the absence of fat-free cocoa solids results in a reduction of its nutritional value. To address this issue, new product development initiatives are underway to infuse polyphenols, antioxidants, vitamins, minerals, and insoluble fibers into sugar-free white chocolate, thus elevating its nutritional content. Furthermore, the incorporation of matcha and lucuma introduces unique herbal and fruity flavors to white chocolate. Matcha contributes a subtle bitterness and earthiness, while lucuma offers a delightful sweetness akin to maple with nuances of caramel and butterscotch. These additions not only enhance the flavor profile of white chocolate but also present an opportunity for innovation, thereby catering to the evolving preferences of consumers seeking healthier, more flavorful, and distinctive indulgences.

Novelty of the work

White chocolate is not known to be a healthy product as it is sweet, fatty, and dense in calories. The idea of a white chocolate product without sugar and with the health benefits of matcha and lucuma is a novelty on the market. Furthermore, the addition of lucuma in the product acts as a natural sweetener, as this 'super fruit' is not widely used in Lithuania. The inclusion of matcha adds a distinct, antioxidant-rich flavor, while lucuma

brings a naturally sweet, nutrient-dense superfruit element. This blend not only differentiates our chocolate with its innovative taste but also enriches it with health benefits, consequently providing a guilt-free indulgence that caters to both flavor enthusiasts and health-conscious consumers.

The benefits and value to the potential users

Matcha is rich in antioxidants and may promote relaxation, concentration, and overall well-being. Lucuma is high in vitamins and minerals, such as beta-carotene, niacin, and iron. Matcha and lucuma add unique flavors to white chocolate. Combining matcha, which provides a slightly bitter and earthy taste, with lucuma, offering a sweet, maple-like flavor with hints of caramel and butterscotch, can enhance the taste profile of white chocolate, which would appeal to consumers seeking flavors beyond the 'traditional' chocolate. White chocolate enriched with functional ingredients such as matcha and lucuma can accommodate consumers with dietary restrictions or allergies, thus allowing individuals who are allergic to cocoa to enjoy the indulgence of white chocolate infused with alternative ingredients. Chocolate producers can tap into a growing market segment of health-conscious consumers seeking flavor diversity and ingredient transparency by incorporating the increasingly popular matcha and lucuma into their products, while leveraging their perceived health benefits and unique flavors.

FLAVOR EXPLOSION, ZERO REGRETS: EXPERIENCE THE CRUNCH MUSHROOM FLAVOR CRISPS MUNCH!

Laurynas Rimkus
Ieva Danieliūtė
Saulė Koženiauskaitė
Agnė Daugėlaitė
Mentor: **Dr. Loreta Bašinskienė**

Kaunas University of Technology

Field of science │ Chemical Technologies

Description of the work

The aim of this work was to create a new, balanced, and uniquely flavored snack. Following market analysis and consumer surveys, conclusions were drawn that, by including a mushroom-flavored snack in the Taler snack lineup, it should generate interest and demand. Mushroom snacks are typically characterized by an intense flavor and crispy texture, which attracts the attention of many people. During the new food product development, various flavor profile combinations and ingredient ratios were examined to offer consumers the most unique tasting product. Different types of mushrooms were tested: shiitake and boletus, combined with other ingredients and seasonings (garlic, onion, bell pepper, spinach powder). The influence of the tested ingredients and the variety of their

quantities on the technological process of the snack production, product quality, sensory properties, and acceptability was evaluated. Knowledge of food chemistry was applied to enhance the natural flavor and aroma of mushrooms. After the completion of the research, the qualitative and quantitative composition of ingredients was selected to ensure the best sensory properties and acceptability to consumers for mushroom snacks. A technology for preparing ingredients for mushroom snack production has also been developed.

Technical or other problems that are solved with the work

There are many types of salty snacks available on the market, but most of them are high in fat and use flavor enhancers. We want to offer a snack that is healthier, but at the same time has a unique and intense taste which would not be provided by artificial flavor enhancers, but can be afforded only by natural ingredients. These snacks would be bought by mothers for their children as a healthy alternative to chips (crisps), but, at the same time, the flavors could also interest gourmet consumers who are looking for new and more exciting products. Also, these snacks would be suitable for people interested in healthy nutrition and people who enjoy active leisure time. It could be a great snack during a trip, a picnic in nature, or when relaxing at home after a hard day's work. This snack is characterized and distinguished from other snacks offered by competitors as it does not make your fingers greasy, it is free from flavor enhancers, and it offers an exclusive, atypical and intense mushroom taste.

Novelty of the work

Recently, more and more people have been looking for a variety of salty snacks in the market, but they also want them to be not only tasty, but also be denoted by health benefits, which most salty snack producing companies cannot offer. Therefore, we want to offer not only an exclusive, gourmet taste, but also healthier waffle chips with dried mushrooms. You can find salty snacks with mushrooms on the commercial market, but, usually, their taste is boosted with the use of flavor enhancers. In our case, the mushroom flavor is provided to the product by natural raw materials; as a matter of fact, the addition of dried mushrooms is not yet available on the market for waffle chips of this type.

The benefits and value to the potential users

A healthier new snack has been created which uses only natural ingredients. Taler wafers are popular because they are made differently than all other chips. They are not fried in fat as they are made from raw materials of natural origin instead. Palm oil, dyes, flavor enhancers, and preservatives are not used in their production. Therefore, talers are also suitable for children. The developed chips with mushrooms are healthier than other salty snack alternatives, and they allow consumers to enjoy a gourmet taste, can be offered as a healthier alternative to regular chips, and mushrooms as an additive enrich the nutrition of the product: mushrooms contain proteins, carbohydrates, vitamins and minerals. They are a good source of folic acid, vitamin D and potassium.

CELLULOSE BASED BIOCOMPOSITES

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Laura Gliaudytė
Giedrūna Pavuolytė
Dovilė Liudvinavičiūtė
Kastytis Pamakštys
Joana Bendoraitienė
Mentor: **Dr. Laura Pečiulytė**

Kaunas University of Technology

Field of science │ Chemical Technologies

Description of the work

Biodegradable polymers represent a solution to the problems of contamination caused by the conventional synthetic polymers. For this purpose, one of the promising biopolymers is cellulose. However, it is not thermoplastic, i.e., it cannot be processed into other products by the conventional methods of the thermoplastics industry, such as extrusion, injection molding, 3D printing, etc. The product we are developing is a biocomposite consisting of a cellulose derivative matrix and a filler made of waste of the agro and food industries. It is a biodegradable composite made from renewable raw materials, which is suitable for further processing into the products by thermal methods used for conventional plastics.

Technical or other problems that are solved with the work

The extensive use of synthetic plastics is a worldwide concern because of the huge amounts of waste which is bound to take years to decompose, due to

which, the world is facing an environmental crisis. The product we are developing is a bioplastic, which is much more environmentally friendly compared to petroleum-derived plastics because it is biodegradable. In addition, raw materials for its production are obtained from renewable sources, and the waste of the agro and food industries is used in the composition. The harmful pollution and the consumption of non-renewable resources will be reduced by using bio-waste and natural materials for everyday and short-lifespan products.

Novelty of the work

A synthetic polymer matrix and synthetic or natural reinforcing materials are usually used for the production of composites. Our composites are special in the sense that both the matrix and the filler are cellulose-based materials of natural origin.

The benefits and value to the potential users

The product we are developing is biodegradable, however, it is suitable for processing by thermal methods used for the conventional plastics (extrusion, injection moulding, 3D printing, etc.). Thus, it can replace the conventional plastics and, at the same time, reduce the amount of plastic waste, including microplastics, as well as contribute to the circular economy. Moreover, the raw materials used to produce that kind of products are obtained from renewable sources, and higher added value is created by using fillers based on the waste from the agro and food industries.
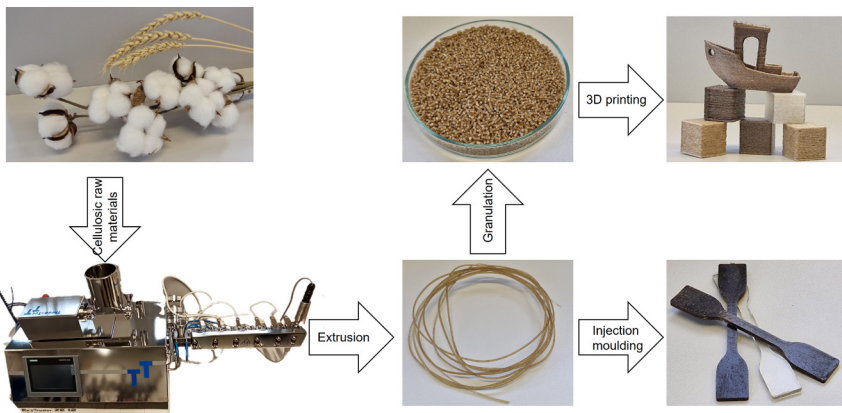
A CRISPY SNACK WITH CHICKPEA FLOUR AND CHIA SEEDS: CRUNCHY, TASTY, AND GOOD FOR HEALTH

Rytis Michalkevičius
Giedrė Zakarauskaitė
Mentors: **Dr. Loreta Bašinskienė, Dr. Aušra Rūtelionė**

Kaunas University of Technology

Field of science │ Chemical Technologies

Description of the work

In order to offer a new food product to the market, the decision was made to create a balanced and uniquely flavored crispy snack. The main goal was to increase its nutritional value by using natural ingredients rich in protein and dietary fiber. Various plant-based additives were considered for this purpose, such as carrot flour, chickpea flour, pea and bean protein concentrates, and others. Considering their technological properties, the idea was chosen to produce a crispy snack with chickpea flour and chia seeds. The product would be made by using a classic crispy snack recipe which includes: wheat flour, rapeseed oil, emulsifier – soy lecithin, water, and salt. The product would be supplemented with additives to increase its nutritional value: chickpea flour and chia seeds, as well as flavor-enhancing spices: dried dill and onion granules. During the process, the impact of these additives on the technological properties of the dough, the sensory properties of the product, and the selection of their quantities were evaluated, thus ensuring the appropri-

ate technological properties of the semi-finished product and the best sensory properties and acceptability for consumers.

Technical or other problems that are solved with the work

Currently, there is lack of healthy crispy snack alternatives in the market. Many of them contain a considerable amount of preservatives and artificial coloring, and/or flavor enhancers. They are fried in oil, due to which they incur high levels of fat and calories with low levels of protein and dietary fiber, which are essential for a balanced human diet. A qualitative consumer study revealed that the majority of consumers (7 out of 10) associate a quality snack with product characteristics such as natural ingredients, no artificial additives, nutritional value, and health benefits. Attention was directed towards this issue when developing a more nutritious alternative to the conventional snacks. Market analysis also indicates that the demand for vegetable, legume, and bread snacks has increased in recent times, as consumers perceive them as healthier alternatives to the 'traditional' snacks. In 2023, the retail sales value in the savory snack category increased by 12% in comparison with the previous year, thus reaching 132 million euros. It is projected that, by 2028, the savory snack sales will reach up to 175.2 million euros. Therefore, with the expanding savory snack market, the proposed product should be in high demand. The target market for the product would be individuals promoting a healthy lifestyle and vegetarians.

Novelty of the work

A crispy snack with chickpea flour and chia seeds is a unique and tasty product, which is perfect for a quick bite, alongside salads or with various spreads. It is not fried in fats and is made from high-quality natural ingredients. In production, no palm oil, dyes, flavor or aroma enhancers, and preservatives would be used. Compared to other savory snacks on the market, there are few products containing chickpea flour or chia seeds. They differ from the presently created product in three main aspects: the type of snack produced (flour cakes, bruschetta), the composition of the flour (chickpea and rice flour, in the case of the created product – chickpea and wheat flour), and the spices used.

The benefits and value to the potential users

Chickpea contains more than twice the amount of protein compared to cereal grains, such as wheat and rye. Chickpea boasts a well-balanced amino acid profile. Chickpea is also rich in potassium, calcium, magnesium, sodium, iron, zinc, and copper, as if contains several times more of these minerals than wheat flour. In chickpea flour, there is a low amount of fat, which helps maintain a healthy digestive system and regulate the blood sugar and cholesterol levels. Chia seeds contain antioxidants, and they also help regulate the blood sugar levels, support weight management, and their proteins serve as a good alternative to animal proteins. During the qualitative consumer study, the benefits highlighted by consumers were confirmed: great taste, concern for health, nutritional value, and trendiness. The resulting product will be enriched with 5% more protein and a 64% higher fiber content, thereby increasing the nutritional value of the snack while providing additional benefits to consumers.

DESIGN AND MECHANICS
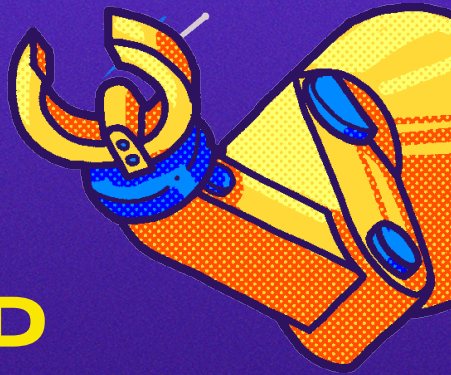
QWEAVE: WEAVING TIME AND SPACE ONE LAYER AT A TIME!

Edgaras Janušauskas
Kamilė Rentauskaitė
Emilija Mieliauskaitė
Mentor: **Dr. Jurgita Domskienė**

Kaunas University of Technology,
MB Inovatorius, Lighthouse Hub Skaitmeninių inovacijų centras,
UAB Filalab

Field of science | Design Mechanics

Description of the work

Several efforts have been undertaken to produce fabric resembling woven patterns by using the conventional, unmodified fused deposition printers (FDM). In 2019, Haruki Takahashi made an attempt, followed by Jack Forman in 2020. Both endeavors encountered a shared issue: limited bending angles, which led to cracks between layers and rendered the fabric unsuitable for practical applications. Our research introduces a genuine 'zero-layer' woven fabric, wherein the fabric warp is 3D printed, while the weft is handwoven. This offers valuable insights into the behavior of thermoplastic-based materials. Beyond merely mimicking woven textiles, this technique facilitates the creation of multi-material fabrics, while combining the optimal properties of various filaments. This innovative approach not only pushes the boundaries of the traditional textile manufacturing but also opens doors to novel applications in fields such as fashion, automotive, and aerospace industries. Moreover, it paves the way for the integration of

the 4D textile concept, enabling dynamic responses to external stimuli, and thus further enhancing the fabric's functionality and adaptability.

Technical or other problems that are solved with the work

3D printing revolutionizes fabric production, while offering complexity and customization unattainable through the traditional means. Material waste diminishes as 4D printing builds structures layer by layer, by utilizing only the necessary materials. Functional elements, such as sensors and shape-memory materials, integrate directly into the fabric, thus enabling the creation of smart textiles responsive to environmental changes. Although the setup costs may be somewhat higher initially, streamlined manufacturing combines multiple steps, ultimately leading to long-term time and cost savings, especially for customized designs. Assembly requirements are reduced significantly, thus simplifying the workflows and cutting down on the labor costs. Rapid prototyping accelerates product development without costly tooling or molds, which fosters innovation. Environmental sustainability is improved through minimized waste and optimized processes, by potentially curbing overproduction and excess inventory with custom-fit products. The market size for 3D printed fabric is currently at the niche level, but it has been growing steadily as the technology has been advancing along with an increased awareness. Its potential to expand is substantial, driven by the increasing demand for customization, sustainability, and functional textiles. As 3D printing capabilities evolve, including the use of advanced materials and faster production processes, the market is poised for significant growth in the coming years.
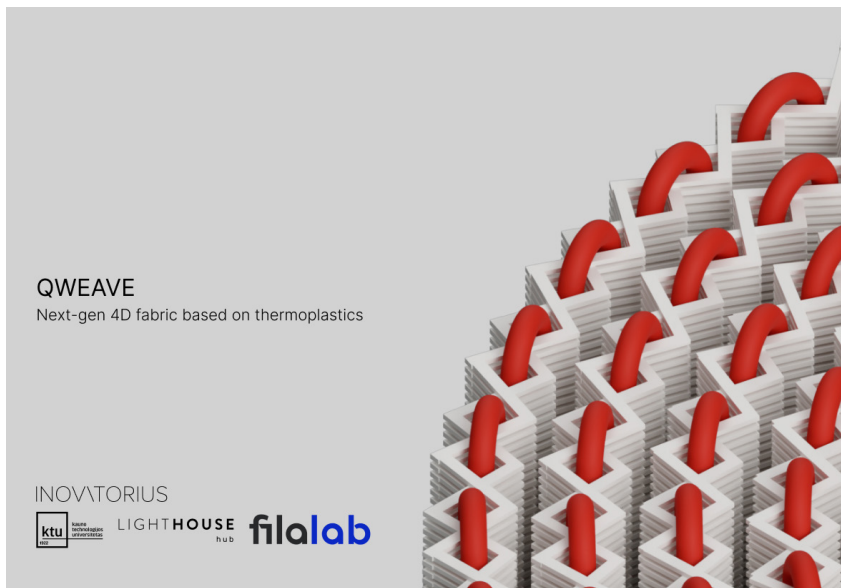
Novelty of the work

The novelty of our work lies in its innovative approach to textile manufacturing through the 3D printing technology. By integrating intricate designs directly into the fabric during production, we are breaking away from the constraints of the traditional methods while offering unprecedented levels of customization and flexibility. This novel approach enables us to create highly detailed and personalized textiles tailored to individual preferences and specific applications. Additionally, our focus on sustainability by exploring the use of recycled materials and reducing waste further distinguishes our work in the textile industry. Overall, our pioneering efforts in 3D printed fabric represent a significant advancement, by pushing the boundaries of whatever is possible in the textile design and manufacturing.

The benefits and value to the potential users

3D printed fabric offers the users customization with intricate designs, rapid prototyping, and on-demand manufacturing. Its flexibility enables tailored solutions across fashion, interior design, and medical textiles. The technology fosters creativity by allowing complex patterns and functional properties, such as elasticity and sustainability. Users benefit from reduced lead times, inventory costs, and material waste. With enhanced performance characteristics and potential for recycled materials, it aligns with the growing demand for sustainable products. Overall, its value lies in offering personalized, innovative, and sustainable solutions to meet the diverse needs of its users.

QWEAVE
Next-gen 4D fabric based on thermoplastics

INOV\TORIUS

ktu | kauno technologijos universitetas   LIGHTHOUSE hub   filalab

ORION SURFACE-TO-AIR DEFENSE SYSTEM

Karolis Žukauskas

Field of science │ Interdisciplinary Works │ Mechanics │ Electricity, Electronics and Energy

Description of the work

I am presenting my project which started as a drone constructing hobby, but soon enough turned into quite a complex device. ORION is a defense system that is meant to launch a guided projectile from the ground to an airborne target (mainly, unmanned aircraft). It uses vision-based object detection to autonomously guide itself towards the selected target. By kinetically colliding with the enemy aircraft, it would disable its ability to fly.

Technical or other problems that are solved with the work

Nowadays, drones are a cheap and expendable tool for bad actors to achieve their goals. That is why it is so important to enforce no-fly zones over sensitive areas such as in the vicinity of airports, prisons or other important and sensitive areas. This way, we could ensure that the critical infrastructure would be safe from aerial attacks.
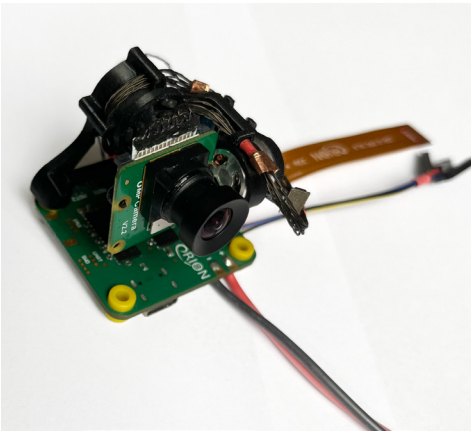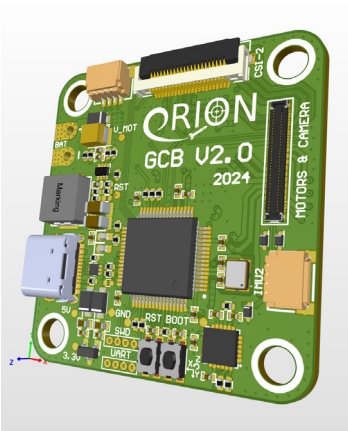
Novelty of the work

Taking out drones in restricted airspace can prove to be a difficult challenge. RF jammers are a popular choice because of their low cost and complexity. However, with advancements in the drone technology, some autonomous

drones are somewhat immune to radio interference and are able to fly even when the signal to the receiver is jammed. A guided kinetic projectile would ensure that any aircraft would be neutralized regardless of their working principle.

The benefits and value to the potential users

ORION is a relatively low-cost and easy to use autonomously guided aircraft for restricted airspace protection, which immobilizes targets on impact.

FOLD OUT BAG

Aušrinė Zavališinaitė-Kiuberė
Vykintė Trakšelytė
Ieva Poškutė
Mentor: **Dr. Erika Adomavičiūtė**

Kaunas University of Technology

Field of science │ Design

Description of the work

An innovative handbag which folds out flat and fits into hand luggage.

Technical or other problems that are solved with the work

Compactness: the bag is denoted by a small size as it can be easily folded to take up minimal space in a suitcase or a backpack.

Lightness: Made of lightweight yet durable materials.

Capacity: Although the bag is small, it can hold all the essentials such as a phone, a wallet, travel documents, and a water bottle.

Convenience: the bag features transformable handles, and therefore it can be carried over the shoulder, or carried in hand by holding its two handles.

Style: The design of the handbag is simple and modern.

The client is a hard-working, active woman who is always on the move.

Novelty of the work

Similar types of handbags are currently offered only by luxury brands and from genuine leather. The product we are developing will target the middle segment; it will be made of artificial leather.

The benefits and value to the potential users

The handbag will not take up much space, but it will come in handy on business trips, when you want to maintain a formal look while holding the most important things by your side.

LOW-COST LOAD-CELL BASED MESH LEVELLING SYSTEM FOR 3D PRINTERS

Francois Breedt

Field of science | Mechanics

Description of the work

This system facilitates flawless calibration of FDM machines by utilizing load cells embedded in the print surface. These load cells can detect when the printer toolhead touches the print surface, thereby allowing the firmware to estimate the curvature and tilt of the print bed with high accuracy. The firmware can account for the curvature to produce high quality parts and reduce print failures without any manual calibration.

Technical or other problems that are solved with the work

Most 3D printers on the market use probes requiring manual calibration whose cost is more than 20 euros. Manual calibration needs to be done frequently; it also introduces the factor of human error, especially if done by someone who is new to the technology. This innovative system requires no manual calibration, it adapts to hardware changes, and costs less than 10 euros. More and more individuals as well as small businesses are using 3D printing, and reliable printers on the market are extremely expensive. If the load-cell based system is implemented on a low-cost printer, its reliability would be similar – if not better – than that of a more expensive 3D printer.
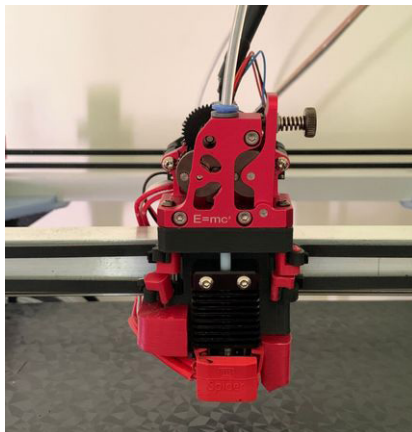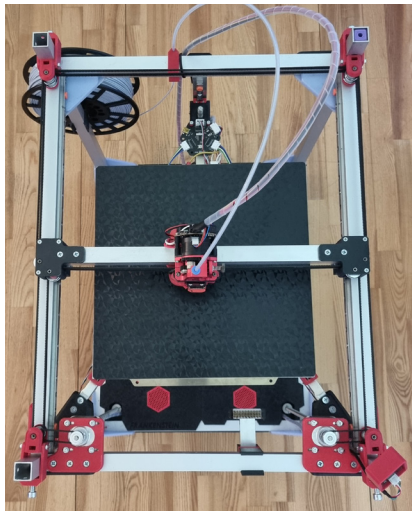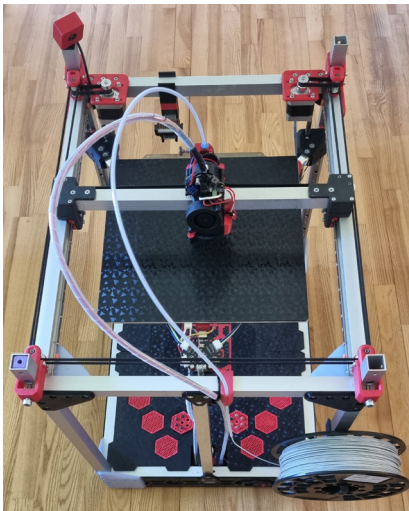
Novelty of the work

The novelty stems from the use of standard and readily available products to do something relatively advanced. Most new solutions to the problem are extremely complicated and expensive, whereas this system removes most of the complexity.

The benefits and value to the potential users

The users will receive a low-cost and easy-to-implement system that enables them to reliably 3D-print without ever calibrating the print surface.

