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# TECHNORAMA

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# CHEMICAL TECHNOLOGIES



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#### **Solution area**

Food

#### **Description of the work**

These days people are living extremely quick, busy lives and prioritise food that can be eaten on-the-go or requires little to no preparation. Our goal was to create a food product that would be convenient and tasty but at the same time beneficial for the health. We have created a new product - an instant gluten-free buckwheat porridge with a variety of dried vegetables - carrots, broccoli and pumpkin. This vegetable combination gives the product a nice range of colours, improves overall texture, flavour and enhances the porridge with vitamins, minerals and fibre. The product is fully organic, gluten free and sustainable with locally sourced buckwheat, moreover, we managed to incorporate a waste product from buckwheat production - buckwheat hulls to increase the fibre content. High consumption of fibre is known to be beneficial for the gastrointestinal health and reduces the risk of non-communicable diseases such as cardiovascular diseases, diabetes type 2, colorectal cancer, it also reduces risk of weight gain. In addition, this product can be prepared in a couple of minutes and it is a healthy option for a meal anytime of the day with a bonus of increasing your daily protein and vegetable consumption.

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There are lack of vegan-friendly instant buckwheat porridge products in Lithuanian market. Creating a convenient food product that is vegan, gluten free and organic but not disappointing in taste when comparing to the regular product. We have formulated new product recipe and technological process to achieve acceptable texture and taste. With our new product we are introducing an option for an established need of quickly prepared, healthy and nutritional product in the market.

#### Novelty of the work

A novel instant vegan buckwheat porridge with a new combination of vegetable. In addition, although buckwheat hulls are not commonly used in food production, we used grinded buckwheat hulls to increase the fibre content by 8%.

#### The benefits and value to the potential users

The product is convenient, quickly prepared meal (takes just 2 minutes), that is a source of protein, high in fibre, low in saturated fat and sugars. The porridge is gluten free, organic and without any artificial additives and no added sugar (only contains naturally occurring sugars).



## GRIKUČIAI

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#### **Solution area**

Food

#### **Description of the work**

Nowadays supermarkets offer consumers a huge variety of different types of chips, however, they tend to be high in trans fats, calories, and salt content. Moreover, not all of them have beneficial properties for human health. Considering that the demand for heathier snacks is extremely increasing, we decided to create a healthy and nutritious snack – buckwheat chips. This product is gluten free, allergen free, vegan, and high in dietary fiber (8 g/100 g). We chose to use sweet paprika, salt, pepper, and garlic powder to give a nice taste to the product. The beetroot powder and carrot powder were chosen to give this product a nice and natural colour and for its high fiber amount. The fiber in the main ingredients, buckwheat cereal and flour, provide feeling of fullness for a longer period of time. Moreover, buckwheat is a rich source of resistant starch, vitamins such as B2, B3 and B5, minerals, flavonoid, and antioxidants. Buckwheat protein is supposed to reduce serum cholesterol.

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

Due to the absence of buckwheat chips in Lithuanian market, the product would introduce consumers to a healthy and delicious snack alternative. Furthermore, during the work the product recipe and its production technology were created, ensuring good sensory properties and consumer acceptance.

#### Novelty of the work

There are currently no buckwheat chips in the Lithuanian market. The natural pigments from beets and carrots used in the production give the product an attractive, consumer-friendly colour.

#### The benefits and value to the potential users

Buckwheat chips are gluten and allergen free, vegan, and high in fiber, even 8 g per 100 g of product. The fiber in buckwheat is released over a long period of time and give a longer feeling of satiety. Buckwheat has a lower GI (glycemic index), which does not cause large fluctuations in blood sugar levels. Moreover, buckwheat is rich in copper, iron, manganese, magnesium, phosphorus, vitamins B3 and B2, iron, potassium, zinc, selenium, and pantothenic acid (B5).

### PROBIOTIC GEL-TYPE BARS ENRICHED WITH PHYTOCHEMICALS

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#### Solution area

Food

#### **Description of the work**

The idea was to evaluate a concept of the valorisation of cereal processing by-products to a new gel-type food product enriched with berry phytochemicals as potential food-like system for delivery of probiotic lactic acid bacteria.

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

Valorisation of cereal processing by-products to functional food components will improve the waste stream management in industry, encourage the opportunities to explore cereal-based by-products through a circular economy approach, and would help to reduce the problem of malnutrition.

#### Novelty of the work

There are currently no nutraceutical gel-type product with combined health benefits – probiotic, prebiotic, antimicrobial – in the Lithuanian market. The innovation is based on the functionalization method of rice bran and creation of gel-type delivery system ensuring the stability during storage and controlled release of lactic acid bacteria cells during digestion.

#### The benefits and value to the potential users

The probiotic microorganisms and valuable components of cereal bran incorporated into the daily diet will support gut health and improve nutrition value. Immobilized probiotic cells have an advantages over free cells, such as maintained cell stability and activity, increased protection during storage, and improved survival in the gastrointestinal tract. Functionalized rice bran is a powerful source of vitamins and minerals, essential amino acids, omega-3 fats, protein and dietary fibre, and contains relatively high level of resistant starch. Lingonberry phytochemicals shows various beneficial effects, such as anti-inflammatory, antioxidant, and anticancer activities.



## NEW ELECTROACTIVE POLYMERS WITH ELECTRONICALLY ISOLATED 4,7-DIARYLFLUORENE MATERIALS FOR OLEDS

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Kaunas University of Technology

#### Solution area

Engineering

#### **Description of the work**

The advantages that organic light emitting diode based technologies offer in terms of brightness, viewing angle, production cost, opportunity for flexible displays, etc. are not rivalled by liquid crystal-based displays. Some OLED based devices, for example smart phones, have been already commercialized. With this technology fully utilized in displays and commercial lighting applications about 15% of global energy consumption can be saved.

Small OLED-based displays already generate hundreds of millions of dollars. Larger OLED displays will penetrate the television market in the nottoo-distant future. Nowadays white displays play important role in lightening. Further advances of these devices substantially rely on development and studying of high-performance organic charge-transport and emitting materials, theoretical understanding of charge and energy transport in the organic systems and their well-balanced application in OLED devices.

We introduce novel electro-active polymers with electronically isolated 4,7-diarylfluorene chromophores as a positive charge transporting materials. Best OLED prototype using hole transporting layers made from our ma-

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terials exhibited low turn on voltage of 3 V, maximum brightness exceeding 200 cd/m<sup>2</sup> and current efficiency of 1.7 cd/A. The efficiency of the device was about twice higher than those of an OLED containing widely used commercial hole transporting layer. These results indicate that our developed materials can dramatically boost efficiency of commercial OLED lighting devices without dramatically inflating the cost of materials. In addition, these devices can be manufactured by spin-coating from solution which could help lower the price of the final product even more.

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

Despite their recent progress, OLEDs are still dealing with the issues of efficient and balanced carrier injection and transportation because of large difference of barrier heights and low carrier mobility. Unbalanced hole and electron current in OLEDs makes the recombination zone narrower, thereby leading to less efficiency with high roll-off and shorter lifetime. It should be mentioned that several good electron transport materials have been successfully developed in reducing the energy barrier for electron injection. Various approaches for efficient hole injection have been also adopted in the past, however, hole transport phenomena is still dealing with the critical issues like low hole mobility, high injection barrier between two highest occupied molecular orbital levels, and morphological and thermal instability caused by Joule heating. Hence, hole-transporting materials possessing low ionization potential for efficient hole injection, high hole mobility, thermal durability and morphological stability with high glass transition temperature are still demanding. Efficiency of OLED devices would be increased several times by using the materials in multilayer structures.

#### Novelty of the work

Design, synthesis and application of new electroactive polymers in OLED devices.

#### The benefits and value to the potential users

The most important benefits to the potential users are cheaper and more efficient devices that use less electricity.

### CriCrack – BUCKWHEAT CRISPS WITH CRICKET FLOUR AND SPICES

Greta Radzevičiūtė, Laurita Donielaitė, Viktorija Vaitkūnaitė Group supervisor: Loreta Bašinskienė Kaunas University of Technology

#### **Solution area**

Food

#### **Description of the work**

Faced with today's fast-paced lifestyle, healthy food choices in stores, and after conducting a consumer survey, we decided to create a product that we are still looking for on store shelves. The product we create is functional, innovative, healthy, and nutritious. It is rich in protein, and natural substances, without preservatives and dyes, making it perfect for every age group and a balanced diet for a healthy life. Cricket flour is used in our product for enriching our product with proteins, and 73% of respondents are in favor of testing and consuming such raw material. Crickets are increasingly used due to their high protein content and sustainability. Recent studies suggest that the cultivation of crickets does not destroy other ecosystems, emitting about a hundred times fewer greenhouse gases. Land is also being saved. Another important ingredient in our product is buckwheat. According to nutritionists, they are among the most valuable foods. 100 grams of buckwheat contains 13 grams of protein, as well as all the amino acids needed by humans, a lot of dietary fiber, B vitamins, minerals, especially copper, magnesium, phosphorus, and manganese, as well as a great source of energy. Buckwheat improves the functioning of the heart and circulatory system and lowers cholesterol. By combining these two main ingredients and adding other useful ingredients such as flaxseed, oatmeal, sesame seeds, and apricots, we have made them a healthy, delicious and most importantly nutritious snack that will suit everyone and will also be widely used in the kitchen and compatible within many dishes.

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Reducing carbon dioxide by contributing to the use of alternative raw materials to create functional food and environmentally friendly packaging. Each year, a single cow belch about 100 kg of methane. Methane from cattle is shorter lived than carbon dioxide but 28 times more potent in warming the atmosphere. For example, emissions to air study reported that 1 kg of crickets produced 1,3 kg  $CO_2$  over a rearing cycle. So it's 77 times less. Although from cow 1 kg meat we get 260 g of proteins, from 1 kg crickets we get around 600 grams of proteins.

The choice of functional foods in the market is still growing, so consumers do not yet have a wide choice, our product would contribute to the expansion of the market for alternative, nutritious snacks.

#### Novelty of the work

There are similar products on the market as bread crisps, but there are no such products as ours with buckwheat, cricket flour, and spices – we obtained such results after market analysis. According to our respondents, they are trying to eat healthily and our product would help them to do so.

### The benefits and value to the potential users

For people who want a healthy and nutritious snack, we are one of the leaders in the food industry innovation, offering the most innovative product to enjoy a nutritious, high-protein snack because our product is designed by following future trends and functional food alternatives in mind. We have combined taste and nutrition into one product, allowing the product to meet the needs of a wider audience rather than one specific group



## BORON ENRICHED GRANULAR NITROGEN-PHOSPHORUS FERTILIZERS

Edvinas Meižys, Klaudija Krasauskaitė, Rasa Šlinkšienė

Kaunas University of Technology

#### Solution area

Food, Environment

#### **Description of the work**

The world's rapidly growing population, but the stagnant area of arable land, complicate food supply. As a result, workers in the agricultural sector strive to maximize yields with the least cost and sustainability policies. By supplying the plant with only macronutrients, a rich and high-quality harvest cannot be expected, so the use of trace elements is very important. The most efficient and economical way to use trace elements is to incorporate them into the main fertilizer. Trace elements can be incorporated at various stages of fertilizer production, but one of the simplest is incorporation during granulation of the fertilizer. Various binders are used to obtain the granular product, which promotes the agglomeration process and improves the properties of the granules. The binder must be selected in such a way that the granular product is given the new required external shape and improved physical and chemical properties, while at the same time being environmentally friendly.

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

These fertilizers simultaneously supply the plants not only with the macronutrients nitrogen and phosphorus, but also with the trace element boU L

ron, and enrich the depleted soil with organic carbon, which enters in the form of biodegradable material starch. Starch is a great source of energy. This is because certain plant chemicals break down this substance into glucose. From this, the seedlings replenish their energy reserves and gain enough strength for rapid growth. Starch is not only involved in the growth process of the plant, but can also be used as a binder in the production of granular fertilizers.