DYNAMIC SHADE: VERSATILE PARASOLS FOR MODERN OUTDOOR LIVING

Emilija Stankutė
Mentor: **Dr. Kristina Žukienė**

Kaunas University of Technology

Field of science │ Design │ Mechanics

Description of the work

Sunlight sustains life on Earth by stimulating various processes and providing necessary warmth. However, sun rays can also pose a threat as over 300,000 cases of melanoma are diagnosed each year. Another issue during summer is an increase of particulate matter concentrations in cities during summer. They rise easily into the air and settle slowly to the ground. Inhaled particles can damage human health by affecting the respiratory tract and lungs, and by causing diseases of the central nervous system or blood vessels. For protection against UV rays and air pollution, a uniquely designed, robust and durable outdoor parasol has been created. The proposed design and mechanism of the outdoor parasol will allow the user to choose the size of the shade zone by adapting the parasol to the geometry of the buildings. For safety reasons, the textile material will detach itself from the structure when winds exceed 32 m/s. The textile material chosen for the canopy with a coat of TiO_2 will protect not only against UV rays and rain but also contribute to environmental air purification.

Technical or other problems that are solved with the work

On summer days, it is essential to seek shade or use sunscreen to protect yourself from harmful UV rays. Overexposure to UV rays can damage cellular DNA and increase the risk of skin cancer. Although sunscreens are an alternative, they do suffer from drawbacks. Sun-filtering additives break down when exposed to sunlight, causing oxidative stress, damaging cellular DNA, and increasing the risk of cancer. The traditional parasols often have fixed shade zones, which limits their effectiveness in different lighting conditions or when the geometry of buildings changes. In addition, most outdoor shading structures are not designed to withstand heavy winds and can be damaged or pose a safety risk. Moreover, in summer, urban air also has a high concentration of particulate matter, which can pose a health risk if inhaled. While street watering helps to reduce this pollution, advanced pavement technologies offer additional benefits. Scientists have shown that titanium dioxide (TiO_2), when exposed to sunlight, can break down pollutants such as nitrogen dioxide, a precursor of ozone, into harmless compounds through photocatalytic reactions. Coating parasol canopies with such coatings can not only provide protection from UV rays and rain but also reduce environmental pollution.

Novelty of the work

The novelty of this parasol is its adaptable design and durable mechanism, which allows users to flexibly adjust the size of the shade area according to their needs and the geometry of the surrounding buildings. Thanks to its durable construction, which enables to withstand wind loads, and a textile material designed to protect against rain, harmful UV rays, and reduce air pollution, this parasol offers both comfort and safety.

The benefits and value to the potential users

Parasol solutions:

- Anti-pollution feature;
- The design and mechanism allows users to adjust the shadow area according to their needs and the building geometry;
- The structure is strong and durable, capable of withstanding wind loads of up to 32 m/s;

- The textile material protects against rain and UV rays. For safety, in high winds, the canopy separates from the structure;
- The textile material is made of two parts and is easy to wash and clean;
- All the materials used in the parasol are resistant to outdoor conditions and can be recycled;
- If more than two fully expanded parasols are used in the same area, additional textile parts can be used to increase the shadow area.
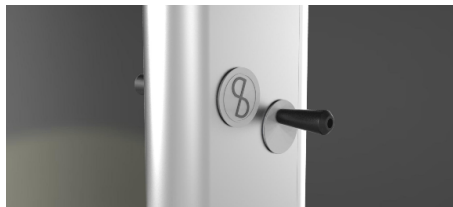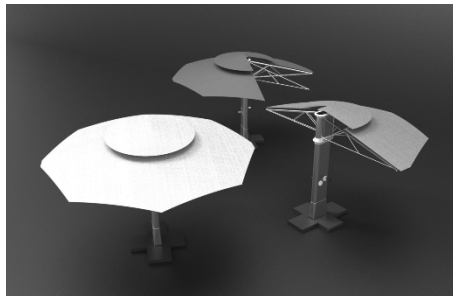
THE 'OUTDOORS KINSHIP' EVACUATION TENT

Eglė Tamaševičiūtė
Mentor: **Dr. Kristina Žukienė**

Kaunas University of Technology

Field of science │ Design │ Mechanics

Description of the work

The escalating climate change triggers increasingly severe natural disasters worldwide, claiming about 60,000 lives annually and leaving millions homeless. Temporary shelters provided after emergencies are uncomfortable, complex to use, especially for inexperienced individuals, in terms of assembly and maintenance, and lack adequate insulation from atmospheric conditions, as well as privacy. By addressing this issue, the 'Outdoors Kinship' evacuation tent offers an exceptionally easy-to-fold-and-deploy technology tent with the ability to seamlessly connect multiple tents by using modular connectors. This innovative tent, made from high-quality and durable materials, ensures resilience against atmospheric elements, while its designed door closure system allows for adjustable internal spaces as needed. The new deployment system in the tent's construction reduces the deployed product's volume by 93%.

Technical or other problems that are solved with the work

Climate change, which is one of the greatest challenges of the 21st century, intensifies annually, causing significant changes in people's lives. The rapidly changing global climate over the past 20 years has been associated with multiple natural disasters, with the number of incidents increasing by 83

percent over this period. The aftermath of the ever-more-common floods, droughts, fires, and earthquakes leaves millions of people homeless. The 'Outdoors Kinship' evacuation tent addresses numerous issues related to extreme situations and people's fates during them. The innovative design of the product emphasizes its advantages while tackling the main shortcomings of the presently offered largely inconvenient and ill-suited emergency shelters. One of the worst issues is the complex setup of the traditional tents, which can delay and cause more concerns for the evacuees. Apart from other essential advantages, our tent ensures resistance to atmospheric elements and provides safe shelter. Moreover, this evacuation tent has the capacity to accommodate large populations due to its modular connection design. This connection extends the space of a single four-person tent and provides shelter for large families or communities. It is worth noting that the tent has been designed to be connected solely with mechanical fasteners, thus addressing sustainability and consumerism issues. The potential clientele for this product includes governmental institutions (municipalities, hospitals, fire departments, etc.), non-governmental organizations (*Red Cross, Blue Yellow Foundation, etc.*), schools, universities, and military units. Considering the current global situation and emerging threats, the target range is expected to grow, while ensuring greater security for the affected population.
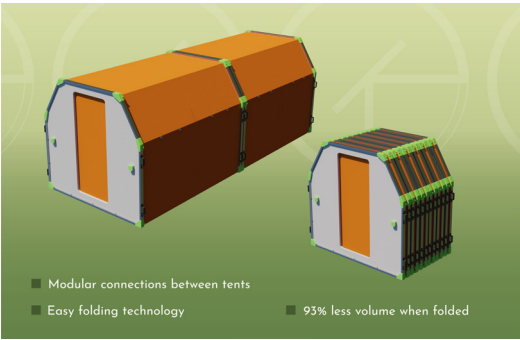
Novelty of the work

The 'Outdoors Kinship' evacuation tent stands out with its modern folding technology which utilizes a special outer tent folding technique (based on the Origami and Shibori textile folding principles) to create smooth textile folding edges during folding. This ensures easy deployment and folding of the tent. The deployed tent ensures insulation properties and resistance to environmental factors (UV radiation, moisture, etc.). The tent kit includes special modular connectors, allowing multiple tents to be connected sequentially and expanding the overall tent space. Additionally, the 'Outdoors Kinship' tent features four exits (i.e., there is an exit on each side), thus ensuring adequate tent ventilation during the hot season, privacy regulation, or quick evacuation of residents in case of emergencies. Moreover, after finding themselves in an extreme situation, the affected residents will find a first aid kit and all the necessary tent setup details in the tent, thus eliminating the need to prepare in advance.

The benefits and value to the potential users

The target audience, including governmental institutions and non-governmental organizations, is bound to receive immense value from the 'Outdoors Kinship' evacuation tent. It provides rapid setup during crises, as it meets the urgent need for efficient shelters. The innovative modular design can accommodate large populations, thus increasing versatility and saving on storage costs. With its durable construction and resistance to environmental factors, it ensures long-term reliability. Easy assembly and disassembly, along with the use of mechanical fasteners, ensure sustainability and reduce user complexity.

BREW2GO, A PORTABLE CAPSULE COFFEE MAKER

Justina Klėjūtė
Mentor: **Dr. Kristina Žukienė**

Kaunas University of Technology

Field of science │ Design │ Mechanics

Description of the work

Brew2Go is a portable capsule coffee maker that can be used anywhere, thus allowing the user to make coffee from any water source. The aim of this project is to create a portable coffee maker that is easy to assemble and clean, which could be used in various conditions. The coffee maker has been designed in a way that the user could easily disassemble the main parts of the product to clean it and insert a coffee capsule. The water tank of this portable device contains a replaceable water filter. The product also includes a removable coffee cup, so the user would not need to carry any additional containers. The design of the device is minimalist and rounded for easy portability so that it could easily fit into a backpack or a bag. A single button is integrated for controlling the system of the product. The portable coffee maker will be charged via the USB charger, thus seamlessly integrating the device with already available or car-installed chargers without the need for any additional items.

Technical or other problems that are solved with the work

Today's society has adopted a fast-paced lifestyle. Considering the daily rush, it is also worth noting that coffee has been the staple product consumed for maintaining the required energy levels since ancient times up

until the present day. Coffee can also be beneficial to health due to its high antioxidant content. Coffee and related products are among the most wide-spread products on the market. Currently, coffee lovers have a wide range of options when it comes to quick and easy coffee preparation methods – from freeze-dried coffee to drip coffee bags, and, of course, coffee cap-sules. More and more coffee roasters and companies see the capsule sys-tem as a new model for the future of coffee. Most coffee consumers do not necessarily have time for a longer coffee brewing method. There are now millions of people who have a coffee capsule brewing machine at home or in the office. Making coffee by using capsules is an extremely quick and convenient process, but most coffee machines are designed to be used at home while the device is plugged in an electricity outlet. Portable products have become highly relevant and useful not only for people who are living a fast-paced life, but also for regular travelers. Therefore, due to the popular-ity of coffee drinking and the lifestyle of today's society, a portable coffee maker becomes a notably relevant product in the market.

Novelty of the work

Brew2Go is an innovative product because the concept of a coffee maker which is portable is completely new, and portable devices are incredibly popular in today's market. Also, a replaceable water filter will be installed in the water tank of the *Brew2Go* coffee maker. The medical-grade hollow fi-ber filtration membrane and activated carbon from coconut shells in the fil-ter are bound to allow the use of water from any source for brewing coffee, as it eliminates 99% of harmful impurities, sediments, and metal particles so that the user will be able to use water from any river, lake or other water source. Most portable coffee makers on the market only work with filtered water; consequently, the development of this portable coffee maker will offer the consumer a new alternative.

The benefits and value to the potential users

By using the *Brew2Go* capsule portable coffee maker, users will be able to enjoy a fresh cup of coffee not only at home but also in any location of choice. With the help of this portable device, coffee can be prepared not only in the car or the backyard but also during remote hikes in the nature. After pre-charging the coffee maker, it can be used anywhere and anytime,

as it is adaptable to various conditions. The user has the option of not carrying additional water for coffee consumption and, with the help of the water filter which makes part of the device, a cup of coffee can be made by using water from a natural source.

BREW2GO

Portable Coffee Maker

DEVELOPMENT OF WIRELESS SELF-SENSING SYSTEM FOR AVIATION SMART COMPOSITES USING MXENE NANOPARTICLES

Gabrielė Jovarauskaitė
Mentors: **Dr. Gediminas Monastyreckis, Dr. Daiva Zeleniakienė**

Kaunas University of Technology

Field of science │ Design │ Mechanics

Description of the work

In this work, an electrically conductive sandwich-structured composite made of an aramid core coated with MXene nanoparticles, glass fiber, spray-coated with carbon nanotubes, and unidirectional carbon fiber is investigated. The main idea of the project is based on the composite's self-sensing principle which relies on the piezoresistive effect of electrically conductive nanoparticles. When defects occur, the integrity of the structure can be evaluated based on the change in the electrical properties. By using a sandwich-structured composite, a 13 × 27 cm wing prototype with 6 output channels connected to an Arduino Nano ESP32 microcontroller has been fabricated. The Arduino microcontroller measures the resistances in the channels in real time and transmits them to the *Arduino IoT Cloud Remote* smartphone application via Wi-Fi, where defects and their propagation can be graphically monitored.

Technical or other problems that are solved with the work

Due to their excellent weight-to-strength ratio, composites are utilized in various sections of aircraft. Despite the significant benefits they offer, composites are vulnerable to defects such as cracks, debonding, delamination, and fiber breakage. Over multiple flight cycles, unnoticed weaknesses can escalate into structural integrity failures, consequently posing a risk to aircraft safety. Early detection of these defects is essential to prevent such failures. The aircraft structure condition is regularly inspected during maintenance by using *structural health monitoring* (SHM) methods employing sensors such as strain gauges and optical fibers. However, these methods have limitations in terms of time and resources. Another SHM technique relies on self-sensing composites incorporating electrically conductive additives to generate a piezoresistive effect, thus indicating potential structural damage. This study aimed to develop a self-sensing sandwich-structured composite using MXene and CNT nanoparticles. Experiments revealed that damage could be estimated based on changes in electrical resistance which gradually increase with the appearance of damage. The developed SHM method effectively detects fiber cracking, delamination, and core material indentation. Additionally, a wing prototype equipped with a wireless self-detection system demonstrates real-time monitoring of composite damage, which is crucial for the aviation industry.

Novelty of the work

In Lithuania, there is currently lack of initiatives in developing self-diagnostic composites. Additionally, the exploration of MXene nanoparticles is still in its infancy, with limited dissemination in research literature. However, the focus of this project presents a promising path from both scientific and practical perspective. Successful outcomes have the potential to elevate the competitiveness of Lithuanian enterprises within the broader European market landscape.

The benefits and value to the potential users

This new technology offers a significant advantage over the currently available sensors manufactured at the industrial level. It can detect both the location and the size of damage, and not merely on the surface, but also within the material itself. This capability promises cost savings on mainte-

nance. Moreover, it is a novel solution applicable across various industries such as the automotive, aerospace, and wind turbine industries. Its adaptability could revolutionize the way we identify and address damage, thus improving safety and boosting efficiency.
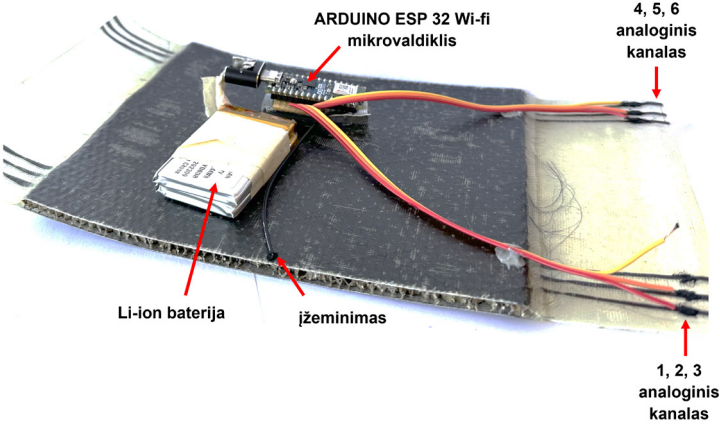
AUTONOMOUS DRONE DELIVERY SYSTEM USING ARTIFICIAL INTELLIGENCE

Muhammed Ammar Abdullah
Mentor: **Muhammed Ammar Abdullah**

Field of science │ Interdisciplinary Works │ Mechanics │ Natural Sciences and Mathematics │ Information Technologies

Description of the work

This project explores the development and implementation of an autonomous drone delivery system utilizing artificial intelligence (AI). It addresses key challenges in the current delivery systems, such as inefficiency and high costs, by integrating advanced AI technologies for navigation, obstacle avoidance, and efficient delivery management. The system design includes machine learning algorithms for real-time decision-making and a robust simulation environment for performance testing. The key components involve computer vision for environmental perception, path planning algorithms for optimal routing, and reinforcement learning for adaptive behavior in dynamic settings. Simulation results and field tests have demonstrated the system's effectiveness in improving the delivery efficiency and reliability. The findings highlight the significant potential for autonomous drones to revolutionize the logistics industry, by virtue of offering faster, cost-effective, and environmentally friendly delivery solutions. This project lays the foundation for future advancements and a wider adoption of AI-driven drone delivery systems.

Technical or other problems that are solved with the work

The autonomous drone delivery system addresses several critical problems in the current delivery logistics. The traditional delivery methods are often inefficient, costly, and environmentally taxing, relying heavily on ground vehicles that contribute to traffic congestion and increased carbon emissions. Furthermore, these methods can struggle with timely deliveries, particularly in densely populated urban areas or remote locations. Our system leverages AI to revolutionize the delivery process by enabling drones to operate autonomously. This solves the problem of inefficiency by providing faster, as well as more reliable delivery times, bypassing ground traffic and thus reducing delays. It also enhances the operational costs, as drones require less maintenance and fuel compared to the traditional delivery vehicles. The AI-driven navigation and obstacle avoidance capabilities ensure safe and precise deliveries, even in complex environments. Additionally, our solution addresses environmental concerns by utilizing electric drones, and thus significantly lowering the carbon footprint associated with delivery services. This makes the system not only economically advantageous but also environmentally sustainable. Overall, our autonomous drone delivery system offers a transformative approach to logistics, enhancing efficiency, reducing costs, and minimizing the environmental impact, which paves the way for the future of smart delivery solutions.

Novelty of the work

The novelty of our work lies in integrating advanced artificial intelligence (AI) technologies to create a highly efficient and adaptable autonomous drone delivery system. The key innovations include the use of cutting-edge AI algorithms for navigation, obstacle avoidance, and real-time decision-making, which allows drones to operate safely and precisely in complex environments. Our system utilizes machine learning techniques to optimize the delivery routes and improve the operational efficiency. By learning from delivery data, the system continuously enhances its routing decisions, thus reducing delivery times and costs. Additionally, the incorporation of computer vision enables drones to accurately perceive and interpret their surroundings, while enhancing obstacle detection and navigation capabilities in the process. Reinforcement learning allows the drones to adapt their behavior based on real-time feedback, thus ensuring continuous performance improvement, particularly in dynamic or unforeseen scenarios. This adapt-

ability enhances the overall reliability and efficiency, making our system robust and dependable. We have developed a comprehensive simulation environment for rigorous testing and validation, ensuring a robust and reliable solution before deployment. The environmentally sustainable design, using electric drones, significantly reduces the carbon footprint of delivery operations, aligning with regulatory and consumer demands for greener practices. Furthermore, our system's versatility makes it applicable across various industries, including retail, healthcare, and emergency services, which demonstrates its wide-ranging potential and innovative approach to the modern delivery challenges.

The benefits and value to the potential users

The autonomous drone delivery system offers significant efficiency and speed improvements. By navigating directly to the delivery points, drones can bypass traffic, which offers drastic reduction of delivery times. Enhanced scheduling and real-time adjustments ensure timely service, even during peak hours or in remote areas, thus providing a more reliable delivery experience. Cost savings are another major benefit. Autonomous drones offer lower operational costs due to reduced maintenance and fuel requirements compared to the traditional delivery vehicles. Their scalability, with minimal human intervention needed, also helps reduce labor costs, which makes them an economically advantageous option for businesses. Their environmental impact is greatly minimized with the use of electric drones which produce no emissions. This contributes to greener, more sustainable delivery solutions. Additionally, by utilizing airspace, drones alleviate pressure on the road infrastructure, thereby reducing the overall traffic congestion and further benefiting the environment. An enhanced customer experience is achieved through reliable and secure deliveries. AI-driven precision ensures that packages are delivered accurately and safely, which augments customer satisfaction. The ability to reach hard-to-access locations adds convenience for customers in both urban and remote areas. Safety and security are integral to the system, with advanced AI algorithms ensuring safe navigation and minimized risk of accidents. Real-time tracking and secure drop-off mechanisms ensure that packages are delivered safely and to the correct recipient, thus providing peace of mind for users. The adoption of the drone delivery technology allows businesses to innovate and stay competitive. It enables market differentiation by attracting tech-savvy cus-

tomers who value cutting-edge solutions. Moreover, embracing such innovative delivery methods prepares businesses for future trends in logistics and evolving customer expectations. Lastly, the flexibility and adaptability of drone delivery systems makes them suitable for various industries, including retail, healthcare, and emergency services. AI enables drones to adapt to changing conditions, such as weather or traffic, while ensuring consistent performance and reliability. This versatility makes the system a valuable addition to a wide range of applications.

NEAT – THE EATING TOOL DESIGNED TO HELP PEOPLE WITH PARKINSON'S DISEASE

Donata Borovikovaitė
Mentor: **Donata Borovikovaitė**

Kaunas University of Technology

Field of science │ Design │ Mechanics

Description of the work

'nEAT' is an eating tool designed to help people with Parkinson's disease or other hand movement restrictions. The device aims to improve the quality of eating and to encourage people with Parkinson's disease to be independent and gain in self-confidence. The stabilizing mechanism in the spoon's handle will ensure that the food does not fall off or spill. The selected materials for eating devices manufacturing ensure impact resistance and durability. The design of curved and round shapes allows a comfortable hold on the device in different ways, whereas the special non-slip, soft handle part not only prevents the tool from slipping out of the hand, but also diversifies the design according to the user's wishes with a range of colors on offer.

Technical or other problems that are solved with the work

About 10 million people worldwide are suffering from Parkinson's disease, the most common symptom of which is uncontrollable tremors. As technol-

ogy advances, there is a growing interest in the development of various assistive devices with promising features for tremor reduction. Although most of these are in the early stages of development, some devices have already been approved as FDA (*Food and Drug Administration*) Class I medical devices and are commercially available. However, many patients with Parkinson's disease still do not have access to this new technology. Uncontrolled tremors cause many difficulties in a person's daily life. One of them is eating. It is a real challenge for people with Parkinson's disease to eat neatly and easily while using the ordinary utensils. Because of this problem, cutlery designed and adapted for people with hand tremors has appeared on the market. However, the assortment of such eating tools is quite limited, and they are, in many cases, prohibitively expensive. Due to the feeling of instability, as well as frequent incidents of food spilling, people with Parkinson's disease lose self-confidence, go out to eat in public less often, and, generally, feel uncomfortable. Tools specially developed for people with Parkinson's disease would help them regain self-confidence and improve their psychological health. They would ensure the feelings of security and stability, and would allow a person to remain self-sufficient as long as possible.

Novelty of the work

The 'nEAT' eating tool created for people with Parkinson's disease differs from the presently available options in several aspects: the product is denoted by an ergonomic design, it is comfortable and easy to operate, while its soft and non-slip handle ensures comfort when using the tool. Unlike other products on offer, 'nEAT' features a rubber handle which comes in different colors, thus allowing the users to customize the design according to their preferences with a touch of individuality. The harmonized design, ergonomic and user-friendly solutions ensure easy maintenance, thus further simplifying the use of the device. By meeting the needs of Parkinson's patients, this spoon is an important step forward in promoting independence and improving the overall quality of life.

The benefits and value to the potential users

An eating tool designed specifically for people with Parkinson's disease provides a game-changing solution for everyday dining. This product, engineered with ergonomic precision with innovative stabilization functions

promotes independence and self-confidence during mealtimes. The new technology ensures the stability of the spoon part, the mechanism in the tool suppresses the vibration amplitude and allows the person to enjoy the food. By prioritizing functionality and user-centered design, 'nEAT' significantly enhances the daily lives of Parkinson's patients, while ensuring comfort and ease of use.

ELECTRICITY, ELECTRONICS AND ENERGY

HOME USE 3LEAD ELECTROCARDIOGRAPH

Gabrielius Zagainov
Mentor: **Dr. Vytautas Daunoras**

Kaunas University of Technology

Field of science │ Electricity, Electronics and Energy

Description of the work

An economical 3-lead electrocardiograph designed for home heart monitoring allows users to observe their electrocardiogram in real time on a computer, while the pulse is clearly displayed on an integrated OLED screen.

Technical or other problems that are solved with the work

This product will solve an important problem related to heart health monitoring at home. Many people experience heart rhythm abnormalities that may go undetected for a long time because professional medical monitoring devices are expensive and only available in healthcare facilities. This product is a cost-effective and easy-to-use device for daily cardiac monitoring.

Novelty of the work

The main advantage of this product over other home electrocardiographs on the market is its price. The price of this device is half that of other similar electrocardiographs available on the market, which makes it more accessible to a wide audience of users.

The benefits and value to the potential users

This product allows potential users to conveniently and affordably monitor their heart health at home. This allows for early detection of heart rhythm disorders, such as arrhythmia or an unstable pulse, and prompts timely medical attention. Early diagnosis can prevent serious health problems and reduce the cost of medical interventions. In addition, regular heart monitoring helps users feel safer, improves their quality of life and provides peace of mind by virtue of knowing that their health is being constantly monitored and controlled.
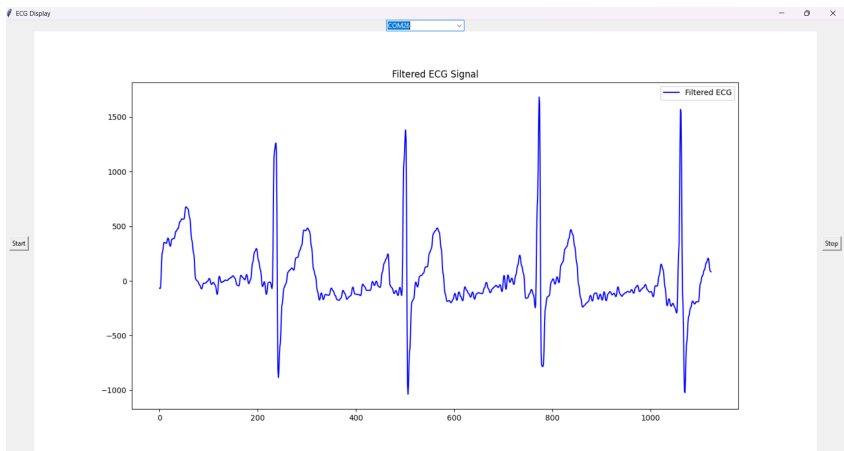
SMART ELECTRIC CONTROLLER: EFFICIENT USE OF ELECTRICITY

Benediktas Valatka
Austėja Stipinaitė
Smiltė Bendziūtė
Arūnė Dunauskaitė
Mentor: **Julija Ilonienė**

Kaunas University of Technology

Field of science │ Electricity, Electronics and Energy

Description of the work

By monitoring market prices, our product observes devices in the home and controls how to use cheaply produced solar energy during the day-time, when electricity is more expensive, or when it is needed while being unavailable. When a person returns home from work, they need not worry about the comfortable temperature of their home or a warm shower, and their car is charged with cheap energy produced or purchased during the daytime, instead of having to pay substantially more for the consumed electricity when the price of electricity rises in the evening.

Technical or other problems that are solved with the work

The problem we are solving is that, during the daytime, when electricity is cheap due to the large amount of solar power plants on the market, the consumption of electricity is very scarce, whereas, in the evening, when the sun is no longer shining, and when people return home and start using

large amounts of electricity, the price of electricity starts rising, and, instead of using cheap daytime electricity, the consumer uses expensive evening electricity. Our target customers are consumers who have solar power plants, heated/cooled houses, electric cars and/or electricity accumulators (batteries), and also those consumers who want to save on electricity and pay lower bills. This market is really immense, because there is definitely a sizable part of the population producing electricity and willing to save.

Novelty of the work

Currently, there are not many similar solutions on the market apart from smart homes or heat pumps.

The benefits and value to the potential users

The value for users is that they will save from 200eur per year while also being more environmentally friendly.

GPS_TRACK_V.2.0 – WIRELESS POSITION LOGGER

Deividas Kairiūkštis
Dominykas Simpukas
Eimantas Triaušys
Andrius Galinskas
Mentor: **Dr. Pranas Kuzas**

Kaunas University of Technology

Field of science │ Electricity, Electronics and Energy

Description of the work

The *Wireless Position Tracking Device*, or GPS_TRACK_V.2.0, is a position tracking and transmitting device, aimed to be used in sports events and competitions, such as marathons, bike marathons, etc., where position tracking is mandatory, and events or competitions extend over many hours or even days. The device has been designed for low power consumption, it can work in harsh environments, collect GNSS data, and then, after calculating the current position, the output is sent via the LTE-M/2G wireless network to a remote server, where the data is stored in the database. Users and organizers can monitor the positions of the participants on the created website in real time and view the history of the proceedings. The device also features a minimal user interface, supports Wireless Qi charging, and has a custom-designed and 3D-printed housing which meets the IP64 Standard and features a universal mounting method.

Technical or other problems that are solved with the work

Various orienteering, yachting, cycling and other competitions are held in Lithuania and abroad. They often cover long distances (sometimes

covering even hundreds of kilometers) and can also last more than one day. When such competitions are held, it is difficult to continuously locate the participants on the track by using only human or technical resources (e.g., filming equipment, judges, or hired/volunteering personnel directly participating in the competition). In this way, one of the main objectives of the competition organizers is to ensure fairness, which, among many aspects, prevents the participants from deviating from the planned course by taking a shorter route. Also, various injuries or life-threatening situations often occur during extreme sports competitions. In such situations, it is of importance to react quickly and notify the relevant services of the participant's location. Currently, there are no cheap, long battery life sports-aimed trackers made in Lithuania to solve the above problems. The market demands the creation of a tracker, with the main objectives being long working hours, a small size and durability. The market is not immense in Lithuania, but it is growing with every passing year because more and more people are getting into bike sports, running marathons, and, overall, healthy lifestyle.
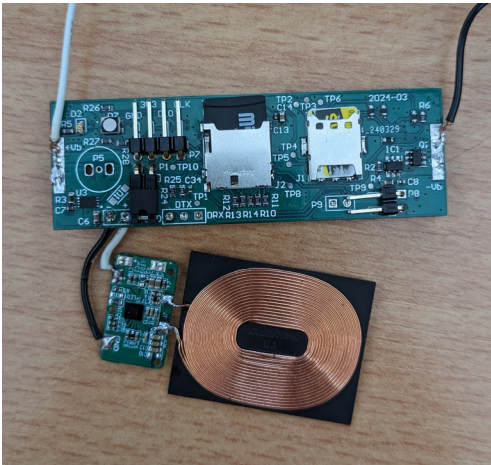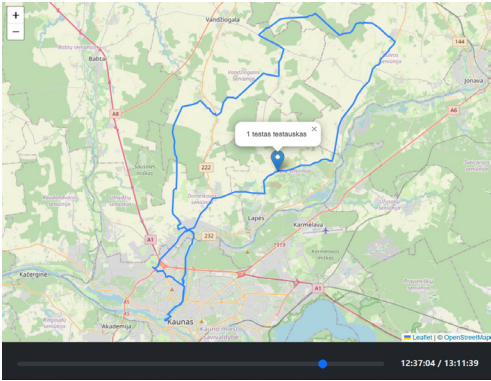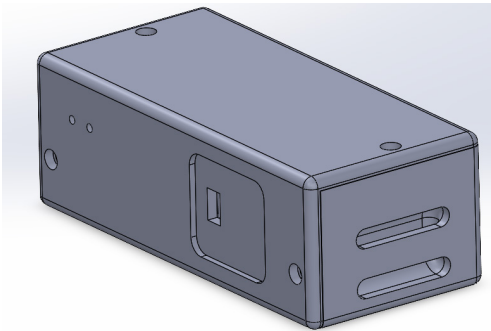
Novelty of the work

The device uses the energy-efficient *LTE-M* technology (under poor signal conditions, it can switch back to 2G), with an operating time of up to 70 hours. Also, the device's hardware solution in the future would allow for an increased position accuracy, or else it would even continue the prediction of the movement trajectory for a short time after the loss of the GPS signal. In addition, if the device detects a possible accident, then, the competition organizers would be promptly notified. The architecture of the system allows many competitions to be held simultaneously.

The benefits and value to the potential users

It will be a local product, aimed at the local needs and local events. Therefore, the organizers will find it easier to set up. The device has been designed to be as cheap as possible, thus ensuring low rent costs. Also, the provided online tool enables watching competitions in real time along with the opportunity to trace their history. After the event, it could help athletes to analyze their performance and facilitate judging to ensure fairness, by giving each contestant a compact device with a universal mounting option.

The tracker would send the data to a remote server at the customer's preferred period, while simultaneously backing up data to the device's internal memory.

SMART NIGHT VISION GLASSES

Aurimas Junevičius
**Simonas Riauka**
Arnas Piaulokas
Mentor: **Dr. Pranas Kuzas**

Kaunas University of Technology

Field of science │ Electricity, Electronics and Energy

Description of the work

Night vision devices have been gaining more and more popularity in the context of hunting, recreational activities, and strategic tactical tasks. The availability of thermal sensors-cameras on the market along with high-performance modern microprocessor platforms allows the implementation of portable solutions in the form of digital wearable glasses. The presented device also belongs to this class of devices. The device consists of optical and thermal cameras, infrared illumination, a microcontroller, and a screen. Image processing and the displaying of additional information on the screen is performed in real time (at the frame rate of the thermal camera). The screen is installed in the body of the glasses, which is designed as a wearable device. The device can navigate in the dark by using IR illumination and an optical camera, or perform lightless surveillance with a thermal camera.
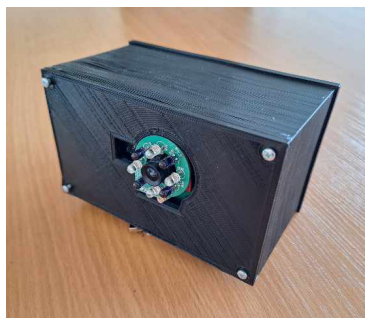
Technical or other problems that are solved with the work

Humans are not innately able to see well at night, but some circumstances make it necessary to work in the dark, and the technologies used to achieve this incur a number of disadvantages:

1 Night vision goggles make it easier to recognize the environment and see clear objects, but most of the work in the night field emphasizes the detection of live objects, which is not easy in the available green/blue shades of the screen.

2 The thermal vision technology distinguishes heated (or warmer) objects from the environment, such as animals or people, but when you try to walk or otherwise move with such glasses on, natural objects in the environment merge into one color and become indistinguishable; as a result, you cannot move efficiently around obstacles.

The project we have created combines two imaging methods into one: contours of thermal bodies are drawn on a night vision image, thus avoiding individual flaws and creating an easy-to-wear system. This type of device could be beneficial for hunting, defense, and leisure markets. Specifically for hunting, such a device would combine the use of two devices into one, whereas, for the application in the military, the solution would enable an individual soldier to perform night operations with the same efficiency as during the daytime. Both areas are denoted by massive demand in all countries, and, especially with the increasing defense budgets, the demand for this type of defense technology is only bound to increase.

Novelty of the work

The developed device differs from the currently available analogues in that it implements a combined thermal and night vision image in an easy-to-wear and portable goggle case.

The benefits and value to the potential users

The user will be able to choose between seeing night/thermal or both combined images at the same time, thus eliminating the need to carry two different devices and simplifying the use. The combined image gives a unique opportunity to use the advantages of both technologies for much more effective work in the dark. The free configuration of the device with menu items adapts the device for real-life use in any environment.

HIGH RESOLUTION PCB UV EXPOSITION DEVICE

Rimas Bacevičius
Martynas Kišonas
Vytenis Kibildis
Abdul Salam Asif
Tchuisseu Ndjionkou Armel
Gante Shankar Dhanalakshmi
Mentor: **Dr. Pranas Kuzas**

Kaunas University of Technology

Field of science │ Electricity, Electronics and Energy

Description of the work

Prototyping in electronics engineering is directly related to the production of printed circuit boards. Factories in Europe and the People's Republic of China can currently offer printed circuit board prototyping services at very attractive terms. However, in some cases, during the experimental development stage of projects, it is not necessary that the printed circuit board prototype should have all the layers of the final product (solder mask, metallization, the screen printing layer). There are also cases when prototypes of printed circuit boards with a relatively large area are required (power supplies, various planar antennas). In those cases, the cost of the prototype increases. Production and shipping times also directly affect the cost of the prototype.

Technical or other problems that are solved with the work

When choosing a prototype of a lower cost, you are made to wait for a long time for the prototype itself, which slows down the development of

the project in cases where the budget is limited. This provides a basis for developing prototyping techniques that an electronics engineer could use in their workplace. Prototyping by using chemical technology gives good results, but the result of the final prototype directly depends on the quality of the exposure mask.

Novelty of the work

The proposed laser exposure unit is a high-resolution solution. In order to obtain the best result of laser exposure, a compact, rigid and light mechanical system has been designed and manufactured, and specialized software and control solutions have been implemented. In order to get the result, engineering problems from the fields of mechatronics and electronics engineering have been solved.

The benefits and value to the potential users

By using the supplied high-resolution laser UV exposure unit, a high-resolution printed circuit board prototype can be produced quickly, cheaply, and with the use of fewer chemicals.
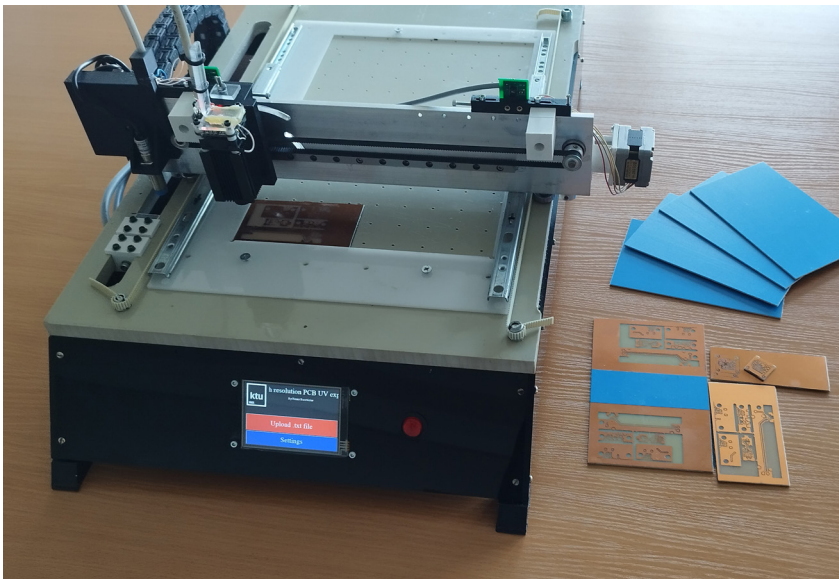
CLAIR – MOBILE AUTONOMOUS PARTICULATE MATTER SENSOR

Dovydas Liutkus
Domantas Savickas
Dovydas Bernatavičius
Kostas Čaplinskas
Mentors: **Dr. Darius Gailius, Dr. Andrius Chaziachmetovas**

Kaunas University of Technology

Field of science │ Electricity, Electronics and Energy

Description of the work

A particulate matter concentration measurement module has been developed which is intended for mobile applications (buses, cars, bicycles). The goal of the module is to collect particulate matter (PM1.0, PM2.5) pollution data. It is self-sustainable with the help of solar panels. The module sends data to a web server, where a pollution map is shown by color-coding the data.

Technical or other problems that are solved with the work

Every year, around 250,000 people in Europe (2020) die prematurely due to exposure to the fine particulate matter PM2.5 (<2.5 micron-sized particles). The concentration of these particles can only be measured by sophisticated and expensive sensors, and the amount of publicly accessible data from these sensors is limited. We are solving this problem by creating

movable stations which would collect and display data online in the form of a pollution map. This innovation has already gained interest from *Kauno autobusai* for measuring air quality inside and outside of the buses. It could also be in the frame of interest of the municipality to inform the public about air pollution and to efficiently locate cases of illegal pollution (such as burning tires, plastics, etc.). Individuals could purchase our product for tracking particulate matter concentration in their personal environment. Our market would cover individual buyers, the Government, and businesses: our predicted market size is 200,000 euros, and it will grow as the green movement is gaining traction. We will start by installing our modules on public transport buses in Kaunas, and we predict that other municipalities will follow suit.

Novelty of the work

Our primary innovation is that the product is intended to be used on the go as opposed to the current, stationary solutions. We expect to achieve this level by using autonomous power from a solar panel and an internet connection to easily access data anywhere. Another part of our innovation is public accessibility and a user-friendly website. Data is not only used for research purposes; it can also be accessed by anyone curious and aware of pollution.

The benefits and value to the potential users

The product is intended to raise public awareness of pollution in cyclic and short-term (extreme) cases. This knowledge would encourage people to lower emissions in transportation and heating (especially regarding the use of coal) and could indirectly improve the population health and lower the premature death count. The Government could use our real-time data to locate illegal human-made air contamination sources.

SOBOTZ – DC MOTOR TESTING STAND

Tomas Sobutas
Mentor: **Tomas Sobutas**

Kaunas University of Technology

Field of science │ Electricity, Electronics and Energy

Description of the work

This project is used to measure the parameters of small DC motors: RPM, stall torque, current, voltage, and temperature. These parameters are displayed on an LCD and relayed through UART to a PC.

Technical or other problems that are solved with the work

These motor parameters are relevant for robot developers since the motors available on the market largely differ, and not all motors have the same power or speed. Therefore, it is of importance to know the real, rather than the declared, parameters. The market is limited, which means that it is at a hobbyist level, and this project is more focused on selling (i.e., comparing with the already existing competitors in the market) specially designed motors under the *SoBotz* brand.

However, STEAM activities are bound to develop not only today, but also in the nearest future, including robotics clubs, which means that advanced robot developers may find it relevant to have a supplier of high-power motors with a good price-quality ratio in Europe. This also applies to other products and services aimed at the robotics market.

Novelty of the work

Affordable testing stands are not readily available online, and, based on the developer's research, most solutions are directly coordinated with manufacturers. As a result, there are limited options for purchasing such stands commercially.

The benefits and value to the potential users

Precise measurements are provided along with the purchased product (motors), including the measurement methods. It is an open-source project; thus, the buyer can delve into how the measurements were taken.
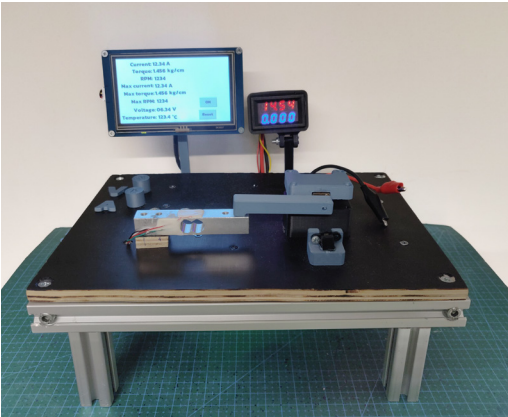
LEG POSITION DETECTION DEVICE

Andrius Striūna
Mentor: **Dr. Mantas Jucevičius**

Kaunas University of Technology

Field of science | Electricity, Electronics and Energy

Description of the work

A device for detecting the activity of patients' legs and their position.

Technical or other problems that are solved with the work

People who are bedridden for a long time (either in clinical or in outpatient settings) have an increased risk of blood clot formation. To reduce this risk, it is necessary to move and change the position of the limbs. Therefore, it is essential to monitor the position of such patients during the outpatient period. This device would remind patients to move/change position if they remain inactive for too long. The information obtained from this device can be used to create interactive games that encourage patients to move more.

Novelty of the work

Many studies based on inertial devices analyze human movements (such as walking or running). Determining the position with an IMU (Inertial Measurement Unit) is a fairly complex task. For this purpose, optical marker systems are often used as a supplementary tool. Therefore, effectively determining
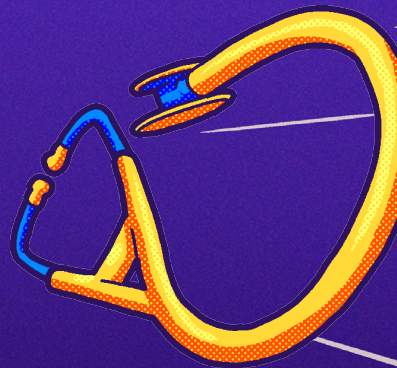
the leg position without additional equipment (i.e., by using only IMU) would be a new and economically beneficial solution.

The benefits and value to the potential users

Reduced risk of blood clot formation, encouraged activity
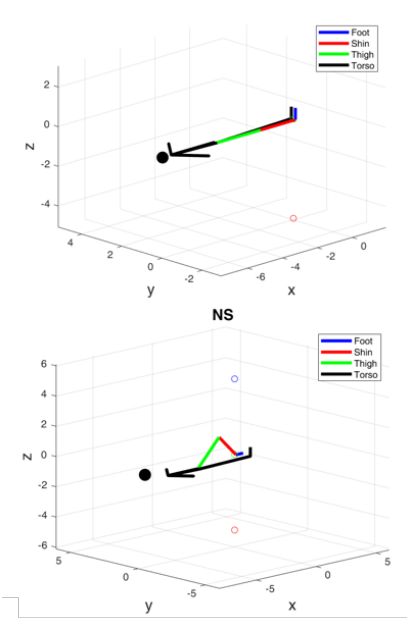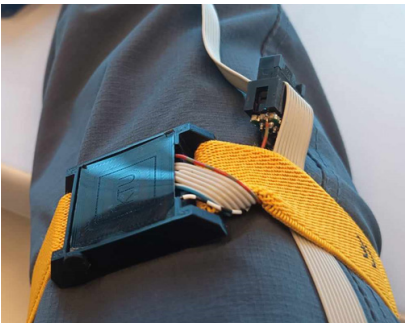
HEALTH
SCIENCES

BIOACTIVE BIOPOLYMER-BASED FILMS FOR ORAL HEALTHCARE APPLICATIONS

Dovilė Liudvinavičiūtė
Emilija Galkauskaitė
Miglė Savickė
Ramunė Rutkaitė
Vaida Kitrytė-Syrpa
Michail Syrpas
Mentor: **Dr. Vesta Navikaitė-Šnipaitienė**

Kaunas University of Technology

Field of science │ Electricity, Electronics and Energy

Description of the work

A device for detecting the activity of patients' legs and their position.

Technical or other problems that are solved with the work

Currently, orally disintegrating bioactive films with prolonged activity are an innovative method for the local treatment of diseases in the oral cavity. In this work, novel orally disintegrating multi-layered films composed of bio-polymers and Spirulina extract have been developed. Spirulina extract has a wide range of inhibitory effects against Gram-positive and Gram-negative bacteria, as well as strong antioxidant and anti-inflammatory properties, which are very important for people with periodontitis and gingivitis. The newly developed films could be an excellent alternative to surgical inter-vention and replacement of the conventional synthetic antimicrobial agents,

which can cause various side effects. Besides, the developed films are bio-degradable, non-toxic, ecofriendly, and their technology is characterized by sustainable solutions. This project has received funding from the Research Council of Lithuania (LMTLT), Agreement No. S-MIP-23-78.

Novelty of the work

According to the World Health Organization report on the state of oral health in 2022, nearly 3.5 billion people worldwide, comprising approximately 50% of the global population, are affected by various oral diseases. These conditions include dental caries, periodontal diseases, tooth loss, oral cancers, oral infections, and other related oral health problems. Currently, only a few synthetic antimicrobial drugs with broad antimicrobial effects and long-term action have been approved for the treatment of these diseases. However, long-term use of such drugs leads to the development of drug resistant bacteria along with various side effects. Natural algae extracts, such as Spirulina, could be a good alternative to replace synthetic active components in the formulations of such drugs.

Novelty of the work

There are many reports on films that quickly disintegrate in the oral mucosa and immediately release biologically active components. However, oral diseases often require local and prolonged treatment. Only several papers so far have reported the use of herbal extracts, essential oils or probiotics, and there is currently no data reporting the use of algae extracts in orally disintegrating films for oral health care applications. In this work, multi-layered orally disintegrating films from bio-based polymers and Spirulina extract have been developed. Each layer of the film performs a different function, such as mucoadhesion, controlled release of active components, modified solubility of films, etc. Besides, the newly developed orally disintegrating films exhibit high biological activity with a prolonged release of active components.

The benefits and value to the potential users

Various oral cavity infections are associated with a worsening quality of life of patients and increased health bills. Conventionally, periodontitis is treated by mechanical debridement and antibiotics. Orally disintegrating films

have several advantages over the conventional drug dosage forms. These films are versatile and can immobilize various drugs, active ingredients and supplements. The newly developed films composed of bio-based polymers and Spirulina extract could be a good alternative for surgical intervention and replacement for the conventional synthetic antimicrobial substances that can lead to various side effects.

Orally disintegrating film composed of biopolymers and Spirulina extract
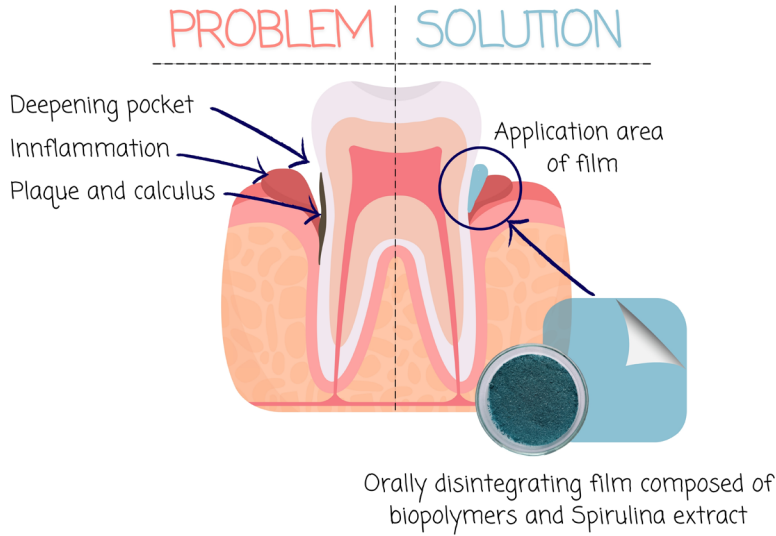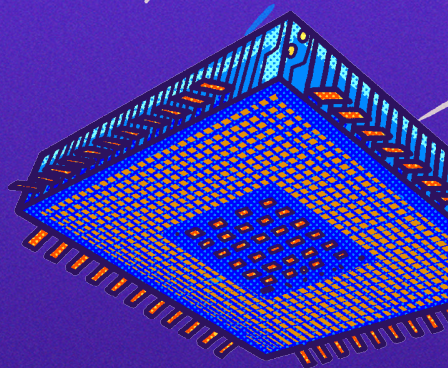
INFORMATION TECHNOLOGIES

DMESYS – FOCUSING AT WORK

Gerda Tumelytė
Vidmantas Žukauskas
Andrius Bielskis
Erikas Ulys
Lukas Navickas
Mentor: **Dangis Rimkus**

Kaunas University of Technology (KTU)

Field of science │ Information Technologies

Description of the work

DmeSYS is an attention point tracking system for office work. When you stay focused, you collect points. The users who collect the most points take the highest places in the leaderboard. Prizes can be unlocked by accomplishing achievements. Reach your highest potential with us!