#### Novelty of the work

Potato starch is used as a binder to granulate the crystalline ammonium dihydrogen phosphate fertilizer.

#### The benefits and value to the potential users

The obtained granulated fertilizers not only enriches the plant with nutrients, but also gives it a new external shape that is much more convenient for potential fertilizer users.



#### Laboratory drum granulator-dryer

1 - drum; 2 - loading gutter; 3 - intermediate capacity of the product;

4 - engine; 5 - gear drive; 6 - support roller; 7 - reducer; 8 - thermocouple;

9 - bandage; 10 - insulating layer; 11 - hull wall; 12 - unloading gutter;

13 - guide blades; 14 - nozzle; 15 - fan; 16 - heating element

## BARS OF BUCKWHEAT CAKE WITH CHOCOLATE GLAZE, ENRICHED WITH DRIED BLACKCURRANT POMACE POWDER

Julija Jurkienė, Augustina Bugenytė, Gustė Kščenavičiūtė, Gintarė Eizintaitė Group supervisor: doc. Loreta Bašinskienė

Kaunas University of Technology

#### Solution area

Food

#### **Description of the work**

Nowadays a lot of people are in a hurry, have less and less time to cook, therefore they often eat in a cafe or buy fast food that is low in nutritional value, high in fat or added sugar. Recently, an active and healthy lifestyle is becoming more and more popular and people are paying more attention to nature conservation and maintenance, making zero waste products increasingly popular. Sales of sweet bars, biscuits and fruit bars increased by 6% in 2021. Growth of 6% is expected by 2026, which will increase the market to 54.1 million euros. Based on market trends, people are trying to include healthier alternatives in their diet instead of the products they already like. Bars from buckwheat cake fragments with chocolate glaze are a tastier, healthier and more energizing alternative that uses circular economy principles to reduce or even eliminate industrial waste. This product is for an active person or a growing body that needs a guick and healthy snack alternative. We created zero-waste, organic and gluten-free bars with reduced sugar content, enriched with dried blackcurrant pomace powder, following an approach to a healthier selection of snacks.

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During the production of buckwheat cakes the waste remains – fragments, which is not used in further production, therefore it is unprofitable for the company. In view of this problem, we have created a bar using this waste, together with other zero – waste additives such as dried blackcurrant pomace powder. In a quantitative consumer survey of 215, more people agreed than disagreed, lacking a choice of specific cereal bars in its supermarkets. According to the survey, consumers choose to pay attention to the positive value, price, composition. During the work, a product recipe and a production technological process were developed to ensure the production of acceptable consumer bars.

#### Novelty of the work

The product is suitable for many consumer groups who choose an organic, zero waste and gluten free product with less sugar. Buckwheat is also less often associated with a sweet taste, making this product unusual for consumers. An analysis of competitors and consumers suggests that a bar from residual buckwheat cakes in the market is unmatched. Quantitative analysis data also revealed that consumers like a variety of new flavors and would not refuse to try buckwheat bars.

#### The benefits and value to the potential users

- The product gives a feeling of satiety but does not complicate the user's digestive system;
- Fast energy source;
- Satisfying the need for sweets (a healthier alternative)
- Promotion of waste-free production;
- Recyclable and paper packaging is more environmentally friendly;
- Accelerates metabolism;
- Does not require additional processing time;
- The product is manufactured according to the principles of the circular economy.

### TORTILLA BAKING MIX WITH BUCKWHEAT FLOUR

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#### Solution area

Food

#### **Description of the work**

A World of Tortilla solutions is today's growing marketplace. Tortillas are those versatile and delicious flatbread rounds prepared with corn or wheat flour. It has been a staple food and key component in Mexican cuisine for generations. Now tortillas are enjoying popularity in a wide variety of offerings, including wraps and snacks. In fact, tortillas are becoming more of a staple in daily meal planning in consumer's homes, with their ease of preparation, low cost and range of options. Our gluten free Tortilla baking mix with buckwheat flour has a highly nutritious value and for many people buckwheat grain consider to be a superfood. Buckwheat is known as a good source of protein, fiber, and energy. Tortilla baking mix with a buckwheat flour is rich in Cu, Fe, Mg, Mn, F, vitamins B3 and B2, P, Zn, Se, and pantothenic acid. Among its health benefits, buckwheat may improve heart health, promote weight loss, and help manage diabetes. People who follow gluten-free diets may consume trusted source lower intakes of whole grains, they miss out on the health benefits they provide. Being a good source of fiber and niacin makes buckwheat a good choice for digestive health. Buckwheat is generally safe to consume and should not cause side effects in most people. Buckwheat is easy to incorporate into a healthy diet. During the technological process we noticed that by giving tortilla baking mix buckwheat flour, Tortillas can be considered a nutritious alternative and a potential replacer for bread, increasing their applications in the food industry.

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Our product reduce food wasting, gives an ability to serve fresh tortillas ant improve the shelf life of their premium quality tortillas, reduce the size of tortillas that is aligned well with the consumption of smaller food portions, and consumers' tendency to incorporate more variety with smaller tortillas, rather than large portions of a single dish.

#### Novelty of the work

Tortilla baking mix with a buckwheat flour, has no analogs in Lithuania at the present.

#### The benefits and value to the potential users

Gluten free Tortilla baking mix with a buckwheat flour is rich in Cu, Fe, Mg, Mn, F, vitamins B3 and B2, P, Zn, Se, and pantothenic acid. Among buckwheat health benefits, our baking mix may improve heart health, promote weight loss, and help manage diabetes. Tortilla consumers are looking for a healthier, organic, authentic taste experience. Overall, ancient grains, gluten free, lower net carbohydrates, and lower fat content are some the fastest growing trends in the tortilla industry.