Technical or other problems that are solved with the work

Office workers do not spend their working time productively enough, they frequently get distracted, engage in extraneous activities, and fail to concentrate. Poor productivity ultimately results in a lower company revenue, whereas the employees are not satisfied with their work.

The product's audience is primarily businesses caring about the efficient use of their human resources.

The product has been developed for both Lithuanian and foreign markets.

Novelty of the work

We have a mascot that sets us apart from the market. The system features a high number of ideas.

The benefits and value to the potential users

We hope that our product will help companies to reduce costs. As a result of initiating the use this product, the productivity of employees will increase.
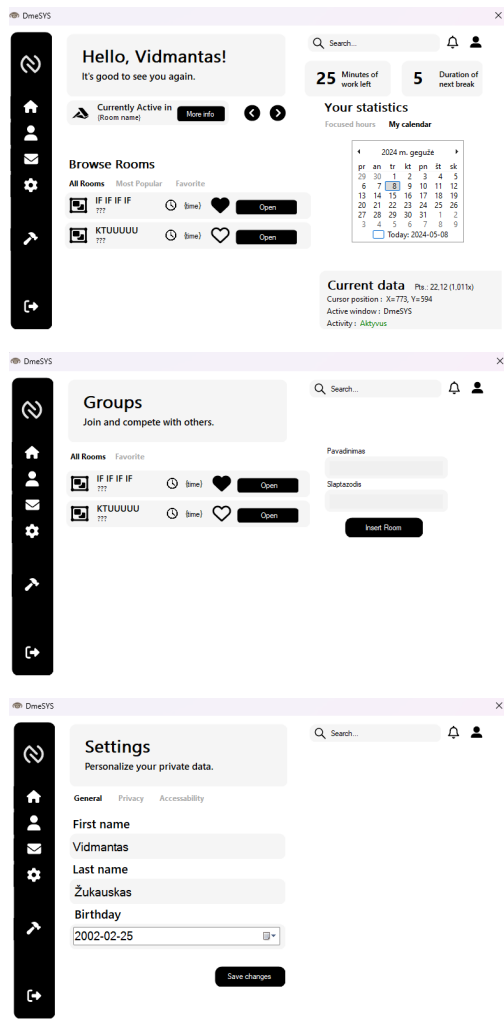
TOKEN TAILS – PLAY WITH YOUR VIRTUAL VAT TO VAVE A CAT IN THE SHELTER

Eligijus Lipskis
Matt Bankauskas
Ernest Rimkevičius
Gerardas Stanevičius
Andrius Žiužnys
Marcin Kolago
Igor Plusa
Krishna Chaitanya
Mentor: **Žygimantas Bagdzevičius**

Field of science │ Information Technologies

Description of the work

Token Tails - Web3 play-to-save game

1 Explore our virtual cat shelter
2 Adopt your purrfect companion
3 Take care of your virtual cat
4 Save virtual cats in the Purrquest RPG game to save real cats in the shelter.

Technical or other problems that are solved with the work

- No real RWA (real-world assets) use cases
- Crypto games lack a real mission
- Web3 gaming is commonly found to be hard rather than entertaining.

Novelty of the work

We are pioneers of the play-to-save genre in web3 where every game is play-to-learn, or play-to-earn, and it is just boring. We differentiate ourselves as our game involves an easy-to-start mission which is driven by a vibrant, dynamic environment, with multi-revenue streams exciting beyond imagination. It keeps users invested and engaged in the project universe.

The benefits and value to the potential users

Simplified Web3 Gaming and Enhancing Entertainment offering an easy playing process, fun for webt2 & web3 users; Real-World Application in Web3; bridging the two worlds by integrating the real cat welfare into the game mechanics; Grinding with a purpose as every minute you play is not wasted, but rather contributes to the welfare of our cat overlords, and everybody loves cats. *MEOW*

VINOVENTURE

Vilius Klangauskas
Gabija Mackutė
Selina Stačiokaitė
Jomantas Seilius
Mentor: **Mantas Vaitkus**

Kaunas University of Technology (KTU)

Field of science │ Information Technologies

Description of the work

The primary goal of VinoVenture is to facilitate an accessible and comprehensive virtual tour experience of any type of food or beverages (in our example, a winery). Designed with a B2B (business-to-business) model in mind, applications are built by using Unity and are tailored for the VR headset, and delivered in the APK format. VinoVenture emphasizes its role in saving costs and time for both B2B customers and the company.

Technical or other problems that are solved with the work

For B2B customers, it is a valuable tool for engaging with their clients or teams with a unique educational journey through the company's offerings, without the logistical expenses and time investment typically required for physical tours. Furthermore, Vinoventure represents an efficient way to reach and educate a broader audience, thereby enhancing brand visibility and customer engagement while optimizing the operational efficiencies. Within this virtual realm, the consumer will be able to explore interactive demos and simulations, and get engaged with the company's offerings like never before. Whether it involves experiencing the company's products in

action or navigating through cases of simulated use, the client will gain a deeper understanding of the company and the produce as a whole.

## Novelty of the work

While the notion of a virtual company tour is not novel, we have integrated elements which promise to elevate the entire experience to a new level of memorability and efficacy. It has a unique take on the virtual tasting experience that has not been replicated anywhere in the business-to-business sector. Its uniqueness stands in the fact that the customer can taste their drink or food in real time, and that the products can be brought directly to the client's home.

The benefits and value to the potential users

We offer potential B2B clients the opportunity to experience our brand from the comfort of their own homes. We provide a tailored package containing a virtual reality (VR) headset along with a selection of our company's products. This immersive experience allows clients to explore our brand, products, and services in a virtual environment without the need to physically visit our premises. By bringing the essence of our brand directly to their doorstep, we aim to create a memorable and convenient way for clients to engage with us and consider the benefits of collaboration.
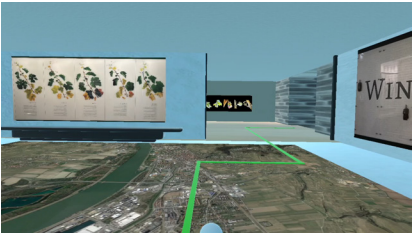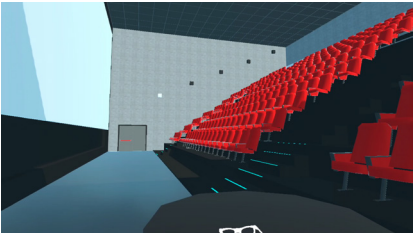
PANKAKE

Aurimas Galkevičius
Rokas Kašinskas
Patricija Borovska
Arnas Švėgžda
Arnas Bradauskas
Mentor: **Povilas Duoba**

Kaunas University of Technology (KTU)

Field of science │ Information Technologies

Description of the work

In the KTU product development project module, our team is developing an application for mobile devices called *Use of Online Content that Preserves Mental and Physical Health.* Our product is a concentration- and productivity-focused application that which uses the pomodoro technique with additional functionality.

## Technical or other problems that are solved with the work

The presently solved issues pertain to the creation of digital content which would support mental and physical health. Nowadays, people find it harder and harder to concentrate because of the amount and scale of the digital content in their daily lives. This leads to attention deficit disorders, fatigue, or even health risks. These problems are addressed in various scientific studies trying to solve the issue in one way or another, and to find out where the issues come from.

Novelty of the work

Our solution is distinguished by the fact that it combines several function-alities into one, and thus stands out from the currently available products on the market, such as: *Pomodoro, Focus-To-Do, or Productivity.* In these apps, the main functionality is the pomodoro timer, and our product com-bines the functionality of creating tasks and completing them within the stipulated time with the *pomodoro* timer.

The benefits and value to the potential users

The goal of this project is to help people who tend to be distracted to focus and plan their time.
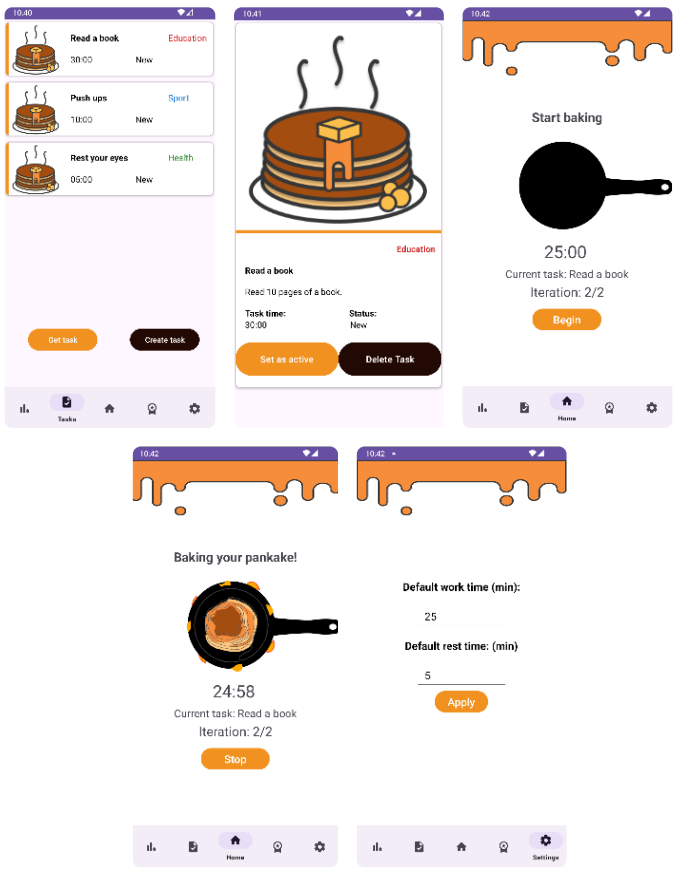
TRADELENT – A FINANCIAL MARKETS TRADING AND ANALYSIS SYSTEM / FINANCIAL EXCHANGE ACTIVE TRADING AND DATA ANALYSIS SYSTEM

Domantas Šurka

Field of science │ Information Technologies

Description of the work

The active trading and analysis system Tradelent is an excellent tool for those traders who seek daily improvement and strive for better results in the financial market. It provides users with an opportunity to have more functionality while trading in real time, thereby allowing them to open positions in different trading accounts simultaneously. The calculator for traders provides functionality to calculate the position size by specifying certain parameters, such as the financial leverage and the desired risk. Additionally, users, by analyzing their positions, have the ability to journalize each situation, by noting what worked for them and what failed – thus enabling them to identify recurring mistakes and analyze the situation of what was happening in the market at that moment. The analysis reports will present trends manifested in the success, efficiency, and profitability of all executed positions, thus allowing for superior understanding of the financial market

and the various factors influencing the trade results – such as the best times to trade, the most profitable financial instruments by month, and so on.

Technical or other problems that are solved with the work

Financial exchange traders cannot manage more than one trading account at the same time. In order to manage financial positions in accounts, traders must log out of the broker's platforms and log in again to change the account. This is a major problem when considering that every second counts in the stock market. It has been noted that there is no such calculator available on the market which would calculate the maximum possible opening of a trading position (when trading CFDs), while taking into account the parameters of the account provided by the broker – financial leverage, the number of contracts, etc. Also, traders are often faced with the problem when, in order to trade effectively on the stock exchange, they have to use the functionalities of different portals, or have to improve their applied strategies and actively monitor the results. Therefore, with the objective to solve this problem, the Tradelent system has been created, which would provide the functionality of real-time trading, position calculation, analysis of the trading positions in one place, as well as the benefits of tracking and improving trading on the exchange market.

The target market is individual traders (i.e., retail traders) who trade with their own capital or personal accounts.

Individual traders traded 23% of the total turnover of the financial exchange in 2023, and this number has been growing.

Novelty of the work

So far, such a solution has never been implemented in the market.

The benefits and value to the potential users

The developed system provides real-time trading, position calculation, as well as trading position analysis functionality in one place and benefits in tracking and improving trading on the stock exchange. as All of this comes together with the functionalities that are not implemented in the market –

such as a calculator for the maximum CFD trading position, management of more than 1 trading account and positions in them at the same time.
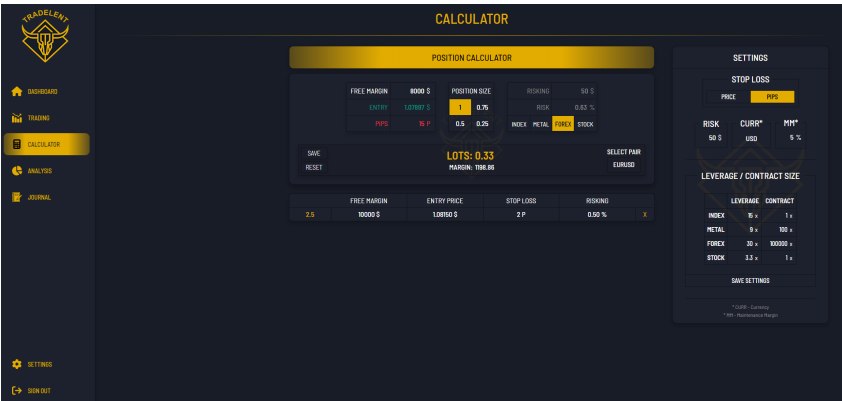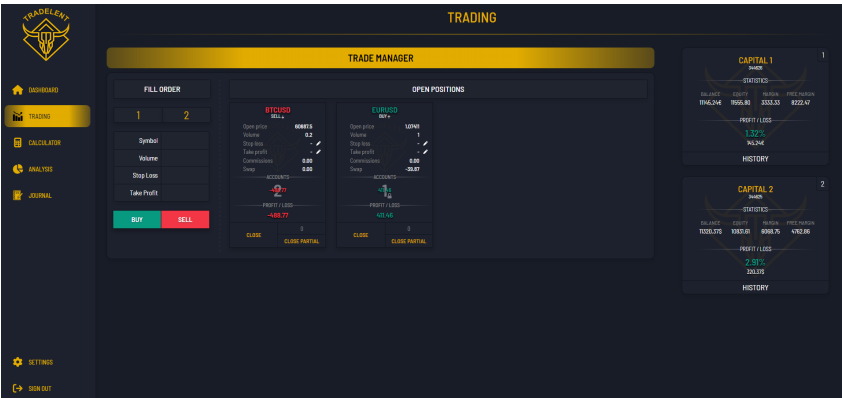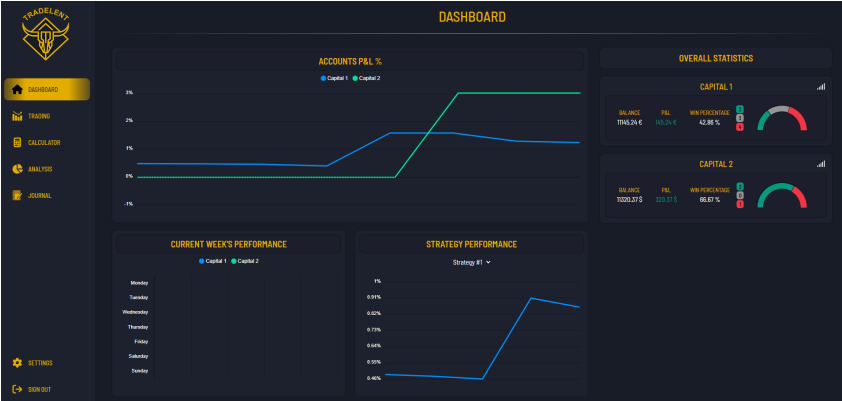
ANALYSIS

Overview Detailed CAPITAL 1

ACCOUNT STATS

Total P&L	145.24 € / 1.32 %	Average volume per trade	0.34
Deposited funds	11000 €	Largest profit	81.86 €
ROI	1.32 %	Largest loss	-32.55 €
Average ROI	1.5888 %	Average hold time (all trades)	3d 43m
Average winning trade	84.83 €	Average hold time (winning trades)	1w 1h 25m
Average losing trade	-12.04 €	Average hold time (losing trades)	4m
Total number of trades	11	Open trades	1
Number of winning trades	3	Total trading days	9
Number of losing trades	4	Winning days	3
Number of break-even trades	3	Losing days	3
Max consecutive wins	2	Break-even days	3
Max consecutive losses	2	Max consecutive winning days	1
Total fees	8.04 €	Max consecutive losing days	1
Total commissions	0 €	Successful buy positions	1
Total swap	8.04 €	Successful sell positions	2

ANALYSIS

Overview Detailed CAPITAL 1

Filter by: Days Weeks Months Time Trade duration

Select time interval: 5 minutes

TRADE DISTRIBUTION BY 5 MINUTES TIMEFRAME

PROFIT BY 5 MINUTES TIMEFRAME

TRADING JOURNAL

Positions Strategies Sync positions CAPITAL 1

DEPOSITED FUNDS	PROFIT / LOSS	WIN PERCENTAGE	AVERAGE WIN / LOSS AMOUNT
11000 €	145.24 €	42.86 %	5.38 RR

1D 1W 2W 1M 6M 1Y ALL

Status	Open time	Symbol	Type	Volume	Partials	Entry price	Net P&L	Net ROI	Strategy	Duration
BREAK-EVEN	2024-04-07 11:27	BTCUSD	BUY	0.01	1	69538.2	-0.5 €	-0.13 %	Strategy #1	18s
WIN	2024-04-07 11:27	BTCUSD	SELL	0.01	1	69438.1	55.23 €	8.07 %	Strategy #1	8d 23h 57m 50s
LOSS	2024-04-17 11:26	EURUSD	BUY	0.1	1	1.08432	-1.22 €	-0.01 %	Strategy #1	26s
BREAK-EVEN	2024-04-18 17:06	GBPJPY	BUY	0.1	1	192.897	-1.7 €	0.00 %	Strategy #1	3m 6s
BREAK-EVEN	2024-04-23 00:44	BTCUSD	BUY	0.1	1	66572.4	-8.52 €	-0.10 %	-	15m 39s
LOSS	2024-04-27 21:48	BTCUSD	BUY	0.1	6	63546.8	-8.02 €	-0.82 %	Strategy #1	14s
WIN	2024-04-27 22:27	BTCUSD	BUY	0.1	1	63252.2	58.03 €	9.91 %	Strategy #1	11h 38m 22s
WIN	2024-04-27 23:27	BTCUSD	SELL	0.1	2	63160.1	39.11 €	2.52 %	-	10d 17h 9m 52s
LOSS	2024-05-07 21:12	EURUSD	BUY	1	1	1.07556	-22.55 €	-0.62 %	-	13m 48s
LOSS	2024-05-13 03:53	EURUSD	BUY	1	1	1.07901	-5.18 €	-0.01 %	Strategy #1	7s

« ‹ 1 › »

GILIA.APP - AI-POWERED PLATFORM FOR DEVELOPING SELF-AWARENESS

Eimantas Butkus
Fausta Dambrauskaitė

UAB Gilia

Field of science │ Information Technologies

Description of the work

gilia is an AI-powered platform for developing self-awareness. It is as if a personal trainer which helps people learn and implement knowledge, reflect and understand themselves, overcome struggles, and stay consistent to build self-awareness in a science-based way. It achieves this by providing a hyper-personalized experience for effective behavior change. Why self-awareness? Due to technological and societal changes, the complexity of the world is rapidly increasing. Since people's thinking does not adapt that quickly naturally, and people are increasingly struggling to deal with the complexity. This results in many social issues (for example, declining mental health, polarization in society, discrimination). Self-awareness solves the root cause of these problems by helping people embrace the complexity. Additionally, self-awareness helps people improve their physical and mental health, implement the desired habits, increase their performance, grow personally, achieve their goals, and have stronger and deeper relationships.

Technical or other problems that are solved with the work

We help people improve self-awareness. Along with countless benefits for individuals, self-awareness has a wider impact. Due to technological and societal changes, the complexity of the world is rapidly increasing. Since people's thinking does not adapt that quickly naturally, people are increasingly struggling to deal with the complexity. This results in many social issues (e.g., declining mental health, polarization in society, discrimination). Self-awareness solves the root cause of these problems by helping people embrace the complexity.
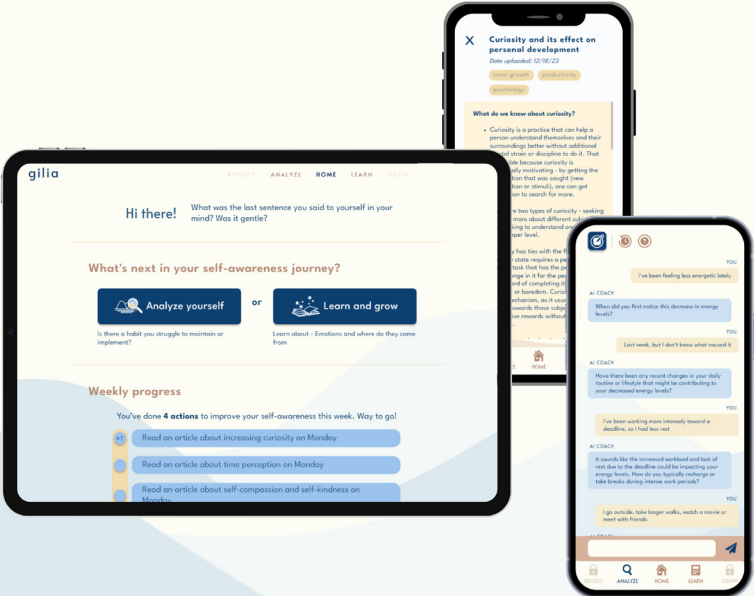
Novelty of the work

Solutions that are currently in the market target different areas of self-awareness (coaching, learning, reflection, accountability). However, targeting a single area is not enough for developing self-awareness. We differentiate by providing a platform focused on improving self-awareness which combines all four areas. We also differentiate by providing a hyper-personalized experience to every user for an effective behavior change. We achieve this unique positioning by leveraging the latest AI technologies as well as a comprehensive collection of research on self-awareness.

The benefits and value to the potential users

gilia acts as a personal trainer for developing self-awareness in a science-based way. It helps people to:

1 Reflect and analyze to better understand themselves (i.e., their patterns, strengths, weaknesses, identity);

2 Learn about the human behavior and implement that knowledge to increase performance and avoid harmful behaviors;

3 Overcome challenges by finding unique solutions and thus achieve consistent personal growth;

4 See their growth and identify gaps and opportunities for further improvement. With an enhanced self-awareness, people improve their physical and mental health, implement the desired habits, increase their performance, grow personally, and achieve their goals, and also have stronger and deeper relationships. This makes people healthier, happier, and more successful.

ECHOCODE AI: TRANSLATE THOUGHTS INTO WORKING CODE

Sri Muthusivam Rethinasamy
Resikesan Sathiya
Mentor: **Tameem Ansari Mahadeer Ali**

Kaunas University of Technology

Field of science │ Information Technologies

Description of the work

As coding students and developers, we know the frustration of constantly switching tabs to search for code examples, utilize generative AI, or troubleshoot errors. This breaks your focus, hinders learning, and wastes valuable time. To address this challenge, we have developed a VS Code extension which seamlessly integrates the power of AI directly into your code editor. Whether you are describing the code you need in a comment or selecting a troublesome section, our extension generates code snippets or offers improved solutions for you. With its seamless workflow, instant AI assistance, and language-independent support, our extension not only facilitates efficient learning for beginners but also significantly boosts productivity for coders of all levels.

Technical or other problems that are solved with the work

Our product solves the problem of constant context switching for programmers while coding. This context switching, which involves moving between

the code editor, web browsers for research, and other tools like generative AI, disrupts workflow, hinders learning, and wastes time. Our target market encompasses all levels of programmers, from beginners struggling to find relevant examples of the code to experienced developers seeking to optimize their workflow. This market is vast and continually growing as the demand for software development has been increasing across industries. The size of the market is substantial, with millions of active developers worldwide who use VS Code as their primary editor. The potential for growth is significant, as the trend towards AI-assisted development tools is gaining momentum. By offering a seamless, integrated AI solution within the familiar VS Code environment, our product caters to the needs of this expanding market and has the potential to capture a significant share.
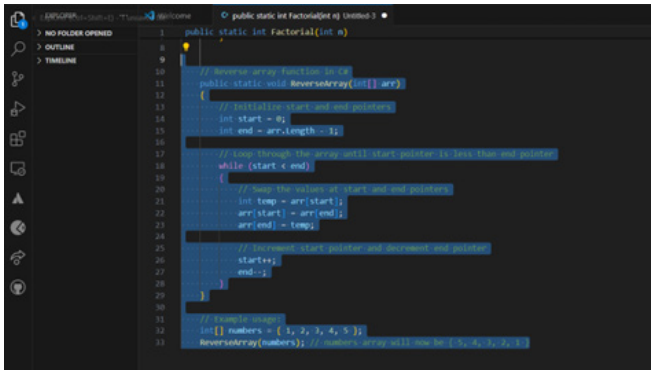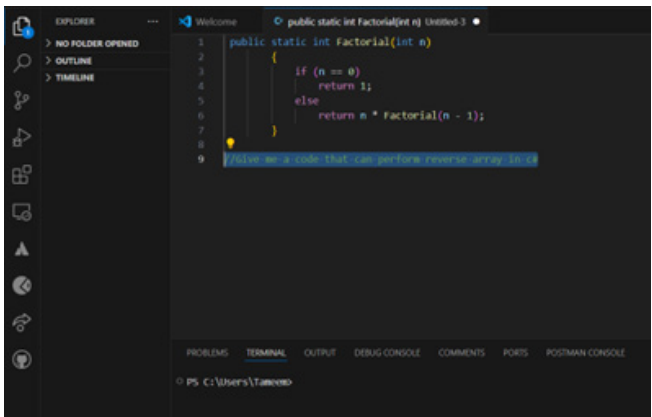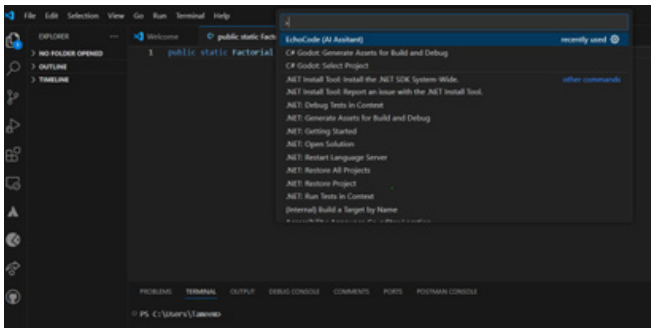
Novelty of the work

The novelty of our VS Code extension lies in its unique ability to not only generate the code, but also to correct the syntax and logical errors while optimizing for better performance. By seamlessly integrating these features within the VS Code environment and leveraging API keys for cost-effectiveness, it offers a comprehensive and affordable solution for developers of all levels. Furthermore, its sleek and user-friendly interface sets it apart from other tools on the market, thus making it accessible to beginners and experienced programmers alike. Unlike other solutions that may focus solely on code generation or error correction, our extension combines these capabilities with code optimization, by providing a more holistic approach to development. Additionally, its cost-effective utilization of APIs and emphasis on user experience distinguish it from competitors, while offering a more powerful and accessible tool for enhancing the productivity and code quality.

The benefits and value to the potential users

Our VS Code extension offers significant benefits and value to both beginners and experienced programmers. For beginners, it accelerates the learning process by providing instant access to the relevant code snippets, while fostering hands-on experimentation and building confidence. It eliminates the frustration of searching for examples, enabling them to focus on understanding concepts and practicing their skills. For professionals, the extension boosts productivity by automating repetitive tasks, such as generating the

boilerplate code. This allows them to dedicate their time and energy to solving more complex problems, and to ultimately deliver higher quality results more efficiently. By seamlessly integrating AI assistance into their workflow, our extension empowers users of all levels to code smarter, learn faster, and achieve their programming goals with a greater ease and efficiency.

STRIDEMILE

Austėja Laurikaitytė
Deividas Grinius
Martynas Lukoševičius
Mentor: **Rimantas Mockus**

Kaunas University of Technology

Field of science | Information Technologies

Description of the work

This product has been created to motivate people to engage in sports and connect with each other, and therefore to adopt and sustain a healthier lifestyle. People can create and join in groups, achieve goals together and personally, as well as track their health. They can also buy items related to health, and various products in general, they can motivate each other through a chat system. Groups can participate in events and challenges, too.

Technical or other problems that are solved with the work

Nowadays, the sedentary lifestyle has been growing in popularity, which therefore causes many modern life problems related to health. 31% of people aged over 14 are not physically active enough every day. Due to insufficient physical activity levels, people may develop eyestrain, poor posture, poor sleep quality, a higher risk of cardiovascular diseases, and obesity. Also, people might start feeling more lonely. Our target market is students, mostly aged 18–25 because they are likely to try out new things, such as our product, they have enough free time, and they would like to get to know new people. Our market size is approximately 40,000 students in Lithuania, and many more in the whole world.

Novelty of the work

On the market, there are no products which would provide users with many functions for groups, which are also free to use and are available anywhere within the range of the mobile network. Our product is also very intuitive, which was lacking in some of our competitors' products.

The benefits and value to the potential users

The product increases the potential users' motivation and physical activity levels; the users also get to know new people with similar goals and interests. By tracking their health, people might gain motivation to keep their bodies healthy. Also, motivation is gained by achieving goals and challenges and by communication with other users.

Sveikatos sekimas
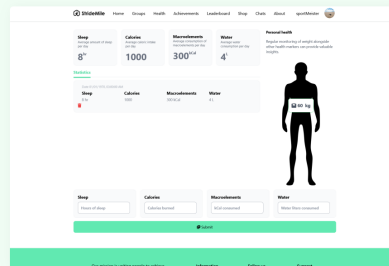
Grupės

Pasiekimai

TRAUMA PREVENTION APP

Austėja Laurikaitytė
Mentor: **Rimantas Mockus**

Kaunas University of Technology

Field of science │ Information Technologies

Description of the work

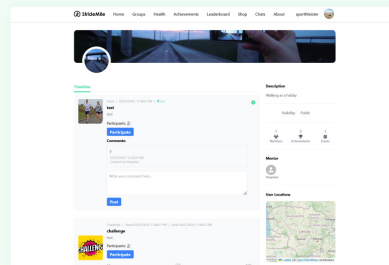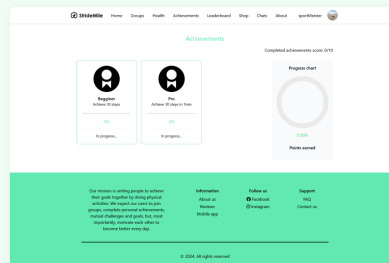We are creating a product for people who want to be informed about personal health risks and possible solutions in order to prevent trauma. Our product is a mobile application, where people can enter their health data in the test when the application has been downloaded. In the test, there are exercises which should be done in order to obtain more accurate results. In our product, people will also get recommendations and suggestions for further analysis.

Technical or other problems that are solved with the work

People could know potential risks before traumas actually happen. It would enhance their health, because every intervention is harmful to some point, and would spend their time in a more effective manner, thus sometimes achieving even better results.

Novelty of the work

In Lithuania, there are no competing marketable products at the moment. Products are either created for getting back on track after incurring an injury, or for tracking health in general.

The benefits and value to the potential users

Among the benefits of the product, there is the fact that people would be healthier and should not suffer from traumas; therefore, they would not need to undergo any interventions and spend time recovering and lying in bed.

LEARNING SCENARIO EDITOR FOR VR

Jonas Kučinskas
Paulius Mongirdas
Žymantas Petreikis
Karolis Šeimys
Mentor: **Andrius Paulauskas**

Kaunas University of Technology

Field of science │ Information Technologies

Description of the work

The solution allows users to create learning scenarios in virtual reality for different domains that simulate real processes. Each scenario that is created consists of a training area environment, a scenery, training objects, tasks, and feedback channels. Learners are involved in these scenarios, they perform the tasks and improve by receiving immediate feedback by finding out whether the tasks have been done correctly, and, if not, how to improve, etc. For accurate learner assessment, the system can also track the entire process of completing the tasks and every action taken. This way, it is possible to monitor not only whether the task has been done correctly or incorrectly, but also how the learner's decisions were made.

Technical or other problems that are solved with the work

Training a new employee can be a challenging process. A job description may only convey the theory behind the nature of the job, but it will never prepare you well for the unpredictable day-to-day practice. Throwing a new employee into the swirl of work from the start will not avoid mistakes, misun-

derstandings, and disruptions that can lead to losses. To avoid this, we can assign a newcomer to be in charge, but the productivity of the newcomer may suffer. A concrete example might be a hospital operating theatre. This is a sterile environment with clear rules and protocols on how to behave in such an environment. Bringing medical students into the operating theatre can be very effective in giving them practical insight into the processes of this environment. However, it must be coordinated to ensure that there are no operations taking place at that time which a learning visit could disrupt, that the students' behavior does not compromise sterility, etc. This can be avoided by creating the same environment and training scenario in the virtual reality.

Novelty of the work

Virtual reality is often associated with entertainment and gaming, but the technology has clear advantages in serious applications. These applications include education and virtual reality applications for training. Training applications are usually developed for specific cases, as well as for specific training scenarios. This solution allows the preparation of any training scenario.

The benefits and value to the potential users

The solution makes it easy and intuitive to create virtual reality training scenarios that would be much more expensive or difficult to prepare in real life. In addition, the entire process of completing the training tasks is logged so that to accurately assess the learner's actions, decisions, progress, and errors, and to make recommendations for improvement. This helps to reduce the training costs, reduce the potential risks associated with training, and improve the efficiency of the learning process.
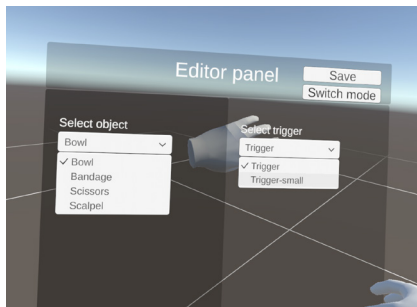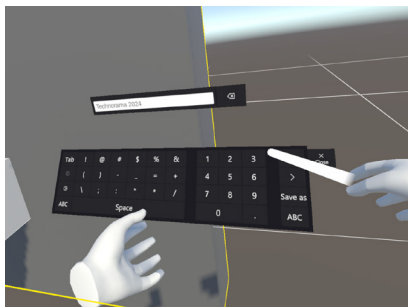
UNIFIT – STEP TOWARDS BETTER HEALTH WITH EVERY MOVE

Vaiva Mačiulytė
Austėja Juškevičiūtė
Sandra Kaušinytė
Lukas Kuzmickas
Mentor: **Gvidas Šutkus**

Kaunas University of Technology

Field of science │ Information Technologies

Description of the work

Our team has developed a mobile app with gamification elements such as 'streaks' and red zones to encourage Lithuanian students to move more often. The product also includes additional features, such as step and calorie counters, rewards and prize systems for the points one has accumulated through moving.

Technical or other problems that are solved with the work

In modern times, the main principle of study and work is associated with constant sitting at computers, books, or other rapidly advancing technologies, which results in people moving less and less. Due to these reasons, young individuals face various health problems such as obesity, muscle weakness, insomnia, anxiety, or even depression. Since an increasing portion of the world's population complains about poor health due to lack of

movement, the product being developed will help Lithuanian students move more often and thus prevent the development of various health issues.

Novelty of the work

Our product includes a "red-zone" feature, wherein users can earn additional points by engaging in activity within designated areas displayed on the real-time map in our app. This feature creates a dynamic environment, allowing users to track the constantly changing locations of these red-zones, thereby facilitating exploration of their city while accruing more points. These points can be exchanged for various prizes.

The benefits and value to the potential users

In our app, playful features will encourage young individuals to improve and change their habits by incorporating movement into their daily lives. The presented product will not only help users maintain their health but also provide opportunities to win various rewards and prizes.

KATH: A NO-CODING DATA PROCESSING AID FOR GENETIC RESEARCHERS

Dainius Kirsnauskas
Gabrielius Salyga
Paulius Preikša
Jūnius Vaitkus
Kajus Černiauskas
Nojus Sajauskas
Mantvydas Deltuva
Mentor: **Dr. Kazimieras Bagdonas**

Kaunas University of Technology

Field of science │ Information Technologies

Description of the work

KATH is a No-Coding Data Processing system designed to assist genetic researchers at Harvard University in their work on mutations in the human genome related to eyesight pathologies. We aim to deploy a no-coding solution that can enable R&D researchers untrained in programming skills to process data from open-source gene databases with advanced DNA processing algorithms via the application of a *Large Language Model* (LLM)-based instruction interpreter. The paper presents the overview of the design system and the current status of the project.

Technical or other problems that are solved with the work

Recent developments in the DNA sequencing technology enable geneticists to acquire vast amounts of genetic data for their research activities. However, the rapid price decrease and rapid increase in the available data do not meet the increase in capability to analyze this data, as training a geneticist is a high-cost and long-term endeavor. Further, by devoting their time to studying genetics, these world-class specialists in genetics lack the IT skills to make use of the most sophisticated tools such as *Artificial Intelligence* (AI), which are often developed by computer scientists without consideration of the wider research community's ability to use them. The limited number of IT specialists who are trained in both software development and genetics are known as Bioinformaticians and are highly sought after in both industry and research institutions. The skills and the limited time of these experts are best used for developing advanced software tools for DNA data processing and analysis. However, in day-to-day research and development (R&D) activities, there are a lot of tasks of relatively simple or moderate complexity that require expertise in IT or computer science.

Novelty of the work

The KATH system has been designed for a user with no significant programming skills. It enables them to express their desired function colloquially. The user's input is converted to a concrete action plan, and subsequently converted to commands by a specialized LLM. The commands are provided to one or several integrated DNA analysis tools. The DNA analysis tools can be run locally, or else communication with them can be realized via network-based APIs. A data retrieval and database refactoring module automatically updates the local database and refactor the gathered data. The data is aggregated and refactored from *LOVD, gnomAD*, and *Clinvar* databases. Open-source analysis tools for genetic data, such as *REVEL, Metadome, AlphaMissense*, etc. are used locally. Currently, there is no alternative no-coding solution designed for genetic researchers.

The benefits and value to the potential users

There are open-source scientific or medical databases of human DNA mutations and associated pathologies that are being amended daily. These open-source tools provide new opportunities for scientific and medical discoveries,

with the existing bottleneck of geneticists and bioinformaticians having suffi-
cient time and skills required to perform data analysis. There is a possibility to
integrate other existing analysis tools, such as *AlphaMissense, CADD, REVEL*,
etc. to make the results more precise. A No-coding tool can reduce the time
spent on data analysis and reduce the barrier of entry for geneticists. Assis-
tance from specialized AI systems can provide a significant benefit for R&D
activities and the entire society.

LABUNI

Kevin Kruber
Siavash Zargoush
Mentor: **Kevin Kruber**

Field of science │ Information Technologies

Description of the work

LABUNI is a platform designed to facilitate the sharing of lab equipment and services among universities and institutions. By acting as a central hub, it simplifies the process of sourcing essential resources, as well as revolutionizing laboratory collaboration. With *LABUNI*, researchers and lab technicians can easily find everything they need with just a click, by enjoying a frustration-free research experience. Moreover, *LABUNI* allows universities to showcase unused equipment and services, thus generating revenue and maximizing resources. *LABUNI* serves not only universities and academic institutions. Industries can also tap into its potential by connecting with nearby labs and equipment for exciting opportunities of collaboration.

Technical or other problems that are solved with the work

LABUNI targets a widespread problem in the research landscape: laboratory equipment is scattered across institutions, making it hard to work efficiently. Researchers lack a centralized platform to share equipment. At the same time, universities miss on the opportunity to monetize underutilized equipment due to lack of tracking and efficient management of their laboratory equipment. Lack of collaboration means that valuable services and equipment go unused, thus hampering research progress and creating barriers for industrial partners. With over 2 million European researchers, a unified platform is needed – as a centralized marketplace – to connect, collaborate, and to drive innovation forward.

Novelty of the work

LABUNI's novelty lies in its ability to form a centralized platform that simplifies sharing laboratory equipment and services. It addresses the industry's critical gap in laboratory equipment and service sharing. *LABUNI* helps institutions efficiently organize and track their equipment usage, thus providing insights which would give them a way to monetize their unused equipment. It fosters efficient transactions and collaboration within the research community by connecting researchers, universities, institutions, and industries. *LABUNI* is a game-changing tool which revolutionizes laboratory work and maximizes resources.

The benefits and value to the potential users

LABUNI is a multi-vendor marketplace addressing a critical gap in laboratory equipment and service sharing in the industry. Due to the insufficient investment in universities and institutions and lacking effort in *search engine optimization* (SEO) and advertising, *LABUNI* identifies the need for a centralized platform where universities, institutions, industrial parties, and researchers can connect, thus simplifying the process of fulfilling their respective needs. By providing a united space for vendors to showcase their offerings and for users to access and engage with these resources easily, *LABUNI* facilitates efficient transactions and fosters collaboration and innovation within the research community. With *LABUNI*, the future of laboratory resource sharing is more accessible, efficient, and interconnected than ever before.
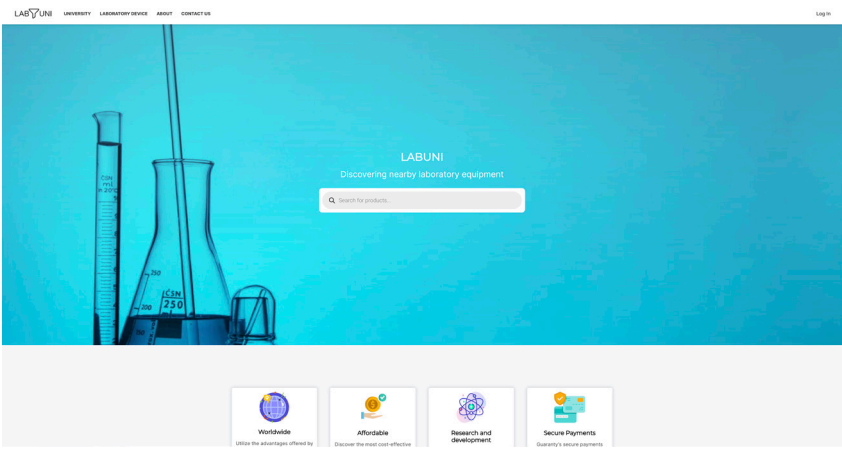
AUDIOCANVAS | UNLOCK NEW AVENUES FOR CREATIVITY AND EXPRESSION

Eylül Güleryüz
Mentor: **Dr. Dalia Čalnerytė**

Kaunas University of Technology

Field of science │ Information Technologies

Description of the work

The project focuses on developing an AI-driven platform to convert images into immersive environmental sounds. The use of AI technology, particularly the *YOLOv8* model trained on the *OpenImagesV7* dataset, and the creation of an algorithm for sound generation based on the *ESC-50* dataset, which was extended by manually extracting and labeling more classes, are objectives which have been successfully achieved in the framework of this project. The platform allows users to upload images, customize sound elements, and save their creations, while incorporating a feedback mechanism to gather user ratings for the further improvement of the system. Overall, the project implements a comprehensive solution which merges cutting-edge technologies with a user-focused design to offer a way to extract sounds from images.

Technical or other problems that are solved with the work

When all the elements of sound are well combined, people can feel as if they are inside the story or the scene that is being described. To make it

even better, instead of just giving information, we can use sounds to emphasize the vibe of the visuals. This way, people can get fully into what is being told, all thanks to the power of sound. Yet, sound is unquestionably as important as pictures, and neglecting it ruins the experience as much as the neglect of visuals. However, it can be challenging to create content and overlay various sounds on it to fully represent what is happening in a picture. This is where the need for a tool that can achieve this feat automatically emerges. To make this process seamless and convenient, an AI-driven tool is needed. By transforming images to sounds, the tool mainly aims to aid in multimedia content creation, as well as education, and it can even enhance accessibility. The market of content creation is already expansive, and it has been continuously expanding at an exponential rate.

Novelty of the work

The novelty of *AudioCanvas* lies in its unique approach to the image-to-sound conversion, thus filling a gap in the market. Unlike competitors focusing on the text-to-audio conversion, the technology is specifically tailored for transforming images into immersive sounds, and it thus offers a unique solution.

The benefits and value to the potential users

Traditional methods often require manual selection and overlaying of sounds onto visuals, which can be time-consuming and challenging to achieve the adequate result. *AudioCanvas* automates this process, by transforming images into sounds that perfectly complement the visual narrative.
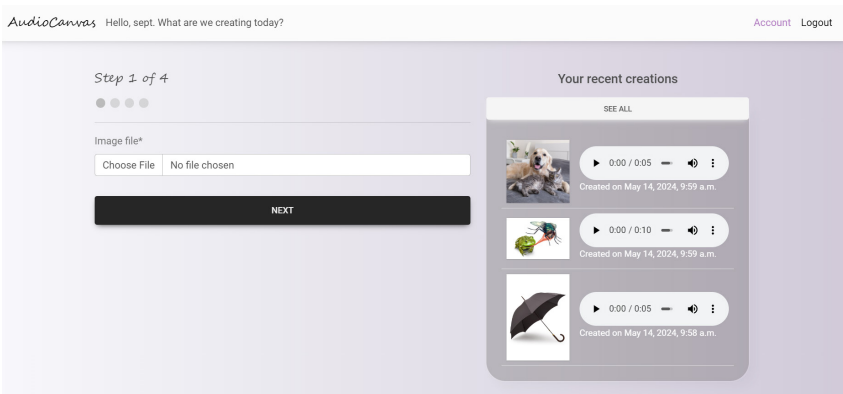
INTERDISCI-PLINARY WORKS

BUROKĖLIS – A PRIVATE SMARTBAND

Erika Jonaitytė
Titas Chimičius
Edvinas Ežerskis
Tadas Jankauskas
Erika Jonaitytė
Dovilė Petrauskaitė
Žymantas Šlajus
Mentor: **Dr. Benas Gabrielis Urbonavičius**

Kaunas University of Technology

Field of science │ Interdisciplinary Works

Description of the work

Introducing *Burokėlis*: Your ultimate companion for a seamless and independent lifestyle. With its innovative design and accessible technology, *Burokėlis* functions autonomously, thus eliminating the need for external connections to your phone. Track your fitness goals, monitor your health metrics, get reminders to keep yourself healthy, all from your wrist. Its intuitive interface and long-lasting battery make it the perfect on-the-go companion for the modern individual who values both convenience and efficiency. Experience freedom without compromise with *Burokėlis*.

Technical or other problems that are solved with the work

People are dissatisfied with their personal data being collected and sold to data brokers, who then pass their information on to other companies for prof-

it. Our product aims to remove such a possibility, by allowing for a higher level of privacy without needing to sell one's own data to use a service. We also aim to make the watch easier to use than their counterparts found in the market. This product has been created for everyone who is interested in using a smart watch to track their health goals and get regular advice how to stay healthy. The size of the market for such devices in Lithuania is $4.49 million, and it is estimated to reach $4.65M in 2028 at 0.88% annual growth rate.

Novelty of the work

Our product does not need any external devices to function, it takes minimal data from users, and the data is isolated within the smart band, it offers functions such as eye exercises that are not commonly seen in other smart watches.

The benefits and value to the potential users

Our product allows for a higher level of digital privacy and ease of use while staying healthy.

CLARITYCART

Martynas Jakovlevas
Brigita Kazlauskaitė
Eimantas Rimkus
Mykolas Žukaitis
Guoda Dženkaitytė
Joris Kviesulaitis
Gina Mankutė
Mentor: **Dr. Jevgenijus Toldinas**

Kaunas University of Technology

Field of science │ Interdisciplinary Works │ Economy, Social Sciences and Humanities │ Information Technologies

Description of the work

Assistive mobile application for visually impaired individuals and seniors to see product information and easily input products into the database for stores

Technical or other problems that are solved with the work

It is difficult for seniors and visually impaired to see product information printed in small letters, and therefore we solve it in the form of an app. After scanning the barcode, we provide organized and easily visible information about the product.

Novelty of the work

With our app, you do not need to scan the text or call volunteers to help. It is enough to scan the barcode to see all the product information in the app.

The benefits and value to the potential users

Users will be able to enlarge the product description so that visually impaired people can easily find the desired product and read the product information written in a small font.
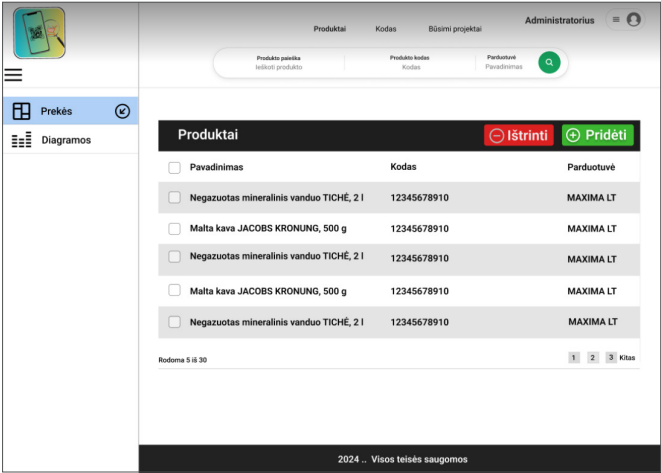
A VIRTUAL REALITY SOLUTION TO OVERCOMING SOCIAL ANXIETY

Simonas Skučas
Gvidas Ambrozaitis
Domas Rinkevičius
Ignas Vytėnas
Mentor: **Dr. Tomas Blažauskas**

Kaunas University of Technology

Field of science │ Interdisciplinary Works │ Economy, Social Sciences and Humanities │ Information Technologies

Description of the work

A virtual reality product is being developed to help children overcome their social fear of talking. An innovative VR exposure therapy is used to create a convincing environment for the child to feel safe and to talk to a character realized with AI technology. This product combines the most prominent technologies of the 21st century – AI, biometrics, and applied psychology.

Technical or other problems that are solved with the work

In this decade, the number of children with speech disorders is further increasing, and therefore psychologists and experts are expressing a great need for additional tools to help them in their work. The developed product provides an opportunity for the child to speak in the environment of his

choice, while for the expert it is an opportunity to observe the child's behavior and analyze the results obtained by the product.

The product is intended for public institutions, psychologists,experts who work with children with speech disorders.

Experts point out that this problem has been worsening in Lithuania, and that there are no products focused on the Lithuanian market.

Novelty of the work

There are no similar products on the Lithuanian market. This product uses VR, biometrics, sensors, and AI-powered services.

The benefits and value to the potential users

For experts, it is an opportunity to observe the child's behavior, to see the results of biometrics.