### 3D PRINTED SURIMI-BASED NOODLES ENRICHED WITH BERRY POMACE

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Kaunas University of Technology

#### **Solution area**

Food

#### **Description of the work**

3D printing technology could essentially change the way we perceive, prepare and consume food. By using 3D printer we could not only create desired complex food design but also enrich food matrix with bioactive compounds just in few minutes. On the other hand, 3D food printing technology can be successfully used for the food waste reduction and sustainability. For example by integrating overripe fruits, vegetables or even berry pomace in the food ink production. The growth of 3D printing technologies depends not only on the market demand for 3D printed foods, but also on their health benefits. Thus, 3D food printing technology is gaining more and more interest due to possibility design different shapes, flavors, textures, tastes, and especially nutritional composition.

An innovative surimi-based food ink has been developed that has been successfully used to print noodles with a 3D food printer. Food ink contain collagen, omega-3 and omega-6 fatty acids, and lingoberry pomace, that is a great source of fiber. To solve the problem of waste reduction, lingoberry pomace formed after juice pressing was used. Thus, printed noodles can be used as a source of protein and fiber.

When designing food inks for 3D food printing besides the nutritional composition it also important to consider the properties of the food ink itself: rheological properties, stability, microbiological safety and suitability for the printing. Surimi was chosen in the development of food ink because the ability of myofibril proteins to form stable gel resulting self-standing form of the product after thermal treatment.

In addition, there has been an effort to create noodles that contains fiber. As a source of fiber selected lingoberry pomace powder. The developed prototype is a healthier alternative to conventional noodles as it gluten-free and had higher amount of protein and fiber.

#### Novelty of the work

3D printing technology has already been used for surimi mass printing (in scientific researches), but has never been used for surimi-based noodles. The developed composition of the food ink is also completely new.

#### The benefits and value to the potential users

Such modified noodles are beneficial to consumers because of the ingredients it contains. Collagen is needed for the repair of damaged joints and blood vessels, accelerates the metabolism of fatty acids and reduces the amount of fat in the human body. The myofibril proteins in surimi are an excellent source of energy, and the omega-3 and omega-6 fatty acids have antioxidant effects, reduce the risk of thrombosis and have a positive effect on the heart. It is worth to mention that these noodles does not contain gluten, so it is suitable for people with celiac disease. Overall, they are a healthier alternative to regular noodles.



### PVA HYDROGEL BEADS FOR WATER TREATMENT

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#### **Solution area**

Environment

#### **Description of the work**

The wastewater treatment plant design engineers around the world are facing the same challenges: an increasing number of micropollutants in wastewater and surface water. Micropollutants are long-term sources of pollution in our ecosystems and food chains. They enter the waterway directly or indirectly every day, mainly with effluent from industry, hospitals, pharmacy, agricultural facilities, domestic units, rainwater, etc.

Today, attention is being paid to advanced water treatment technologies that help to remove impurities from wastewater faster, more efficiently, and without requiring major infrastructure changes. One of the ways to improve biological wastewater treatment is the addition of hydrogel beads. They have macropores of an appropriate size to immobilize microorganisms. Polyvinyl alcohol (PVA) hydrogel beads have a three-dimensional gel network that is connected by chemical or physical connections. PVA hydrogel beads are mechanically stable and therefore suitable for long-term use.

The bacteria play a significant role in this process – they use ammonia, phosphate, organic compounds, and other dangerous chemical substances as nutrient and energy sources. PVA hydrogel beads help to improve biological wastewater treatment by up to 5 times. A wide spectrum of bacteria is immobilized inside of gel bead.

PVA hydrogel beads showed great adsorption capacities for organic micropollutants and pharmaceuticals as well. The dangers of pharmaceuticals in water are increasing and they have raised concerns about human and ecoU L

system health. The incomplete removal of these drugs from the wastewater treatment process may become an increasingly difficult problem in the future. The combination of PVA hydrogel beads and active sludge is a robust and effective improvement of the biological wastewater treatment process.

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

- The use of PVA hydrogel beads allows to keep microorganisms on the surface and immobilize them inside the bead. The size of the bead macropores ensures that the microorganisms will colonize inside the PVA hydrogel bead.
- The sedimentation is a critical process for effective biological wastewater treatment. Settling properties of the combined system are more favorable than those of activated sludge flocs. A large number of microorganisms are attached to both the surface and internal structures of the PVA hydrogel beads. This allows PVA hydrogel beads to be efficiently separated during the sedimentation stage.
- The use of PVA hydrogel beads for biological wastewater treatment provides a new way to improve the process without major construction or other infrastructure changes.
- PVA hydrogel beads are resistant to biodegradation and aging and have substantial mechanical strength.

#### Novelty of the work

PVA hydrogel beads application for removal of micropollutants during biological wastewater treatment.

#### The benefits and value to the potential users

- minor changes to the infrastructure of wastewater treatment plants;
- hydrogel beads are regeneratable and reusable;
- good mechanical strength, thermal stability, chemical resistance;
- reduced amount of excess activated sludge;
- removal of micropollutants;
- Iongevity.



## TWO STEPS ADSORPTION PROCESS OF CU<sup>2+</sup>/SO<sup>2-</sup> IONS BY SYNTHETIC MAYENITE AND UTILIZATION IN CEMENT STONE

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Kaunas University of Technology

#### Solution area

Food

#### **Description of the work**

An environmentally friendly and economically attractive technology which is applied in the production of adsorbent materials, was created.

- Synthetic adsorbent used for cleaning hazardous heavy metal from water and wastewater (Cu<sup>2+</sup> ions and SO<sup>2-</sup><sub>4</sub> anions).
- After adsorption process we have possibility regeneration/activation our products which used for second adsorption cycle: the maximum adsorption capacity increases and the cost of the product decreases.
- The final product adsorbent (after all sorption processes) does not need to be stored (as technogenic waste) because we used as additive for cement (with positive efect).

After all these steps – we have: industrial ecology – waste-free technology: clean wastewater, when heavy metals are immobilized in binding materials and this additive have positive affect the early hydration of cement samples.

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We focus on hazardous heavy metal pollution of water and wastewater cleaning, which after adsorption process fully immobilization and solidification in cement stone.