For children, this is a way to enter the VR world, choose the environment as well as the scenario they like.
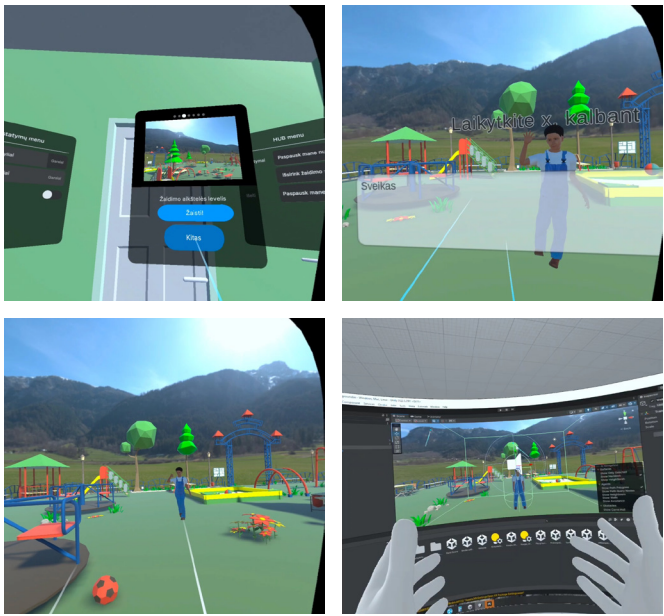
MEAL QUEST. EAT HEALTHY, EAT PLAYFULLY – LIVE MEANINGFULLY!

Matas Palujanskas
Tadas Gataveckas
Ernestas Kuprys
Ignas Eismantas
Lukas Mikalauskas
Mentor: **Giedrius Tribandis**

Kaunas University of Technology

Field of science │ Interdisciplinary Works │ Economy, Social Sciences and Humanities │ Information Technologies

Description of the work

We have developed a mobile app which makes diet plan recommendations based on data provided by the user. The app is gamified and thus engages users to achieve their wellness goals. The mobile app is supported by a companion (mascot) who works in cooperation with the user to achieve a healthier lifestyle by eating the same food and encourages the user to achieve their goal. Once the user has completed their dietary planning, they can learn more about vitamins and the nutritional properties of food through a gamified graphical user interface. Integrated games using the mascot of the app help the user stay engaged and achieve their goals.

Technical or other problems that are solved with the work

Improper eating habits often lead to health-related consequences: the immunity weakens, the sleep quality deteriorates, fatigue and irritability develop,

and it becomes difficult to concentrate. Instead, it is extremely important to control what kind of food we eat and how much of it we consume. Our mobile app will not only help you track your daily food intake, but also help you learn more about the valuable nutrients, vitamins and other useful information about healthy eating.

The elements employed in the app are aimed at the teenage and student market. The target customer is a 16–26-year-old young man who is interested in taking care of their health and tends to play mobile games. The people representing this market segment often share what they like with their peers, thus creating online trends. Our intended market segment is between 10 thousand and 100 thousand individuals. The potential for growth is huge, and similar apps like *MyFitnessPal* have over 100 million downloads, while Pou has over 500 million downloads, and *Calorie Counter App: Fooducate* has over 1 million downloads. The app we are developing aims to combine various aspects of these fundamentally different apps.

Novelty of the work

The mascot, gamification and design of the app will help you stand out from the users of other nutrition apps on the market. The app contains games that help you learn about the beneficial properties of foods and vitamins. This learning and development process becomes natural and easily accessible to everyone, even to people who are not at all interested in healthy eating. The app includes aspects of wellness, play and education, thereby distinguishing itself from similar products on the market.

The benefits and value to the potential users

Nutrition tracking will help you achieve your goal (weight loss, maintenance, or gain). The talisman and the mini-games will motivate you to delve into the principles of healthy nutrition, and the desire to apply the knowledge you have learned – will prompt you to log in every day and track your diet.

SMART CHESS BOARD

Mantas Tušas

Kaunas University of Technology

Field of science │ Interdisciplinary Works │ Information Technologies │ Electricity, Electronics and Energy

Description of the work

A smart chess board is being developed which would be capable of helping new players learn the difficult and strategic game that is chess.

Technical or other problems that are solved with the work

This chess board is designed for new chess players who do not know the moves and the rules of the game, and who want to learn them passively while focusing all their efforts on strategizing, thus accelerating their growth as a player.

Novelty of the work

Simple boards do not have any indicators where to do what kind of move, and you have to remember everything by yourself. Also, especially for inexperienced players, illegal moves can be made, or invisible check/checkmate may be overlooked. This board follows the rules and displays them to the player as the game progresses.

its and value to the potential users

The device facilitates the process of learning the game of chess. It could attract more people to playing chess, and they could grow up to be great masters of this game.
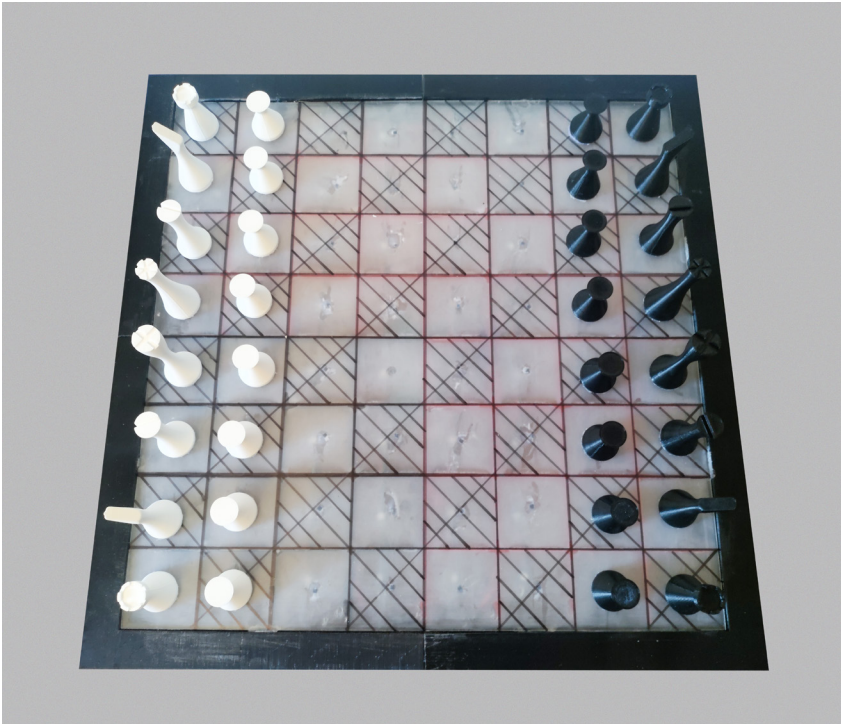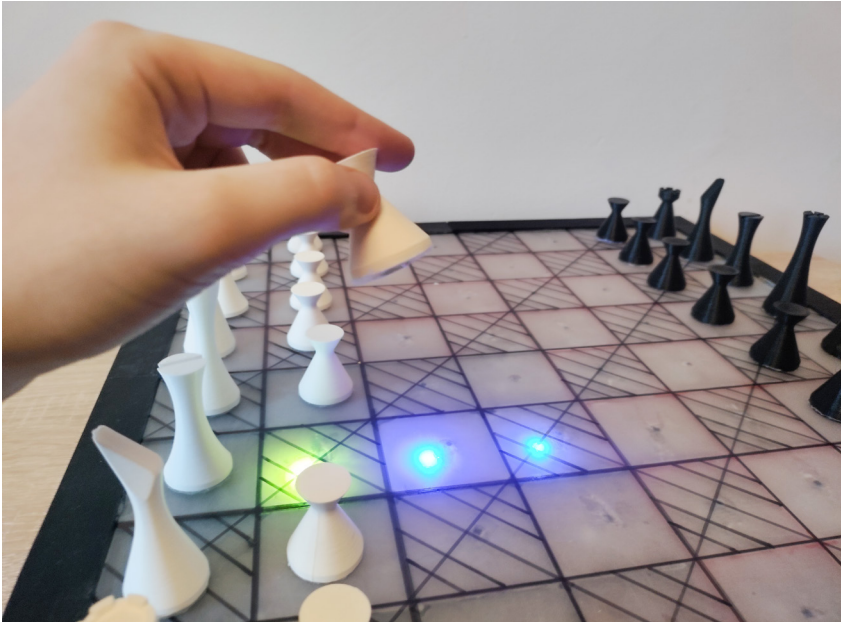
ALEX7REHAB DEVICE DEVELOPED BY *INOSPORT* COMPANY

Timas Akelis
Deividas Zelickas
Paulina Grigutytė
Mentor: **Dr. Valdas Grigaliūnas**

Inosport

Field of science │ Interdisciplinary Works │ Economy, Social Sciences and Humanities │ Information Technologies

Description of the work

Alex7Rehab is a rehabilitation device which provides the opportunity to perform a wide range of exercises. It collects information about each exercise performed and, with the help of a rehabilitation specialist, allows you to adjust the difficulty of the exercises more quickly and effectively, according to the current situation.

Technical or other problems that are solved with the work

Our product addresses the inherent limitations in the traditional rehabilitation methods by offering a solution which revolutionizes data collection and analysis. The conventional approaches lack simplicity in data gathering, thus making it challenging to track progress effectively. Moreover, the currently available rehabilitation equipment often suffers from sensitivity limitations and restricted functionality. These shortcomings hinder the quality of care and impede patient outcomes. Our solution provides a streamlined process for data collection, while offering comprehensive insights into the

patient's progress. By leveraging the advanced technology, we enhance sensitivity and functionality, thus surpassing the constraints of the traditional equipment. Furthermore, our product offers cost-effective data gathering capabilities, thereby globalizing access to valuable insights for rehabilitation facilities of all sizes.

Novelty of the work

Our work introduces a novel approach towards rehabilitation by seamlessly integrating the testing and treatment processes. Unlike the conventional methods which often involve separate testing and rehabilitation equipment, our solution combines both functionalities into a single, versatile platform. This integration offers unprecedented flexibility, thus allowing users to transition seamlessly between the assessment and intervention phases without the need for multiple devices and/or complex setups. By consolidating the testing and rehabilitation capabilities, our product streamlines workflows, enhances efficiency, and maximizes the use of resources.

The benefits and value to the potential users

Our solution offers several benefits to potential users in the rehabilitation field. By simplifying data collection and analysis, it allows professionals to track the patient's progress more effectively, thereby leading to tailored treatment plans and improved patient outcomes. The enhanced sensitivity and functionality of our equipment ensures a higher quality of care, enabling therapists to address patient needs with precision. Moreover, our cost-effective solution eliminates financial barriers, thus making valuable data accessible to facilities of all sizes. Overall, users can expect an increased efficiency, better-informed decision-making, and, ultimately, enhanced rehabilitation outcomes for their patients.

PSRACING FORMULA STUDENT TEAM

Martin Gomez
Giovanna Andino
Mentor: **Steven Lamino**

Kaunas University of Technology

Field of science │ Interdisciplinary Works │ Economy, Social Sciences and Humanities │ Information Technologies

Description of the work

Our organization, the *Formula Student Team*, is a dedicated group of engineering students passionate about design and innovation. As part of the global *Formula Student* competition, we design, build, and race a single-seat race car prototype, pushing the boundaries of engineering excellence and teamwork. Through hands-on experience and collaboration, we develop practical skills in design, manufacturing, and project management, thereby preparing ourselves for future careers in the engineering industry.

Novelty of the work

Our project differs from other ideas since it is a multidisciplinary project which is something new at the university and in Lithuania since there is no other Lithuanian team in the grid of formula student competitions; also, it differs from other projects by having a practical approach towards the engineering industry.

The benefits and value to the potential users

The benefits that our users, in this case – students, can get are hands-on experience, self-development, practical skills, mainly in the areas of design, manufacturing and project management.

DIGITAL TWIN FOR KTU CAMPUS BUILDINGS OPERATIONAL CARBON FOOTPRINT AND CLIMATE MONITORING AND IMPROVEMENT

Justas Kardoka
Vytautas Bocullo
Rytis Venčaitis
Lina Morkūnaitė
Mentor: **Dr. Darius Pupeikis**

Kaunas University of Technology

Field of science │ Interdisciplinary works │ Construction and Architecture

Description of the work

The project *Digital Twin for KTU Campus Buildings Operational Carbon Footprint and Climate Monitoring and Improvement* presents the CO_2 footprint of the KTU campus buildings in real time, broken down by distinct types of energy and the aggregation of buildings, systems and equipment. The monitoring is provided by collecting data from various APIs that broadcast in real time more than 2000 parameters from physically installed sensors in the KTU campus. The data of the sensors is visualized and provided by linking it to the buildings' geometry and the relevant attributes by utilizing technologies such as photogrammetry, BIM, 360 panorama, etc.

Technical or other problems that are solved with the work

The construction and use of our built environment accounts for 39% of global greenhouse gas emissions, leading to climate change and catastrophic negative impacts. Of this, as much as 80% of carbon dioxide emissions come from the operation of buildings. The main part of this CO_2 footprint comes from various types of energy consumption and waste disposal. Electricity, gas, heat, water consumption, wastewater and waste disposal are the main factors influencing the carbon dioxide footprint of the built environment.

Novelty of the work

The main innovation lies in the development and application of a digital twin for buildings serving the objective to monitor the building performance and, consequently, implement improvement measures; e.g., one of KTU's most modern and energy-efficient buildings, MLAB, had the following structure of its operational CO_2 footprint in March 2024: it consisted of the 8% thermal energy consumption, 37% electricity consumption and solar generation, 2% water supply and waste water disposal, 3% ventilation, and as much as 51% goes to waste. The obtained data indicates a problem area in this regard. Looking into more detail, 4% of these is glass waste, 21% – metal, 42% – mixed household waste, 33% – paper and cardboard. In the general context of the KTU student campus, the MLAB building is the 'greenest', whose monthly footprint in March 2024 was 2.23 tCO_2e, while the footprint of the entire Campus amounted to 3793 tCO_2e at the same time. All of these comparisons and the ability to do them at macro/micro levels show areas for improvement.

The benefits and value to the potential users

The investigations show that proper energy monitoring can already reduce the negative effects by up to 10%. It is also a fundamental basis for more efficient energy management and savings. The operational CO_2 footprint of the buildings on the KTU campus in March 2024 was 74% of the thermal energy for heating and hot water, 30% of electricity, 4% water supply and wastewater disposal, 5% waste generation, -7% solar energy, and -7% electric vehicle charging. The mitigation effects due to the installation of solar power plants and the charging of electric vehicles amounted to a mitigation effect of -14%, respectively. In the longer term, as the heating season

recedes, the reduction effect will have a more significant impact. At the same time, this indicates signals to the University management to increase the use of renewable energy sources, as well as electro vehicles, and to improve the energy consumption of buildings through more efficient regulation (especially that of thermal energy).
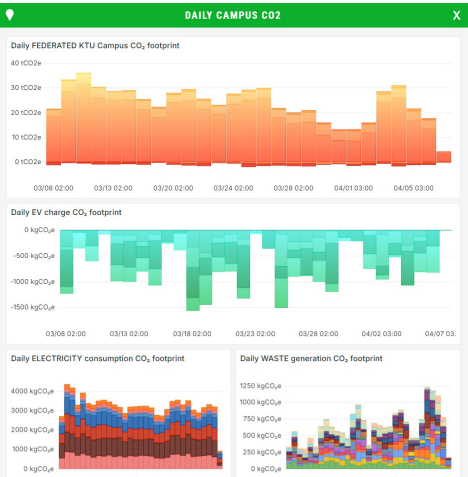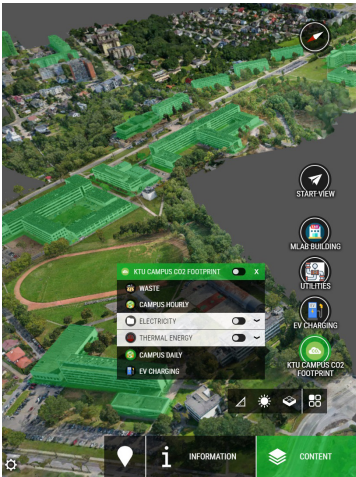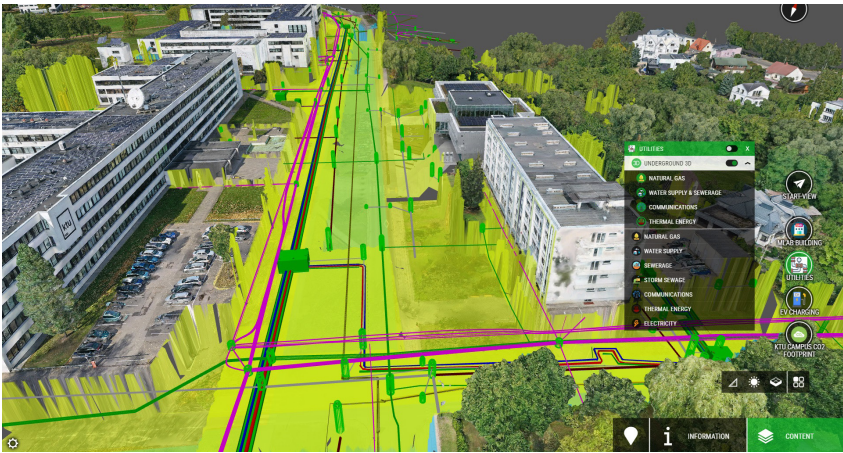
OPEN-SOURCE MONITORING SYSTEM FOR HYDROGEN AUTOMOTIVE FUEL CELL PARAMETERS

Titas Dobilevičius
Justina Kuprijanovaitė
Miglė Armonavičiūtė
Mentor: **Dr. Benas Gabrielis Urbonavičius**

Kaunas University of Technology

Field of science │ Interdisciplinary works │ Construction and Architecture

Description of the work

The project is designed to efficiently track the performance and degradation of fuel cells in hydrogen cars over time. The system, developed by using open-source software, allows experts to monitor important parameters such as the fuel cell temperature, hydrogen pressure, the generated voltage and power in real time. A built-in data analysis tool helps to identify performance anomalies and potential fault points, thereby ensuring vehicle safety and reliability. The system includes modules for data acquisition and processing. The use of open-source solutions makes the system accessible to the wider community, thereby stimulating innovation and improvement in the hydrogen car sector.

Technical or other problems that are solved with the work

Monitoring the parameters of hydrogen fuel cells is essentially important for several key reasons. Safety is a major concern as fuel cells generate energy through chemical reactions between hydrogen and oxygen; thus, any deviation in pressure or temperature can lead to an undesirable reduction in efficiency. By monitoring these parameters, we can optimize the efficiency of the fuel cell, which depends on the pressure of the hydrogen and the operating temperature. The right combination of these parameters allows us to maximize fuel utilization, improve energy production, and ensure a longer cell lifetime. In addition, continuous monitoring helps to detect early signs of failure, thereby allowing for timely maintenance and avoidance of costly repairs. At present, no such systems exist that would be open to engineers and scientists working in the fuel cell field. Research on fuel cell degradation is based only on mathematical models and not on practical data. Open-source solutions and the availability of data encourage scientists and engineers to analyze this data, improve the presently existing technologies, and develop new ones, thus contributing to a sustainable and innovative energy future.

Novelty of the work

Such fuel cell parameter monitoring systems are virtually non-existent, or they are only used in conjunction with sophisticated manufacturer-developed diagnostic platforms. This solution is the first to use open-source principles. It has been designed exclusively for *Hyundai* fuel cell monitoring.

The benefits and value to the potential users

An open-source monitoring system for hydrogen automotive fuel cell parameters provides several key benefits. Firstly, it fosters innovation and collaboration by allowing researchers, developers, and manufacturers to share findings and improve technology collectively. This accelerates the development of more efficient and reliable fuel cells. Secondly, it reduces costs by eliminating the need for proprietary software, thus making it easier for smaller-scale companies, startups and scientists to enter the field. Additionally, such a system enhances transparency and trust in the fuel cell technology by providing accessible data on the performance and safety

metrics. This can lead to better standardization across the industry and quicker adoption of the hydrogen fuel technology in the automotive sector, thus ultimately contributing to advancements in sustainable transportation solutions.

> **TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)**

SLIBINOMOBILIS 1.5

Titas Dobilevičius
Kasparas Pečeliūnas
Gintarė Gabrielė Gabšytė
Justina Kuprijanovaitė
Arnas Kripavičius
Ieva Janušaitytė
Dovydas Lukoševičius
Vilius Medika
Gvidas Brilius
Mentor: **Dr. Benas Gabrielis Urbonavičius**

Kaunas University of Technology

Field of science │ Interdisciplinary Works │ Mechanics │ Natural Sciences and Mathematics │ Electricity, Electronics and Energy

Description of the work

Slibinomobilis is a character created by Kaunas physicists whose life goal is to show that Kaunas physicists can also implement crazy ideas, and, by joining them, you can become the best version of yourself. Hidden under the skin of the *Slibinomobile* is a *Jaguar XJ40* – a car with a 'soul'. The idea of sustainability has been an important thread in project development. *Slibinomobilis* 1.5 greets everyone refreshed, and it roars and exhales plumes of smoke. The interior of *Slibinomobilis* has also been refurbished. The *Slibinomobilis* platform is being prepared for a new phase, and it will be the first car in the country to be powered by a hydrogen internal combustion engine. Every time *Slibinomobilis* appears in public, it invites you to get to know Kaunas physicists and wants to inspire everyone to take the plunge and bring to life even the most bizarre ideas.

Technical or other problems that are solved with the work

There is a common misconception that you can become a physicist only in Vilnius. That is factually not true. This project aims to increase awareness that physicists in Kaunas are as good (if not even better :)) than physicists in Vilnius. The *Slibinomobilis* project is intended to highlight that physics students @ KTU can weld, grind, drill, glue, design and 'do a skid' while employing their vast knowledge in physics and material engineering, without ever forgetting strict deadlines. With the new stage of hydrogen power, this will be the unique test platform for further research in the field.

Novelty of the work

This is a single such project in the world – to the best of our knowledge – and it is a colleague to the legendary Lithuanian symbol of physics *Dinas Zauras*. This is a generally new development in the promotion of fundamental and engineering sciences @ KTU, as well as hydrogen combustion technologies.

The benefits and value to the potential users

By virtue of being a social/technical innovation, the main value of *Slibinomobilis* is the created awareness of the importance of fundamental and engineering sciences, their value and potential for society.

TRAILLINK: MAKING MOUNTAIN BIKING COMPETITIONS SAFER

Eidenis Kasperavičius
Evaldas Katilius
Mentor: **Dr. Mindaugas Čepėnas**

Kaunas University of Technology

Field of science │ Interdisciplinary Works │ Electricity, Electronics and Energy │ Health Sciences

Description of the work

Mountain biking competitions are inherently risky – as high-speed racing through tracks in forest and mountainous terrain is bound to cause accidents and injuries. In fact, on average, 40 injuries occur per 1000 hours of competition! However, only a small part of them cause fatalities (2 per million). So, if the rescuers get promptly notified and reach the injured athletes in time, the worst consequences can be avoided. *TrailLink* provides a wearable tracker that monitors the physiological parameters of the bikers, and the developed software reports the detected accidents, thus ultimately making mountain biking safer.

Technical or other problems that are solved with the work

Mountain biking competitions face a significant challenge since accidents and injuries are bound to occur as participants navigate high-speed tracks through forests and mountain paths. Despite the use of helmets, special-

ized clothing, footwear, gloves and other protective gear, injuries still occur since the speeds reached on the racing course which is full of obstacles and denoted by rough terrain is much higher than that of the 'regular' cyclists. Studies indicate that, on average, 40 injuries occur per 1,000 hours of competition; however, the recorded death rate is only 2 per million. Hence, *TrailLink* uses a wristband designed to detect and report accidents, which enables the rescuers to quickly find athletes in challenging, obstacle-filled terrain, and ultimately prevents fatal outcomes among athletes.

Novelty of the work

TrailLink, unlike all commercially available alternatives, is specifically designed for long MTB courses conducted in wild nature. It enables long-range monitoring and synchronous use of the collected data without the need for an internet connection. In addition, *TrailLink* stands out from other research efforts by offering automatic anomaly (i.e., accident) detection.

The benefits and value to the potential users

TrailLink has been designed for mountain biking competitions, thus enabling their organizers to track each athlete's physiological parameters and to be updated on their current condition. The organizers are also relieved of manual real-time data analysis by the use of anomaly detection algorithms. In turn, the system provides safety to the competitors, and they can focus on performing their best, by knowing that the organizers are always at hand.

YELLOW HOUSE EDUCATION – UNIVERSAL BILINGUAL EDUCATION PROGRAMME; SLOGANS: LEARNING STARTS WITH LISTENING AND EMPOWERING ALL GENERATIONS

Katarzyna Biersztańska
Prof. Magdalena Olpińska-Szkiełko
Claire Selby
Krzysztof Misztal, Ph.D.
Aleksandra Kubica-Misztal, Ph.D.
Prof. Jarema Drozdowicz
Elżbieta Rzeszutko
Maja Wrzos
Joanna Napora
Diana Ulanicka
Katarzyna Sobkowicz
Karolina Moczydłowska
Gustaw Miksa
Rafał Lew-Starowicz
Mentor: **Waldemar Miksa**

Yellow House Education – Universal Bilingual Education Programme

Field of science │ Interdisciplinary Works │ Economy, Social Sciences and Humanities │ Information Technologies

Description of the work

Every child is a citizen of the world with the natural right to understand and be understood everywhere. Our mission is to make that happen. Since learning starts with listening 3 months before birth, and a second language only positively influences a child's development, which is proven even when they are 7 months old, we want to create a universal tool for everyday contextual immersion in the universal language for children and their parents. In our approach, the Universal language is English, representing only universal values and content. This way, we will generate English as a universally used language and create a worldwide community of UL native speakers' generation.

Technical or other problems that are solved with the work

We are the first EdTech company to help every child achieve native competency in English in parallel with their local languages. We have created a special program (thanks to the cooperation with scientists from universities and also other experts) in order to make Universal Bilingual Education possible and easy to implement. The program is based on three dedicated series of videos, songs, storybooks, contextual dictionaries, and games. The characters speak only English, so children associate them with this language and acquire it from the context. Thanks to the unique expertise resulting from R&D projects, our product has an evaluation and recommendation system. What is more, the universal content is also delivered through our innovative approach incorporating STREAMS – science, technology, robotics, engineering, art, math, and social skills. Our solution has already been successfully implemented in over 3000 educational institutions and over 500 districts across Poland. In 2024, together with NŠA (the National Agency for Education), we started testing our program in over 25 kindergartens and class 0-1 of Lithuanians schools. We have also been expanding our program to other countries and developing a B2C-oriented mobile application. This could have a direct impact on the global growth of our program. A successful B2C application has the potential to enhance awareness of bilingual education, thus enabling us to reach not only individual households, but also governmental and private institutions worldwide.

Novelty of the work

We are the world's only experts in *Universal Bilingual Education*. Universal Bilingual Education combines two processes – bilingual upbringing with En-

glish as well as full individualization of all teaching based on three pillars: universal language, shared values (e.g., friendship, empathy), and S-T-R-E-A-M-S. We also use TOLA-GIMME (Engine): total language immersion through games – Development of a content generation engine, which will then be used by a universal gaming platform for total immersion in the English language through games (TOtal LAnguage-Game IMMErsion).

The benefits and value to the potential users

With a coherent system, the Bilingual Future Programme helps parents and early education teachers (both with and without English language teaching qualifications) immerse children in the language through daily activities and play. The system has been designed to allow every child to develop in accordance with their aptitude while providing comprehensive bilingual education.

DEVELOPMENT OF A SMART ORTHOPEDIC BRACE

Umaid Shah
Mentor: **Donatas Daublys**

Kaunas University of Technology

Field of science │ Interdisciplinary Works │ Design │ Mechanics │ Electricity, Electronics and Energy │ Health Sciences

Description of the work

The goal of this work is to introduce the created prototype of a smart orthopedic brace which is bound to facilitate the recovery of athletes from knee injuries during their rehabilitation. The advanced sensors integrated in the brace will track the patient's knee movements and provide real-time feedback on their healing progress. In addition to monitoring the recuperation, this prototype seeks to shorten recovery periods, improve comfort, and lower the chance of re-injury. The project will integrate the sensor technology, test the brace's strength and functionality, and assess its effects on society, the economy, and the environment. By making healthcare more dynamic and individualized, this novel strategy aims to cut down healthcare costs and lessen the reliance on in-depth professional care.

Technical or other problems that are solved with the work

Our product solves the issue of inadequate rehabilitation support from the traditional orthopedic braces following knee surgeries, particularly for athletes. These conventional braces often provide static support and fail to adapt to individual healing processes, thus ultimately leading to longer re-

covery times, discomfort, and a higher risk of re-injury. Our smart orthopedic brace integrates advanced sensor technology thus enabling continuous knee movement monitoring, while offering personalized feedback and adaptive support. This innovation not only accelerates recovery but also enhances the wearer's comfort and safety, thereby reducing the healthcare costs and dependence on professional care.

Novelty of the work

The novelty of our work lies in the dynamic and personalized approach towards orthopedic rehabilitation. Unlike the traditional braces which tend to offer static support, our smart orthopedic brace utilizes an integrated sensor technology to provide adaptive support. This system monitors the wearer's real-time biomechanical data, thereby adjusting support levels based on the specific phase of healing and individual movement patterns. This capacity for customization is unprecedented in the current market offerings which typically feature one-size-fits-all solutions with limited adaptability. Additionally, the integration of feedback mechanisms enables not only the patients, but also the healthcare providers to track progress and optimize rehabilitation strategies, which sets *FlexiRecover* apart as a leader in personalized medical technology for sports rehabilitation.

The benefits and value to the potential users

The product enhances the rehabilitation process by providing continuous, adaptive support tailored to each user's personal recovery needs. The product's benefits include a reduced recovery time, while also minimizing the risk of re-injury, along with an enhanced comfort during rehabilitation, and decreased healthcare costs. This smart brace has been designed for athletes aiming for a quick, safe return to their peak performance levels.

MOBILE AIRCRAFT TRACKING SYSTEM (ADS-B TRAC)

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Kipras Jasiūnas
Tadas Rybelis
Lukas Nagulinas
Tautvydas Dirsė
Kasparas Jasiūnas
Almantas Karosevičius
Darius Kybartas
Simonas Riauka
Mentor: **Dr. Pranas Kuzas**

Kaunas University of Technology

Field of science │ Interdisciplinary Works │ Information Technologies │ Electricity, Electronics and Energy

Description of the work

Our ADS-B TRAC system has been designed to receive ADS-B communication packets that are mandatory in commercial aircraft. They include aircraft ID, GPS coordinates, altitude, velocity, the planned trajectory etc. The USA Government has plans to make ADS-B transponders mandatory in every consumer drone under ~250grams. The ADS-B TRAC started out as a semester project at the Electronics Engineering Department of Kaunas University of Technology and was developed by students up to the fully functional prototype stage. Our ADS-B TRAC system is able to track aircraft by employing two methods: 1. The ADS-B packet decoding method, which involves receiving and decoding ADS-B packets by using only one device. 2. The multilateration method is ued for Processing the received ADS-B pack-

ets in the server, and the aircraft position based on the packet arrival time-stamp is calculated. This method requires at least four ADS-B TRAC units for a 3D coordinate solution in a passive radar mode. Our research goal is to assess the aircraft tracking speed, resolution and precision by combining these two methods, and to explore the feasibility of using this technology for high-speed tracking of consumer drones and other types of aircraft in distance-limited areas up to several kilometers of range.

Technical or other problems that are solved with the work

The devised portable ADS-B tracking system *ADS-B TRAC* can find its use as a local solution for the tracking of drones equipped with ADS-B transponders and in those cases when some aircraft is not transmitting its global coordinates in the ADS-B message.

Novelty of the work

The novelty of the work is based on the embedded solution of the tracking system which possesses a flexible ability to discriminate the required signals or patterns in the selected frequency band, and to assign a unique high resolution time stamp to the decoded packet by using the GNSS synchronized or local time reference.

The benefits and value to the potential users

The integrated modular portable solution ADS-B TRAC with the ability to track, process and time-stamp the arriving ADS-B packets and to store the data in an Internet server for analysis, visualization and long-term storage. The prototype solution has been offered in a water-resistant case with the ability to operate autonomously for up to two hours and from a 12–15V external power supply.

GEOSUSTAIN: SUSTAINABLE ENERGY SOLUTIONS WITH LITHUANIAN RESERVOIRS

Abdul Rashid Memon
Dr. Shruti Malik
Dr. Apoorv Verma
Mentor: **Dr. Mayur Pal**

Kaunas University of Technology

Field of science │ Interdisciplinary Works │ Information Technologies │ Electricity, Electronics and Energy

Description of the work

This work presents a multifaceted approach aimed at reducing CO_2 emissions, enhancing geothermal energy production, and transitioning to clean energy sources. CO_2 emissions from industries are captured and injected into deep saline reservoirs underground, where the heat generated from geothermal sources is utilized for electricity generation. The injected CO_2, upon contact with hot rocks, absorbs heat, expands, and becomes less dense, thus facilitating its extraction along with brine through production wells. The extracted heat from CO_2 is transferred to a secondary fluid, such as water, to drive turbine generators and produce electricity. The cooled CO_2 is compressed and reinjected into the reservoir to maintain the pressure. Meanwhile, the surplus geothermal energy

is converted into hydrogen through electrolysis and stored underground for future use. The reservoir must meet compatibility criteria for both hydrogen storage and production. This integrated approach optimizes resource utilization, reduces environmental impact, and fosters a sustainable energy landscape.

Technical or other problems that are solved with the work

Our product addresses the pressing challenge of transitioning to a sustainable energy future by integrating renewable energy sources with efficient energy storage. It combines the renewable energy generation and storage in a unified solution, thus helping to mitigate climate change by reducing greenhouse gas emissions, optimizing energy production and consumption, and promoting the adoption of clean energy technologies. Our solution enables energy companies, industries, governments, and research institutions to effectively manage their carbon footprint, comply with emissions regulations, and contribute to the global efforts to combat climate change. By providing a comprehensive and scalable approach to clean energy production, storage, and carbon management, our product empowers stakeholders to drive the transition towards a low-carbon economy and build a more sustainable future for generations to come.
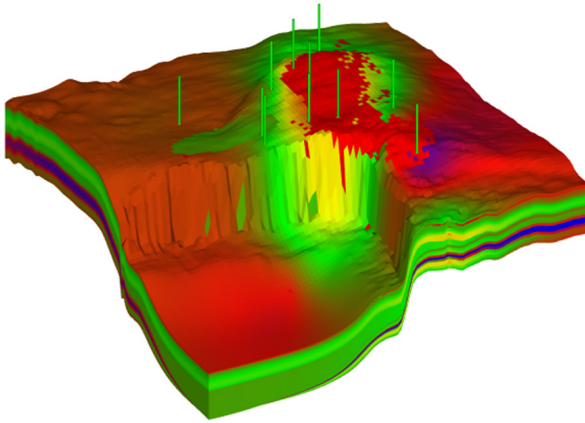
Novelty of the work

Our work in Lithuanian reservoirs presents a novel approach towards sustainable energy utilization, by capitalizing on the abundant geothermal resources and unique geological characteristics of the region. By tapping into the geothermal anomaly prevalent in Lithuania's subsurface, particularly in the western part of the country, we aim to address energy security challenges while minimizing costs and environmental impact. Furthermore, we offer innovative solutions to mitigate greenhouse gas emissions and facilitate renewable energy storage in Lithuanian reservoirs. This comprehensive approach bridges the gap between the traditional energy practices and emerging sustainable solutions, thus positioning Lithuania as a leader in pioneering clean energy technologies. Our work fills a significant gap in Lithuania, which makes us unique in our contribution to sustainable energy development within the region.

The benefits and value to the potential users

The solution aligns perfectly with the ambitious net-zero emission targets set by the European Union (EU) and other regulatory bodies. It enables users to significantly reduce their carbon footprint and mitigate the impacts of climate change by optimizing energy production. Additionally, it enhances energy reliability and resilience by providing efficient energy storage solutions, and reducing dependence on fossil fuels. It also plays a crucial role in accelerating the transition to a low-carbon economy and ensuring compliance with the stringent environmental regulations.

GREI-CIO

Gabrielė Galdikaitė
Mentor: **Dr. Virginija Jankauskaitė**

Kaunas University of Technology

Field of science │ Interdisciplinary Works │ Design │ Mechanics │ Electricity, Electronics and Energy

Description of the work

GREI-CIO is a motorized shoe which helps you move 2 times faster than normal. The mechanism built into the shoes gives the user extra speed, allowing them to move more efficiently. The product aims to create a sustainable mobility tool that is universal and suitable for all types of casual footwear. The operation of these motorized shoes is based on the energy of human movement, and so the user does not need to put any extra effort while traveling. The product is designed based on the principles of ecological design which makes it possible to easily separate and sort all the components that make up the product. The product has a size adjustment function which allows the product to be adapted to a wide range of users, thus encouraging users to share and reduce over-consumption and waste of resources. The materials chosen to make motorized shoes are easily recyclable, thus promoting a circular economy.

Technical or other problems that are solved with the work

Currently, there are about 1.5 billion vehicles in the world, of which, about 413 million are in Europe. The transport sector is one of the biggest sources of pollution in cities, which constantly produces greenhouse gases. Research shows that, due to solid particles in the air, heart, lung and respira-

tory tract infections are increasing, and, as a result, about 7 million people die annually in the world, and about 3 thousand people die in Lithuania. In the last decade, electric micromobility vehicles have been rapidly gaining popular in cities around the world as a great alternative to vehicles with internal combustion engines. Such electric micromobility devices do not get stuck in traffic jams, they take up little space when stored at home, and do not require high costs for maintenance and use. However, these electric tools, like cars, do not contribute to the implementation of the daily physical activity norm of the user. Research shows that one in three Europeans is physically inactive. Physical inactivity is a major risk factor for non-communicable diseases that can increase the risk of cardiovascular disease, diabetes, cancer, and other passive lifestyle-related diseases. Therefore, a product that promotes sustainable movement and improves public health is an invaluable contribution to the well-being and health of the population of all Europe. Motorized shoes promote sustainable movement and, at the same time, reduce environmental air pollution and congestion in cities. The development of alternative transportation means the improvement of the living environment and the promotion of people's health and well-being, which has a long-term positive impact on the Lithuanian and European society.

Novelty of the work

There are only several units of products with this principle of operation on the market, therefore, it is still difficult to draw comparisons. *GREI-CIO*, unlike the other analogues, has a size adjustment function and is based on the principles of ecological design. Compared to other similar motorized vehicles, by using the *GREI-CIO* product, a person contributes to the daily norm of physical activity, since the movement is based on walking.

The benefits and value to the potential users

Walking is the most natural form of human movement that does not require any special preparation and is also an environmentally friendly way of traveling. Although moving on foot has endless advantages, people tend to cover even a short distance with the help of cars. Such a choice of transportation pollutes the environment without any contribution to human physical health. In this context, motorized shoes solve the problem of short and medium distance movement in the city. GREI-CIO allows users to move the

same distance twice as fast, saving time while traveling without any extra effort. The product is an efficient and economical way of transport, as the device is quickly and easily charged. Since the shoes have the function of changing the size, the product can be adapted to more than one person.

SLYP: SLEEPING PAYS OFF, LITERALLY

Meda Budrytė
Gabija Dūdaitė
Egidijus Sinkevičius
Lora Drazdauskaitė
Vilius Malinauskas
Rūta Degutytė
Mentor: **Dr. Tomas Iešmantas**

Kaunas University of Technology

Field of science | Interdisciplinary

Description of the work

SLYP is a personalized sleep tracking app which provides customized suggestions for improving the sleep quality based on individual user parameters. To achieve greater personalization, the user will be able to select the goals they want to achieve with this app (gain knowledge about sleep health, discover the factors that influence their sleep most of all, receive discounts, etc.). Users who consistently achieve their goals and tasks will be motivated by a virtual coin system, which will allocate points for each completed goal, which can be exchanged for discount codes or physical prizes from the project partners.

Technical or other problems that are solved with the work

A person spends as much as a third of their life sleeping, thus making the importance of sleep undeniable for a fulfilling individual life. One of the essential

factors for high-quality sleep is its duration. A young adult (18–35 years old) should plan their day in a way that ensures they get no less than 7 hours of sleep per day. However, the spirit of the youthful lifestyle is extremely fast-paced and unpredictable, thus making it quite a challenge for modern individuals to establish and adhere to a proper sleep schedule. Additionally, while a young person may recognize the connection between the sleep quality and productive work, they often lack knowledge about the sleep health, as well as understanding how to nurture it properly, and what physiological factors or lifestyle peculiarities can influence a good night's sleep. The SLYP app is aimed at young people who care about their health, nurture a healthy lifestyle, and recognize the importance of quality sleep for well-being and productive work, which is an inseparable part of high-quality life.

Novelty of the work

The currently available sleep health-related applications do not track such factors as the daily stress level, sleep disorders, disrupted heart rhythm, etc., which *SLYP* evaluates and then creates personalized suggestions for improving the sleep quality, which sets the app apart. In addition, SLYP utilizes the most recent machine learning techniques to forecast the sleep quality and endeavor to enhance so that it will adapt to each individual sleep schedule and learn from each unique style. Moreover, the ability to earn points and exchange them for discount codes is among the most highly valued features by the modern users, which, in the case of *SLYP*, would become a competitive edge in the realm of the sleep health.

The benefits and value to the potential users

SLYP offers a multitude of benefits for its clients. Firstly, the users can enjoy discounts as they accumulate points through app engagement, thus enhancing their incentive to maintain healthy sleep habits. Moreover, *SLYP* provides invaluable education on sleep health, empowering individuals with knowledge about the optimal sleep practices. Additionally, the app offers useful metrics and insights into the sleep patterns, thereby enabling users to better understand their sleep quality and make informed adjustments. Through personalized self-analysis features, the clients can delve deeper into their sleep habits, while fostering self-awareness and facilitating targeted improvements. In essence, *SLYP* not only incentivizes healthy sleep

behavior, but also educates, informs, and empowers its users to achieve the optimal sleep and overall well-being.
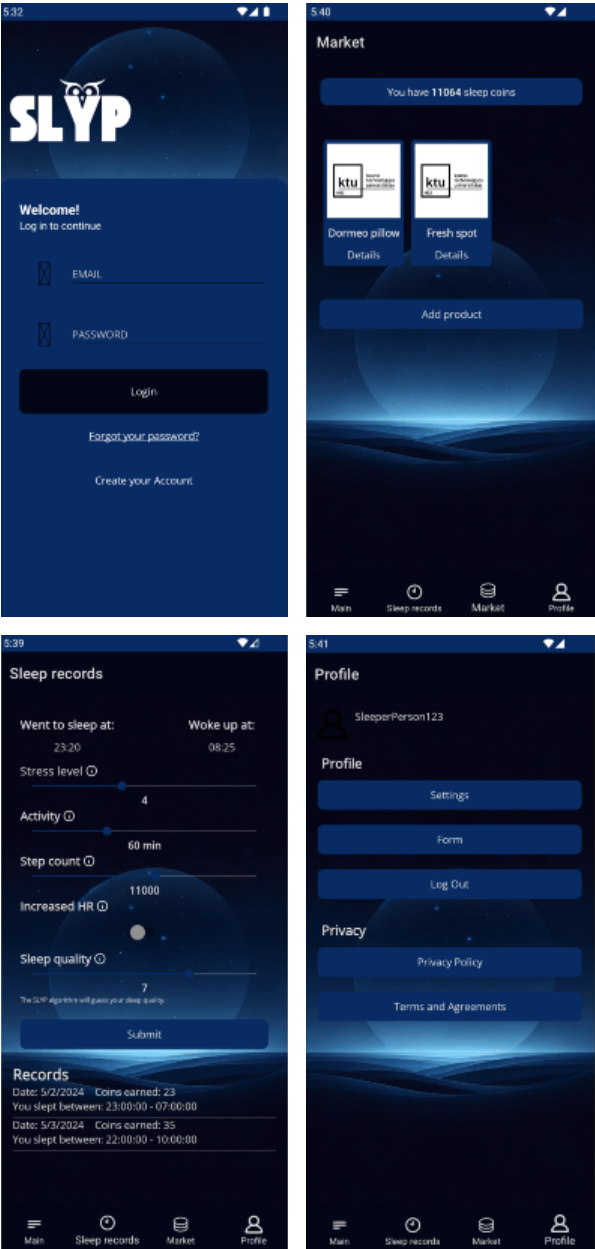
WRIST-WORN DEVICE FOR IMMEDIATE DETECTION OF ACUTE MYOCARDIAL INFARCTION IN OUT-OF-HOSPITAL ENVIRONMENT

Karolina Jančiulevičiūtė
Dr. Andrius Petrėnas
Dr. Daivaras Sokas
Dr. Saulius Daukantas
Mentor: **Dr. Andrius Petrėnas**

Kaunas University of Technology

Field of science │ Interdisciplinary Works │ Information Technologies │ Electricity, Electronics and Energy │ Health Sciences

Description of the work

Acute myocardial infarction (AMI) is a life-threatening condition caused by blocked blood flow in the heart. An easy-to-use technology for immediate AMI detection in the out-of-hospital environment is essential for the prevention of deaths due to delayed treatment. A wrist-worn device developed at KTU Biomedical Engineering Institute is capable of simultaneously capturing two ECGs, thus opening the possibility to synthesize a 12-lead ECG, facilitating clinical interpretation. The main novelty is that an echo state neural network is used to synthesize the 12-lead ECG from just two ECGs acquired through a wrist-worn device. Fifty-four participants, including 14 with AMI, were enrolled to test the clinical utility of the wrist-worn device. Four cardi-

ologists, blinded to whether the ECG was conventional or synthesized, were asked to diagnose AMI. The synthesized ECGs show comparable accuracy to the conventional ECG in diagnosing AMI. The proposed wearable-based approach holds promise as a screening tool in out-of-hospital environments.

Technical or other problems that are solved with the work

AMI causes heart damage, thus every minute from the symptom onset to the treatment initiation counts, thus making timely identification crucial. According to the *Eurostat* report (2024), effective health management and timely interventions in the population under 75 years of age could prevent 2 out of 3 deaths, of which AMI is the leading cause. The AMI problem is especially prominent in Lithuania where the AMI-related death rate is 3 times larger than the EU average. Since AMI is becoming increasingly common even among those with no cardiovascular risk factors, the development of new preventative strategies is highly encouraged. However, AMI is usually diagnosed through laboratory tests or/and the analysis of 12-lead ECG, neither of which can be done outside the hospital immediately after the first symptoms, such as chest pain, are being experienced. Meanwhile, clinical reduced-lead ECG recorders provide limited benefits since it is nearly impossible to predict the occurrence of AMI and prescribe ECG monitoring in advance. Therefore, a convenient and inexpensive technology for timely AMI identification, which is simple enough for independent use by the owners themselves, is prominently needed.
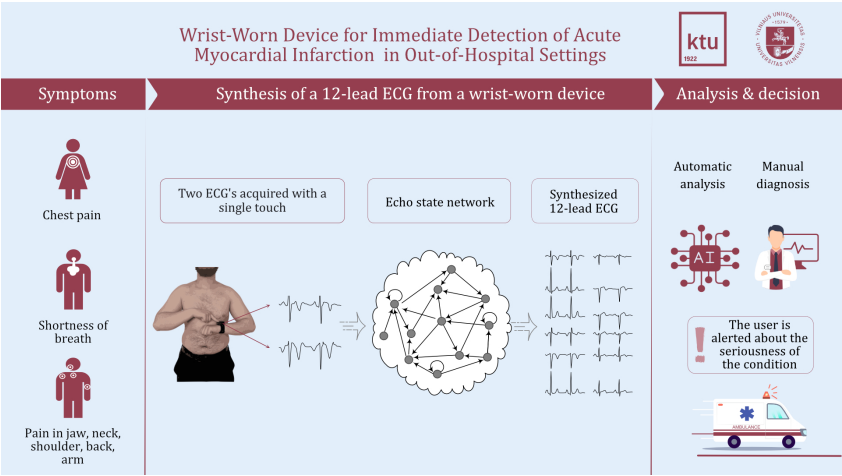
Novelty of the work

The latest smartwatches can record a single ECG; however, it is insufficient for diagnosing AMI. We propose to increase the number of ECGs by utilizing the dedicated wrist-worn device, along with software for deriving the conventional 12-lead ECG. The device allows acquiring two ECGs with a single touch. However, one ECG is non-standard, thereby posing a challenge in clinical interpretation. To present information in a comprehensible and useful manner for clinical interpretation, an echo state neural network is proposed to synthesize a 12-lead ECG from two ECGs acquired by using a wrist-worn device. After automatic and/or manual ECG analysis, the user will be informed about the analysis outcome by an alert, thus aiming to increase awareness about the seriousness of the condition.

The benefits and value to the potential users

A widely available technology for immediate AMI detection in the out-of-hospital environment is essential for the prevention of potentially avoidable deaths due to delayed treatment. The reluctance to seek medical examination is worrying since the risk of mortality within 1 year increases by 8% for every half-hour treatment delay. This is a serious social issue, demanding greater efforts to be made to raise awareness of those who are experiencing AMI-related symptoms about the life-threatening consequences due to the delayed treatment. Wearable technology will stimulate the development of new telemedicine services. By providing wearables to individuals at risk for AMI, e.g., those with cardiovascular comorbidities or history of previous AMI, the user and healthcare providers will immediately be informed about the suspected AMI.

Wrist-Worn Device for Immediate Detection of Acute Myocardial Infarction in Out-of-Hospital Settings

DETENDO – FOR EMPLOYEES AND EMPLOYERS

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Andrius Jokšas
Silvija Petkevičiūtė
Monika Stalšinskaitė
Valentas Deimantas
Motiejus Gladkauskas
Mentor: **Dr. Tomas Iešmantas**

Kaunas University of Technology

Field of science │ Interdisciplinary Works │ Information Technologies │ Electricity, Electronics and Energy │ Health Sciences

Description of the work

Detendo is an employee stress detection system for companies, assisting the company's representative in assessing the quality of the work environment. *Detendo* determines results by using a questionnaire that evaluates the psychological state and suitability of the subject for the study, as well as physiological signals indicating the existence of stress, without relying solely on self-analysis by the subject. The study uses four different biosensors measuring physical body signals, it collects data, and, by using a machine-learning model, determines the level of stress. At the start of the study, employees from various sectors wore biosensor devices during work hours. With the subject's consent, an anonymous report with statistics on the employee stress experienced throughout the company and its departments is provided to the company representative on a website. *Detendo* aims to identify the level of stress experienced by employees in the work environment, initiate change, and thereby improve the company's results.

Technical or other problems that are solved with the work

After conducting a survey of working individuals in Lithuania, we found that 90% of our respondents were experiencing stress in the workplace due to various reasons. Research indicates that prolonged exposure to stress affects the physical and emotional health of employees, as well as their work efficiency and quality. In order to reduce the level of stress experienced in the company, while thus improving the work outcomes, it is essential to first identify the extent of the problem. Our target market consists of medium-sized and large companies established in Europe that aspire to assess and improve their workplace atmosphere. The survey also revealed that nearly 80% of the participants would like and agree for their employer to take an interest in their stress levels. By identifying the level of stress within the company, personalized solutions and self-analysis can be implemented based on the results obtained. However, to evaluate the changes made, it is essential to conduct regular research in the company with Detendo. Considering this, and knowing that the number of companies in Europe is incredibly high, the growth potential of Detendo is also unlimited.