In our case described efficient method for the heavy metal ( $Cu^{2+}$ ) and anion ( $SO_4^{2-}$ ) removal, by new adsorbent and special preparation technic (1 STEP). In the next step, the product (after 1 STEP), which characterization as technogenical waste is used as a raw material additive and have positive affect the early hydration of cement samples (2 STEP).

#### Novelty of the work

Our method are specifically oriented to either cations and anions absorption (2 or more cycle) at the same time.

After the absorption process (final adsorbent – technogenical waste) used as a raw material in the new products manufacturing (cement stone). For this reason,  $Cu^{2+}$  ions and  $SO_4^{2-}$  anions fully utilized in cement stone.

To the best of our knowledge, no similar technological solutions has been publishedor patented.

#### The benefits and value to the potential users

Cheap and efficient (high capacity) sorbent. After sorption, the adsorbent is fully consumed as an additive to the cement: the adsorbed ions are utilized and have positive affect on the hydration process. All of these factors lead to a waste-free process.

### Ice-shrimp – ICE CREAM FROM FREEZE-DRIED SHRIMPS (CARIDEA)

Emilija Auškalnytė, Jonas Damašius

Kaunas University of Technology Kaunas Jonas Jablonskis Gymnasium

#### Solution area

Food

#### **Description of the work**

We are introducing an innovative food prototype – ice cream from freezedried shrimps (Caridea). The product prototype was obtained in cooperation with Kaunas Jonas Jablonskis Gymnasium and Kaunas University of Technology, conducting research work at the Faculty of Chemical Technology, Department of Food Science and Technology. The product is natural, extremely nutritious, and low in sugar. This spicy dessert is an alternative to unhealthy desserts.

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

The presented idea addresses the issue of a healthy lifestyle and diet choices.

#### Novelty of the work

To the best of my knowledge, no one produces ice cream from freeze-dried shrimps. This is a new and innovative idea.

#### The benefits and value to the potential users

Consumers can discover a new type of dessert, an ice cream.



## "RITUAMI" – IT'S A SMALL EVERY DAY RITUAL THAT CHANGES OUR LIVES FOR THE BETTER

Sima Giržadaitė, Daiva Leskauskaitė, Milda Keršienė, Vita Lesauskaitė, Jurgita Knašienė, Gytė Damulevičienė, Marius Užupis

Kaunas University of Technology Lithuanian University of Health Sciences MB "WeZoop"

#### **Solution area**

Food, Health

#### **Description of the work**

Our product is designed for elderly people with special needs. In cooperation with medical professionals, we promote therapeutic nutrition as an integral part of therapy, which increases the effectiveness of treatment and the quality of life of those who consume it.

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

Ageing-related health problems are a growing concern worldwide. Malnutrition affects between 13.5% and 29.7% of older adults (ESPEN) in Europe. Lack of nutrients – proteins, vitamins, minerals, as well as insufficient caloric content have a fatal effect on health and body functions, including:

- increased weakness,
- delayed wound healing,
- progression of chronic diseases,
- higher mortality rate.

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Malnutrition is a consequence of objective age-related psychological and physiological changes: decreased appetite or impaired absorption and metabolism. However, often the elderly rarely eat in a balanced way, since their diet is influenced by habits, then limited to food that is ""tasty"" and easily prepared. The daily ration is filled with the same monotonous products. We lose balance in the diet, deficiencies in specific substances are formed.

Older people consume far too little protein, group B vitamins, vitamin C, zinc and selenium, suffer from a lack of polyunsaturated fatty acids.

Malnutrition reduces muscle strength and mass, can lead to impaired vision, taste sensation, harder healing of wounds, osteoporosis, weakening of the immune system.

Nutritional insufficiency and vitamin D deficiency are associated with sarcopenia, as well as Alzheimer's disease and other dementias.

"RITUAMI" – functional food for elderly people. Designed with appetite in mind, changes in taste perception, swallowing and nutrient needs to ensure adequate nutrition, which helps to stabilize and slow down the onset or progression of old age diseases (sarcopenia, dementia).

#### Novelty of the work

TECHNOLOGY AND NATURE UNION FOR OUR HEALTH!

The basis – fermented milk products, which serve as a carrier of nutrients and a source of protein.

The ""encapsulation"" technology chosen to insert vitamins and nutritious micromaterials helps to maintain their biological activity. Studies have confirmed that these substances are excreted during digestion and are absorbed in the intestine. When developing the product, special attention was paid to the content of vitamins, minerals and polyphenolic compounds.

#### The benefits and value to the potential users

Not medicine! The communication being developed will create positive emotional involvement in natural aging processes, stimulate interest in rational nutrition, enable daily light and pleasant rituals to balance the human diet.

The consistency of the product is convenient for the elderly. It is easy to swallow and does not cause pain.

BALANCE FOR THE DAY

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200 g of the product – consists of a daily dose that satisfies the daily need for full vitamin A (800  $\mu$ g), vitamin C (80 mg), vitamin D (10  $\mu$ g), vitamin B12 (1 mg), folic acid (800  $\mu$ g), calcium (500 mg), zinc (15 mg) and selenium (60  $\mu$ g), as well as additional antioxidants.

#### RESULTS OF CLINICAL TRIALS

After taking this food product for 10 days, the nutritional status of elderly patients improved:

- increased vitamin B12 levels,
- vitamin D levels tended to increase,
- accelerated gait,
- increased the volume of the upper arm.

The change was greater than when using a commercial product. All subjects perfectly tolerated the product.





### BIOCOMPOSITES FROM WASTES OF AGRICULTURE AND FOOD INDUSTRY

Laura Pečiulytė, Jonas Luneckas, Klaudija Bojanauskaitė Group supervisor: Joana Bendoraitienė

Kaunas University of Technology

#### Solution area

Environment, Raw materials, Food

#### **Description of the work**

In recent years, wastes of agriculture and food industry has received growing interest from local, national and European policymakers, international organizations, non-governmental organizations as well as academics from various disciplinary fields. Scenarios for Europe indicate a considerable potential for reducing emissions through the reduction of agriculture and food industry waste along the stages of the food production and consumption chain. Secondly, the biggest ecological problem of our time concerns polymeric materials. Plastics surround us and a lot of them stay with us longer than we would like. Plastics themselves are a huge opportunity for humanity. It is our decision how to use its, that our life among polymeric materials will be in harmony with nature.

The research related to the production of biocomposites, which consist of new composition. There were offered solution of two problems: the usage of agriculture and food industry waste such as husks of buckwheat, sunflower and hemp seeds, coffee grounds and hemp shives in bioplastic compositions for general purposes products; reduction of common plastics usage. U L

Natural pollution and the consumption of non-renewable natural resources will be reduced by using bio-waste and natural materials for everyday and short-life products. Biocomposite can be made into packaging materials, cups and other single-use items.

#### Novelty of the work

New biocomposites developed of wastes of agriculture and food industry such as coffee grounds, hemp shives, husks of sunflower, buckwheat and hemp seed and polysaccharide matrices.

#### The benefits and value to the potential users

New biocomposites are more environmentally friendly. The development of new biocomposite has many benefits for the environment such as reducing fossil fuel usage, plastic waste, and carbon dioxide emissions.



### NO ADDED SUGAR SWEET BUCKWHEAT CAKE RESIDUES WAFFLES

Kristina Iljenkaitė Group supervisor: Loreta Bašinskienė Kaunas University of Technology

#### Solution area

Food

#### **Description of the work**

Creating this healthy snack we use buckwheat cake residues (bio-product) resulting from production and in this way we are creating sustainable food product that contribute to solving the environmental problem. Sweet buckwheat waffles are rich in copper, iron, manganese, magnesium, phosphorus, vitamins B3 and B2, iron, potassium, zinc, selenium and pantothenic acid, contain a high amount of fiber. Buckwheat cake residues are gluten – free, so it is perfect for people who suffer from gluten intolerance, it has a low glycemic index which does not cause blood sugar predominance. What does not cause blood sugar predominance is also that in these buckwheat waffles are no added sugar. Instead of sugar we are using natural sweetener erythritol, as decoration we use chocolate with stevia, what is also natural and healthy sweetener extracted from Stevia rebaudiana plant. Waffle toppings on melted chocolate such as lyophilized berries (wild blueberries, mango, strawberries) gives not only sweet & sour taste but a lot of vitamins such as vitamin C and give antioxidant properties to this product and potential users.

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

Increasing healthy life-style and facing environmental problems give us opportunity to create healthy and sustainable snacks. Based on global sugar conU L

sumption worldwide we can see that sugar consumption is gradually increasing from 2009 to 2022 – from 154.1 – 174.1 (in million metric tons). Also there is serious food waste problem that is needed to be fixed. A lot of food industries are facing and trying to solve this problem. Introduce consumers to eco – friendly healthy snack alternative. The product recipe and technology were developed by our team. Product is eco – friendly because this technology uses buckwheat cake residues (bio – product) that are resulting from production. Also, these waffles are without added sugar so it is suitable for diabetics and for people who suffer from gluten intolerance.

#### Novelty of the work

A competitor analysis was carried out that the only waffles on the market are from wheat flour. Buckwheat waffle product could be innovative for consumers as it would be the only waffles from buckwheat cake residues. Furthermore, we conducted a quantitative study with our potential buyers which shows that majority would buy our product (86,2 %). In this product we also use eggs, butter, instead of sugar we use natural sweetener erythritol, salt, cinnamon, milk and white chocolate with stevia, lyophilized wild blueberries, lyophilized strawberries, lyophilized mango fruit, almond.

#### The benefits and value to the potential users

This healthy sweet and sustainable snack will help consumers to reduce sugar consumption leading to healthy life style or it can be great snack alternative for those who are diabetics or suffer from gluten intolerance. By eating this product protentional users will get high amount of minerals, vitamins and all necessary nutrients Moreover, eating this product protentional users will contribute to zero - waste in food industry.



V T V


### MyPots – BIODEGRADABLE MYCELIUM BIOCOMPOSITE PLANT POT

Zinta Zimele, Linda Mezule MyPots

### Solution area

Environment

### **Description of the work**

MyPots provide an alternative to peat and plastic pots – biodegradable mycelium biocomposite plant pots that do not damage plant roots, do not need to be removed during re-planting in the soil and, thus, produce less waste.

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

EU agriculture and horticulture industries generate 1 200 Mt of plastic waste each year, with almost 30 % coming from nets, clips, pots, and trays. Production of biodegradable pot and tray alternatives from peat have shown to contribute to about 10% of greenhouse gas emissions from the land use sector. Furthermore, plastic and slowly biodegradable pots cause root damage and induce stress in plants during replanting, thus, resulting in increased death rate. By replacing traditional plastic pots with MyPots up to 5% reduction of horticulture industry plastic waste and up to 9% of  $CO_2$ emission reductions from peatland drainage can be obtained.

### Novelty of the work

MyPots plant pots are produced from biomass waste (grass, garden material) and specially selected fungal mycelium that is abundant in the nature. The

product is biodegradable, reusable (if used accordingly), eco-friendly and provides additional nutrients to the soil during decomposing.

Mycelium-based bio-composite materials have been invented and widely applied to different areas, including construction, manufacturing, agriculture, and biomedical. The vegetative part of a fungus, mycelium has the unique capability to utilize biological (mostly crop) waste as a substrate without energy input or extra waste generation. Mycelium binds organic matter through a network of hyphal micro-filaments in a natural biological process to produce strong, resistant and at the same time biodegradable and low-value raw materials that can be used for packaging, and higher-value composite materials.

### The benefits and value to the potential users

MyPots plant pot solution:

- Biodegradable but still reusable plant pots that do not damage plant roots.
- Replant with the pot concept no need to take the plant out from the pot.
- Less waste from horticultural activities.

Our internal research (field scale test) demonstrated first degradation of MyPots within one week after replanting in the soil. At the same time no visual disruption of peat pots was observed even after 6 weeks of the experiment.