Novelty of the work

Upon conducting competitor analysis, we were unable to find any other providers of such services in the market. *Detendo* combines psychological and several physiological indicators in conducting the research, while, in the market, there are only products or services that analyze merely one of these indicators, making their results less reliable for this reason. In the *Detendo* study, up to four non-intrusive and work-friendly biosensors measuring respiration, electrocardiography, electrodermal activity, and temperature are used; thus, the study accurately determines the presence of stress. The data is processed, and the result is obtained by using a trained machine learning model, which, in trial stages, achieved very high accuracy considering the sensitivity of the data.

The benefits and value to the potential users

Detendo holds value for both parties within the company. Employees have the opportunity to participate in research for the sake of their own well-being, and, if the results indicate elevated stress levels in the company, it is highly likely that changes in the workplace will be made. Employees are also able to view their own results regarding the existence of stress. The

value for the employer lies in the improved results of the company's work. Stressed employees are prone to making errors and working less efficiently. If this is the case in the company, the employer can accurately identify it by using *Detendo*. By doing so, the company would also demonstrate its social responsibility and care for its employees.

VIRTUAL REALITY TOOL FOR TREATING *ANOREXIA NERVOSA* BASED ON EXPOSURE THERAPY

Emma Bučinskienė
Paulius Černius
Emilija Kravčenko
Mentor: **Saulė Lideikaitė**

Kaunas University of Technology

Field of science | Interdisciplinary Works | Information Technologies | Health Sciences

Description of the work

The treatment sessions aim to create a safe therapeutic environment, where patients, under the supervision of a psychiatrist or a psychotherapist, can confront their fear of food in virtual reality. Normalizing eating through repeated exposure is crucial in treating this disorder, and virtual reality offers an advantage in facilitating this process.

Technical or other problems that are solved with the work

The main challenge faced by psychiatrists and psychotherapists in treatment is not only the increasing number of cases of *anorexia nervosa*, but also the frequent relapses among patients. Since cognitive-behavioral therapy is currently the most commonly used approach, we believe that specialists and clinics would benefit from incorporating our virtual reality therapy tool as a complementary treatment.

Novelty of the work

To the best of our knowledge, there are no equivalents on offer in Lithuania. However, a startup called *C2Care* in France offers only a program to the Lithuanian market for around 1600 euros, while we would also rent VR headsets for a lower monthly fee and provide the necessary assistance and support.

The benefits and value to the potential users

Virtual reality provides the opportunity for the patient to immerse themselves in an environment where they can choose their favorite foods, or, vice versa, under the guidance of the doctor, try foods they dislike. This allows the doctor to gradually tailor a more individualized treatment for the patient. On the other hand, even selecting the food stimulates the patient's brain, potentially leading to a more effective therapy sessions with the specialist. Therefore, inspired by the possibilities of virtual reality and the demand from doctors, we have decided to develop a tool based on virtual reality therapy to treat *anorexia nervosa*.

RASMELE. HEALTHY SENSORYPLAY FOOD MADE FOR KIDS

Rasa Balčiūnaitė
Amelija Grigaitė
Mentor: **Veronika Guželytė**

Field of science │ Interdisciplinary Works │ Chemical Technologies │ Design │ Health Sciences

Description of the work

Rasmele, led by the youthful visionaries Rasa (11) and Amelija (13) and mentored by the product designer Veronika Guželytė, is pioneering a transformative project within the realm of school dining experiences. Tackling widespread issues like lengthy queues, food wastage, and mundane meal options, *Rasmele* is at the forefront of healthy food innovation for kids and busy people. Through meticulous research and experimentation, they have uncovered the potential of smaller food portions to revolutionize the mealtime, while prioritizing enjoyment and play, by engaging all the senses – fostering curiosity, and creativity. In a world dominated by screens, *Healthy SensoryPlay Food for Kids* encourages real-world engagement and social interaction, bringing friends and families together to share in the joy of food and connection. This idea emerged during the *VIVITA Vista* global accelerator program in 2022, where children harnessed their creativity to address pertinent issues.

Technical or other problems that are solved with the work

Rasmele's journey showcases the remarkable potential children hold as innovators. Their quest began with a mission to enhance the school dining

experience for children, while addressing concerns such as long queues, food waste, and uninspiring options. Through research, Rasa (9 years old) and Amelija (11 years old) discovered the transformative impact of smaller food portions, leading to the genesis of *SensoryPlay Food for Kids*. This innovative vision aims to provide engaging dining experiences while maximizing the break time for children to enjoy and play. As kids say, "less food – you eat faster, so there is more time to play!" Globally, school meal issues persist, thereby impacting the student well-being and academic performance. Recognizing this, many nations are implementing changes in their nutrition standards and mealtime management. Rasmele envisions revolutionizing school meals with innovative systems, starting with the introduction of healthy *SensoryPlay* snacks for kids and busy individuals. The market for innovative school dining experiences is substantial, valued at billions of dollars globally. With an increasing emphasis on health and wellness, demand for interactive dining experiences, adoption of technology in education, and awareness of sustainable practices, the potential for market growth is significant. Rasmele is poised to capitalize on these trends, by positioning itself as a leader in transforming children's mealtime experiences in schools.

Novelty of the work

The novelty of *Rasmele's* work lies in its approach to revolutionizing the school dining experience through innovative solutions created by children themselves. Unlike the traditional approaches to school meals, which often lack creativity and fail to address key issues such as long queues and food waste, *Rasmele* empowers young innovators to design solutions that are engaging, sustainable, and tailored to the needs of their peers. Furthermore, *Rasmele's* focus on smaller food portions as a means of maximizing the break time and promoting healthier eating habits represents a novel approach to school dining. By prioritizing the voices and ideas of children, *Rasmele* ensures that its solutions are not only effective, but that they would also resonate with the intended audience, thus fostering a sense of ownership and empowerment among young learners. Unlike the traditional food brands driven by market trends and corporate agendas, *Rasmele's SensoryPlay Food* is a product of genuine grassroots innovation, born from the minds of children who pinpointed a problem and dared to dream of a solution. Overall, Rasmele's work represents a fresh perspective on school dining, one that prioritizes innovation, creativity, and community engagement to create a more positive and fulfilling experience for children worldwide.

The benefits and value to the potential users

Rasmele embodies a unique approach where children actively participate in shaping their dining experiences. Rasa's and Amelija's vision of integrating children into decision-making processes ensures that *SensoryPlay Food* is not only about creating future food solutions, but also empowering children to contribute to their own futures. By involving kids in decision-making, *Rasmele* fosters a sense of ownership, responsibility, and inclusivity, thereby ensuring that solutions are designed with their needs and perspectives in mind. This innovative approach creates a community where children feel heard and valued, thus laying the foundation for a more equitable and sustainable society. Through our innovative blend of sensory exploration, interactive technology, and culinary creativity, *SensoryPlay Food* offers engaging, nutritious, and enjoyable dining experiences that cater to the unique preferences of children, while addressing broader challenges within school dining, such as long queues, food waste, and limited options.

INNOVATIVE POLYMERIC MEMBRANES FOR ADDRESSING MULTIPLE SKIN ISSUES

Naomie Ach
Miglė Kizelytė
Agnė Anusauskaitė
Mentors: **Dr. Odeta Baniukaitienė, Dr. Edvinas Krugly**

Kaunas University of Technology

Field of science | Interdisciplinary Works

Description of the work

Recently, the cosmetics industry has been increasingly focusing on developing polymer membranes which are considered highly promising for addressing complex skin issues. Depending on the encapsulated bioactive compounds, these membranes can moisturize and brighten the skin, reduce redness, the depth and width of wrinkles. Additionally, membranes can help regulate sebum production, promote skin regeneration, and restore the functions of the skin's protective barrier. The currently available polymer-based membranes in the market are film-like; therefore, they have low sorption capacity, do not adapt well to skin irregularities, and do not provide sustained release of bioactive compounds. During the project, innovative polymer membranes were created from cellulose derivatives by using electrospinning and 3D printing technologies. It has been found that the morphology of these membranes is influenced by the concentration of polymers, the solvents used, and the technological parameters of the equipment. Bioactive substances were ei-

ther encapsulated within the polymer membranes during their formation, or incorporated by impregnating the membranes with bioactive compositions. Innovative polymer membranes have been developed specifically for skin affected by acne, atopic dermatitis, and seborrheic dermatitis.

Technical or other problems that are solved with the work

Seborrheic dermatitis and atopic dermatitis are inflammatory skin diseases which disrupt the normal skin function. Individuals with these conditions have skin that becomes permeable to various microorganisms and environmental allergens, resulting in an increased water loss from deeper skin layers, which causes sensations of tightness and itching. In seborrheic dermatitis, there is an increase in sebaceous gland activity and rapid proliferation of the yeast *Malassezia*. Acne is another inflammatory skin disease characterized by clogged pores, which creates favorable conditions for bacteria such as *Propionibacterium acnes* to proliferate. To manage these diseases or reduce symptoms, it is crucial to suppress inflammation. This is accomplished through the use of topical or systemic hormonal treatments, antibiotics, antiseptics, and agents designed to restore the skin's barrier function. These are usually medical devices or various cosmetic products. Innovative polymeric membranes are among the most promising solutions for addressing multiple skin problems. Such membranes ensure the prolonged release of bioactive compounds. Based on the encapsulated bioactive compounds, these membranes can help regulate sebum secretion and decrease the presence of acne-causing bacteria, as well as restore the protective barrier functions in skin affected by seborrheic and atopic dermatitis. It is of importance to note that there is a significant global demand for products against acne, atopic, and seborrheic dermatitis. In 2023, the market size for anti-acne cosmetics and atopic dermatitis treatment products was each estimated to be approximately 14 billion U.S. dollars, with projected growth by 2030. Additionally, the global market for seborrheic dermatitis products was valued at about 2.7 billion U.S. dollars in 2023, with anticipated growth as well.

Novelty of the work

Polymeric membranes currently available on the market are typically in the film form, resulting in a low sorption capacity, poor adaptation to skin irreg-

ularities, and sustained release of bioactive compounds. In contrast, the newly developed innovative polymeric membranes feature a porous structure, are hydrophilic, can absorb large amounts of liquids, easily conform to skin irregularities, and ensure extended release of active compounds. Depending on the encapsulated bioactive compounds, these membranes can help regulate sebum secretion and decrease the presence of acne-causing bacteria, as well as restore the protective barrier functions in skin affected by seborrheic and atopic dermatitis. It is crucial to highlight that numerous products available on the market include ingredients such as ethoxylated compounds, parabens, synthetic thickeners, dyes, and fragrances. The innovative polymeric membranes are formulated without these skin-irritating ingredients.

The benefits and value to the potential users

Innovative polymeric membranes have been developed for skin affected by acne, atopic dermatitis, and seborrheic dermatitis. These membranes are crafted from cellulose derivatives by using electrospinning and 3D printing technologies. Such advanced technologies facilitate the creation of porous 3D membranes. The innovative polymeric membranes are hydrophilic, capable of absorbing significant amounts of liquids, conform easily to skin irregularities, and ensure the extended release of active compounds. Skin damage can negatively impact psychological well-being and may even lead to depression. By providing effective products to society, it is possible to prevent many adverse psychological effects and enhance public health.
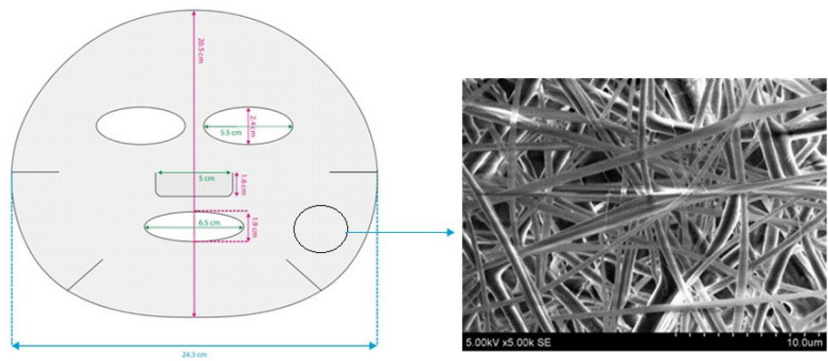
MB *BALTIC BIO FUSION* – THE BEGINNING OF THE WELLNESS JOURNEY! INNOVATION, UNIQUENESS AND SCIENTIFIC PROGRESS ARE OUR COMMITMENT TO YOU

Vitalija Gudėnaitė
Tadas Gudėnas
Tadas Gintauskas
Mentor: **Dr. Rūta Jukonytė**

MB Baltic Bio Fusion

Field of science │ Interdisciplinary Works │ Chemical Technologies │ Health Sciences

Description of the work

MB *Baltic Bio Fusion* supplies not only the highest quality biotechnology products, but also offers unique, personally tailored solutions for you. We know that each person is a unique individual, so our products are created with uniqueness in mind, based on scientific research, based on a multidisci-plinary – holistic approach to overall human health. Our products technology is based on the fermentation method, during which, the product is enriched with probiotics, psychobiotics, and prebiotics. And this helps to regulate the natural microbiome of the intestine, which facilitates the functioning of the intestine. *Dab Drink* is intended for children. The product is enriched with oat flakes, which are rich in β-glucan. This polysaccharide is an important stim-

ulator of the immune system. β-glucan activates cells, while also improving the immune system functions. *Neuro Powder* and *Neuro Bite* are products designed to maintain brain efficiency and adapt to persons who are suffering from Alzheimer's or other forms of dementia. The added value of the product is contributed by its unique composition supplemented with ingredients such as Ashwagandha, which improves the quality of sleep and reduces stress and anxiety, and the Lion's mane (*Gericius*) mushroom which contributes a neuro-genesis effect, i.e., which promotes the growth of neurons.

Technical or other problems that are solved with the work

These products help support a healthy gut microbiome and brain function. At the same time, the consistency of the products is adapted to people with chewing and swallowing disorders. We have specifically adapted the product design and developed a special packaging to facilitate this process for people with cognitive impairments, thus helping to maintain the independence of people with disabilities. Currently, more than 55 million people have dementia (WHO, 2023), and this number is constantly growing. Almost everyone with dementia faces the challenges of malnutrition. People with AD/D often have difficulty swallowing and chewing due to cognitive impairment, so the diet often lacks fiber and vitamins, which commonly affects the gut microbiome, and, at the same time, nutritional insufficiency can develop, which, in the long term, has a negative impact on the general functions of the body. Since large amounts of neurotoxins accumulate in the brain, foods with antioxidant properties are essential. Individuals with AD/D also have difficulty opening a normally packaged product on their own due to cognitive impairments. This often makes them highly dependent on other people and makes them feel uncomfortable. The products of the Neuro line are created in order to meet the consumption expectations, wishes and preferences of people suffering from Alzheimer's or other forms of dementia. All of these products have been created by using the latest food processing technologies which allow the production of innovative or more economical products.

Novelty of the work

Our solution differs from others in the sense that these foods are fermented and contain unique fermented grain bran. It is also rich in probiotics, psy-

chobiotics and prebiotics. These ingredients improve digestion as well as support better brain function and the overall health thanks to antioxidants, including flavonoids, which have been studied in raspberries/blueberries for their potential to reduce the risk of dementia.

Novelty of the work

Due to these and a number of other properties, the product promotes neurogenesis, improves brain health, regulates blood sugar, strengthens immunity, supports gut health, normalizes blood pressure, promotes better sleep, uplifts mood, and all of this is achieved while also being vegan-friendly. It is also unique because the product is adapted to special needs, such as easy chewing and swallowing.

ELECTRIC SCOOTER STAND

Matas Kuncevičius
Mentor: **Dr. Pranas Kuzas**

Kaunas University of Technology

Field of science │ Interdisciplinary Works │ Mechanics │ Electricity, Electronics and Energy

Description of the work

The work consists of a physical stand that holds electric scooter in place and an embedded system which measures the driving dynamics of a scooter. The scooter's motor is placed in between the freewheel and wheel which creates controlled mechanical resistance. As the motor spins, the stand creates mechanical resistance by using air pressure controlled clutch. With the help of an embedded system, the intensity of the resistance along with the data from force and RPM sensors are collected in the computer. Measurements are displayed in graphs. The result of these measurements is the change in RPM's and torque at a certain level of mechanical resistance with respect to time.

Technical or other problems that are solved with the work

In the market of electric scooters, there is a lack of detailed information on the product being sold. The maximum motor power specification alone (that the manufacturer provides) is an abstract unit of measure since the conditions at which maximum power is achieved are unknown. Manufacturers refuse to specify parameters such as maximum RPM's and torque. By knowing these parameters, the consumer will be able to better evaluate if

their electric scooter of choice suits their needs. For instance, if the electric scooter would often be used to climb hills or to carry heavy loads, a scooter capable of driving a high-torque motor would be preferred. The market would be focused on electric scooter repair shops and tech journalists that make reviews on electric scooters. With electric scooters gaining more popularity each year, the need for more detailed information on the product will be required so that the distinction line between various electric scooters models would not fade.

Novelty of the work

No such product exists in the market. Similar solutions for cars and motorcycles have been in existence for decades, but nothing similar has yet been made for electric scooters.

The benefits and value to the potential users

The target customer is able better understand the capabilities of the selected electric scooter. If the scooter is to be tuned or modified, then such product would provide the measurements required to customize the scooter's performance. If electric scooter is experiencing technical issues, such product would be useful in finding the root cause of failure.
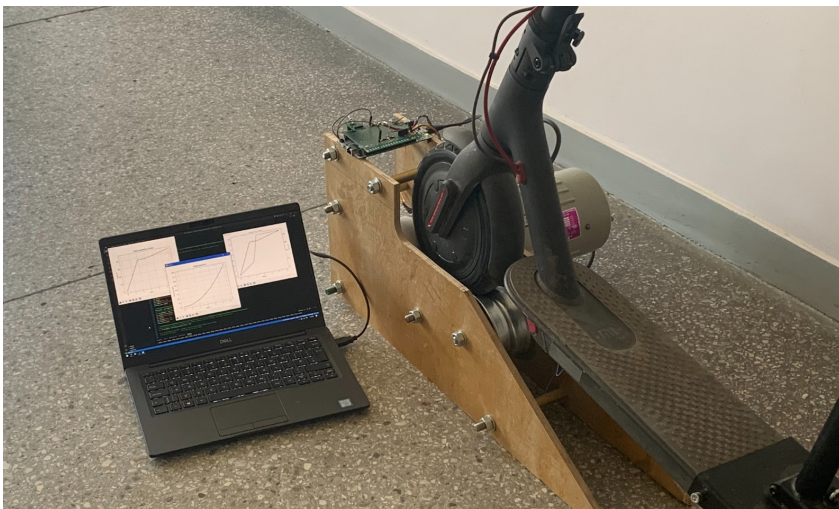
FIRST AID DEVICE *GIJIS*

Ugnė Zasčiurinskaitė
Mentor: **Dr. Virginija Jankauskaitė**

Kaunas University of Technology

Field of science | Interdisciplinary Works

Description of the work

GIJIS is a portable device for the delivery of first aid at the scene of a disaster. The device is bifunctional as it allows the formation of an innovative antibacterial healing material on the wound (achieved by employing the electric spinning method), and also the formation of a solid splint (made of rigid foam). Due to its small size and lightweight components, it can be used in a wide range of applications, e.g., in the military industry, medical sector, household, etc.

Technical or other problems that are solved with the work

There are numerous types and causes of injuries which depend on various factors such as gender, age, work experience, qualifications, motivation, nature and method of work, organization, working conditions, social and economic factors, etc. If a skin injury is not properly treated, the patient not only experiences discomfort but also faces increased risks of scarring and infection. The currently marketable bandages do not ensure an ideal environment for wound healing. Whereas, by using the electrospinning method, a very thin porous non-woven layer is formed. This type of layer is made from materials denoted by antibacterial properties, it promotes cell regeneration, and contributes soothing effects. The integration of the rigid splint formation technology helps protect the patient from pain during transpor-

tation and minimizes the risk of bone displacement. This type of device is relevant not only for various institutions (hospitals, emergency services, schools, kindergartens, etc.) but can also be applied in critical situations, such as war zones.

Novelty of the work

GIJIS stands out from other portable electrospinning devices by incorporating an additional feature: the application of the rigid splint formation technology. This multifunctional device not only creates a non-woven bandage on a wound but also aids in stabilizing bones in the event of a fracture.

The benefits and value to the potential users

The product has been designed to not only reduce patient discomfort at the accident site in the case of a wound but also to protect against infection, prevent scar formation, and create an optimal environment for the healing process. In the event of a fracture, the product forms a rigid splint which adapts to the human anatomy, while preventing bone displacement and reducing discomfort during transportation.
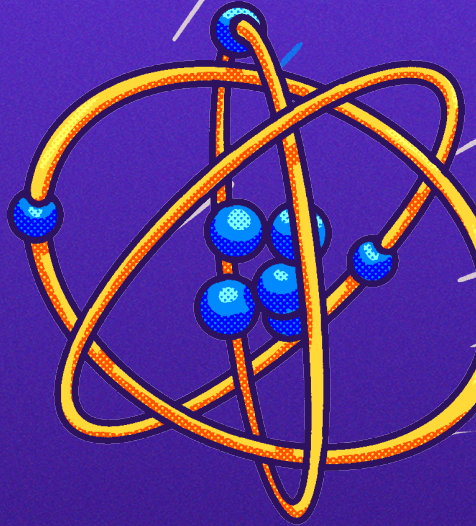
NATURAL SCIENCES AND MATHEMATICS

A NEW METHODOLOGY FOR PREDICTING ONCOMING TRAINS

Ugnė Orinaitė
Rafal Burdzik
Mentor: **Dr. Minvydas Ragulskis**

Kaunas University of Technology

Field of science | Natural Sciences and Mathematics

Description of the work

This study introduces a method for forecasting the arrival of trains by analyzing signals of track vibrations. The proposed algorithms are based on H-ranks of track vibration signals and outperform warnings generated by the standard train detection systems. The proposed vibration signal analysis technique is capable of generating earlier alerts indicating the approaching train vehicles. Experimental vibration signals are collected for different types of trains traveling at different speeds. The proposed algorithms are robust to the inevitable additive noise, and also show robustness under complex environmental conditions. The developed method for rail vehicle prediction based on advanced vibration signal processing is distinguished by its range of detection and independence from the currently existing rail traffic control systems, including the power supply system. As a result, it significantly increases the reliability of the safety and control system in rail traffic, which confirms its great potential for application and implementation.

Technical or other problems that are solved with the work

Despite the extensive history spanning over a century in rail vehicle detection and numerous recent publications exploring new detection methods, track circuits with simple open/close circuit principles remain the most popular system for detecting rail vehicles moving on tracks. However, it is crucial to highlight that railway engineers frequently encounter unstable or faulty operations of track circuits due to electromagnetic interference. This issue inevitably poses risks to the safe operation of trains. Therefore, our project introduces a novel approach based on utilizing vibration signals, which are immune to electromagnetic interference, for predicting the approaching trains. This experimental validation is critical, as the signal processing approach will account for all possible disturbances of the vibration signal, thereby confirming the practical feasibility of implementing the proposed system. Such a predictive system constitutes an innovative contribution to both the historical literature and the current state-of-the-art technology. The proposed scheme not only enables the detection of a passing train, but also helps to forecast its arrival. This prediction opens up new possibilities for use in railway safety systems, particularly at level railway crossings, where there are no measures to separate the road and rail traffic.

Novelty of the work

A novel technique for detecting the approaching trains through the analysis of track vibration signals has been introduced. The proposed method relies on the H-ranks of vibration signals obtained from a real experimental setup, where the vibrations produced through the interaction of the wheel with the track are inevitably affected by environmental noise. It appears that the predictions performed by the proposed method do outperform the standard techniques for the detection of approaching trains.

The benefits and value to the potential users

The proposed scheme not only enables the detection of a passing train, but also helps to forecast its arrival. This prediction opens up new possibilities for use in the railway safety systems, particularly at level railway crossings, where there are no measures to separate the road and rail traffic.

Impulse-based sensors

400 m

Vibration sensor
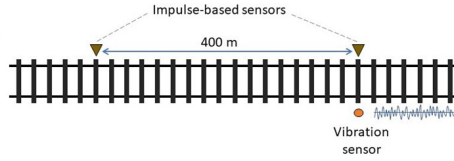
$$(x_k)_{k=1}^{+\infty} \;\rightarrow\; H_k = \begin{bmatrix} x_1 & x_2 & \cdots & x_k \\ x_2 & x_3 & \cdots & x_{(k+1)} \\ \vdots & \vdots & \ddots & \vdots \\ x_k & x_{(k+1)} & \cdots & x_{(2k-1)} \end{bmatrix} \;\rightarrow\; \text{H-rank}\,(H_N) = \sum_{l=1}^{l} \mathbb{1}\big(\sigma_l^2 \geq \varepsilon\big)$$
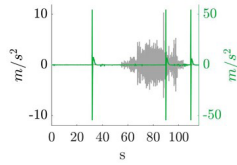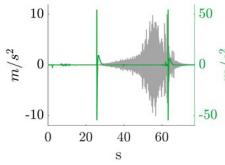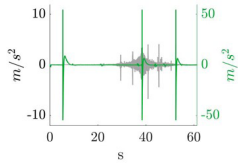
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