We expect that with the introduction of MyPots products and subsequent technology licencing we will be able to reduce horticultural plastic waste in EU by 5% in 2030 and contribute to a 9% reduction of  $CO_2$  emissions caused by peatland drainage.



### MOBILE DEVICE WITH A SUSTAINABLE POWER SOURCE

#### Justė Bukauskytė

Kaunas University of Technology

#### Solution area

Engineering

### **Description of the work**

Each electrical device needs a power source, but not always is available. External battery extends our devises usage time, but after the battery depletes and we are back trying to find an outlet to charge our devices. Renewable energy such as solar, wind, and hydro-based portable generators solves the charging problem, but not always there is sunlight or wind nor any flowing water. Sustainable electrical energy could be extracted by energy from motion, so energy could be generated by walking around and could be used there alternative generators are insufficient to charge.

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

Mobile device with a sustainable power source solves many problems, one of which is environmental protection – aims to reduce the amount of greenhouse gases in the atmosphere. The second is social – attempts to reduce energy poverty in developing countries. And the last is about our comfort – charging devices, where are no electrical outlets.

### Novelty of the work

Renewable energy such as solar, wind, and hydro-based portable generators are commonly sold, but all those generators to be used need external factors, if there are no factors energy can not be generated. Sustainable motion energy solves external factors requirement problem, but this kind of energy generator lack in the market. And these generators are inefficient. Technorama

### The benefits and value to the potential users

- Mobile device with a sustainable power source does not require external factors, that's why a potential user's device could be used anytime while walking.
- Electric energy source is always nearby and fully charged (if the user has walked), and there is no need to search for a place where to charge your smartphone or other electrical devices.
- Using this device with a sustainable power source will contribute to climate change mitigation.
- In third world countries, this device will improve the quality of life (for example, the possibility to have a light source during the dark hours of the day).



# MECHANICS

## ZETS COLLECTS WASTE COOKING OIL SMARTLY

Nicolas Drouby, Fooad Drouby, Malak Bakkour, Simon Khoury

Kaunas University of Technology UAB Ekologinių sistemų sprendimai

### Solution area

Food, Environment, Digital solutions, Raw materials, Engineering

### **Description of the work**

Our solution includes a barrel that is controlled by a programmable logic controller and an application for restaurants and households that they can download on their smart devices.

The goal is to make the collecting of used cooking oil as simple and unobtrusive as feasible. We have different container sizes. During each pickup, we will keep track of the amount of oil in the barrel and replace it with an empty barrel. Our containers are also smart, connected to a platform, and powered by batteries! container will be delivered that meets the individual specifications Depending on how much cooking oil you use.

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

We are trying to reduce the water pollution caused by oil as well as air pollution caused by gas produced by cars by replacing the diesel with biodiesel. Easier and more effective collection of oil waste.

### Novelty of the work

Integration of a full oil collection system. An automated system that sends notifications to tell the level of the oil inside the barrel. When the barrels from different restaurants are almost full, a managed collection with a predesigned route takes place. And finally, an automatic invoice will be generated for each restaurant by the application.

### The benefits and value to the potential users

The restaurants will benefit from:

- An automatic used oil disposal. No more paying attention for the oil level, and contacting someone to collect.
- An automatic invoice will be generated each month by the app.
- Marketing for the restaurant on the application for his contribution in biodiesel production.

The impact on the environment:

- Decrease the air pollution. The oil will be sent for recycling and biodiesel production, which will decrease the usage of diesel.
- Decrease the water pollution. The wrong disposal of oil results in water pollution. If the oil collection is managed, less oil waste in the water.



BRUNTOR



Raimonds Jurgelis, Ēriks Lielbardis BVP College of Business Adminstration

### Solution area

Mobility

### **Description of the work**

We have created electric drive train for different types of micro mobility. At this moment we have used it to build an electric off road skateboard. You can ride it where you want – mud, sand, gravel and even up in the hill. At this moment we are working on 4 wheel scooter and 4 wheel cargo platform.

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

Regular skateboard steering is not for off road use. it does turn the wheels when you are riding uneven surfaces. There is no suspension and very low riding quality if ridden on bad road surface or off road. The same with electric scooters – they are simple bult for good road conditions – what about cubble stone streets? Or roads in bad condition. Acording to statistics in 95% of scooter accidents ther are no other part involved – its just skidding or hitting pot hole. That can be solved with our platform wich delivers much safer and smoother ride in both scenarios.

### Novelty of the work

We have created drive train which is more like a small car suspension system with complete different steering as existing off road skateboards.

### The benefits and value to the potential users

Electric scooters are part of urban mobility. Are they safe? Not that much! Can you take cargo with you? Not realy! With our solution user will have more comfortable ride, more control for not as experienced users, it will be much safer in greater speeds and you will be able to transport some cargo like shopping bags with you.





## VIBRO-ELECTROCHEMICAL REACTOR FOR THE FABRICATION OF AAO NANOPOROUS MEMBRANES

Urtė Ciganė, Arvydas Palevičius, Giedrius Janušas Group supervisor: Arvydas Palevičius Kaunas University of Technology

### Solution area

Engineering

### **Description of the work**

This work is intended for the research and development of innovative functional nanoporous membrane manufacturing technology.

A novel vibro-electrochemical reactor is designed for the synthesis of anodic aluminum oxide (AAO) nanoporous membranes. AAO is a self-organized form of aluminium oxide that consists of parallel pores arranged in a honeycomb-like array. Porous AAO can be formed in the anodization process in electrolytes under different conditions. In our case, the electrochemical etching process uses a frequency excitation method to control the areas and properties of nanopores of different sizes. The effects of vibrations, temperature changes, and the mixing process have already been studied in the vibro-electrochemical reactor and it has been established that the theoretical results coincide with the experimental ones. By using frequency excitation, the reactor can reach resonant modes. The results of the vibration analysis revealed that the design of the reactor is suitable to produce AAO nanoporous membranes. Vibration analysis shows that the use of frequency offers a real opportunity to develop innovative membranes with different controlled nanopore areas. This would increase their functionality and applicability in various bioengineering branches, such as skin tissue engineering or drug delivery systems. The relationship between the me-

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chanical strength and biocompatibility of nanoporous membranes will depend on innovative technologies, combinations of new materials, scalability, and sustainability of new methods. In the rapidly expanding bioengineering field, this work contributes to further research on nanoporous membranes.

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

Many membranes are characterized by insufficient mechanical strength, biocompatibility, or toxicity to the human body. The need to produce better quality and mechanically stronger nanoporous membranes appears from the need to apply functional membranes in various fields of bioengineering. Therefore, the novel vibro-electrochemical reactor allows to ensures the same conditions during the two-step anodization process and allows to control the properties of the nanopores.

### Novelty of the work

Frequency excitation during the two-step anodization process to fabricate AAO nanoporous membranes has been previously unreported. AAO nanoporous membranes fabrication technology using a novel design vibro-electrochemical reactor is planned to be applied for a patent.

### The benefits and value to the potential users

The invention could be useful in bioengineering to improve the functions of nanoporous membranes and extend their application in drug delivery systems or skin tissue engineering.

### BICYCLE AND SCOOTER PARKING STATION

#### Kornelijus Daukantas

Kaunas University of Technology

#### Solution area

Mobility

### **Description of the work**

In order to improve the infrastructure of two-wheeler vehicles in the city, a new universal parking station is being developed to provide owners of electric (and conventional) bicycles and scooters with a highly safe and convenient vehicle locking and the possibility of battery charging.

Although there are various parking stations for two-wheeler vehicles available, their quantity is insufficient for a fully developed infrastructure. In addition, there are problems with versatility, as they are not suitable for private users and most of them are only suitable for bicycles. Also, they do not provide fast vehicle locking, charging, and proper security. In most cases, the driver has to take care of his own charger and lock, when using such parking stations. It means that the safety of his vehicle depends only on the quality of the lock owned, which is often not very secure. The relevance of the bicycle safety problem is confirmed by the fact that almost 300,000 bicycles were stolen in the United Kingdom in 2018.

Thus, the introduction of new, universal electric scooter and bicycle parking stations would encourage people to exchange polluting cars for environmentally friendly two-wheeler vehicles and would make a significant contribution to the development of this transport infrastructure.

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

 Insufficient infrastructure available limits the development of environmentally friendly transportation;

- Current solutions have limited versatility;
- Current solutions are not adapted for private two-wheeler vehicles;
- Current solutions do not provide fast vehicle locking, charging, and proper security;
- Private locks do not guarantee the safety of a vehicle.

### Novelty of the work

There are various parking stations for two-wheeled vehicles available, but their target users are rental companies as current solutions are not suitable for private vehicle parking. Some aspects (like "Plug & play" adapter) are taken from current parking stations in the market and adapted for personal bicycles and e-scooters, providing simple and standardized locking and charging.

### The benefits and value to the potential users

With the introduction of safe locking and charging in the infrastructure of electric scooters and bikes, it is likely that more people will be able to travel longer distances without having to worry about a sufficient level of battery charge and about the safety of a parked vehicle. Fast and secure "Plug & play" locking allows the driver to not have a personal lock and charger, which are very inconvenient to carry with you at all times.

Furthermore, preferring a two-wheeled vehicle in the city, not only improves one's personal health but also contributes to the well-being of society by reducing air pollution and noise in the city. Using a two-wheeler vehicle can also help to avoid congestion in the city during peak hours and save money by eliminating the need to buy fuel for a car on a regular basis.



## SELF-SENSING SANDWICH-STRUCTURED COMPOSITES

Gabrielė Jovarauskaitė, Gediminas Monastyreckis Group supervisor: Daiva Zeleniakienė Kaunas University of Technology

### Solution area

Engineering

### **Description of the work**

Aircraft structure reliability is one of the most critical aspects of safe air travel. In recent years, heavy metallic structural parts have been replaced by composite materials due to lower weight and less fuel consumption. However, composites require precise maintenance procedures. Structural health monitoring (SHM) is used to observe any potential damage with the help of various sensors, such as strain gages, optical fibres and accelerometers, although the sensing can be limited and complex. Another novel SHM method which is under the scope of many researchers is based on the piezo-resistive effect of electrically conductive composites.

This study aimed to develop a self-sensing sandwich-structured composite using an embedded carbon fibre grid and carbon nanotube modified epoxy matrix. The experiments showed that the damage could be estimated according to local electrical resistance change, which increases gradually towards a damaged area. The presented SHM method is capable of detecting fibre cracking, delamination and indentation of the core material. Also, the composite damage propagation can be monitored in real-time, which is vital for the aviation industry.

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

- Ensures reliability and safety of the structure;
- locates damage and tracks its expansion;
- estimates mechanical properties of the damaged composite and predicts its lifetime;
- reduces maintenance time.

### Novelty of the work

Novel embedded carbon fibre grid technology and damage sensing method.

### The benefits and value to the potential users

- Maintenance cost reduction;
- the novelty of the product and technology;
- scalable and applicable technology for various industries: automotive, aerospace, wind turbines.



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### WATER WORKER PLATFORM

Paulius Briedis UAB "RM7"

### Solution area

Defence, Food, Health, Environment, Mobility, Engineering

### **Description of the work**

A drone that floats on water, delivers food, and can also rescue drowning people, delivering other cargo. Water occupies most of the Earth. But water transport, especially autonomous transport, is probably the least used. Autonomous ships can do a lot, especially using modern drone components and algorithms. Our prototype also demonstrates this.

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

Water works are usually very expensive. For example, an hour of search work can cost tens of thousands of euros. Rescue work on the beaches is still carried out by people swimming. Our robot – prototype primarily solves the problem of food delivery on water. We want to use the platform for the delivery of other objects and the transportation of rescue equipment.

### Novelty of the work

Autonomous delivery on water using a remote-controlled catamaran with planned automatic route guidance. The solutions on the market are not suitable for delivery work. Similar rescue solutions have their drawbacks, and no solution is produced in the European Union, which would prevent the device from being adapted quickly for defense purposes.

#### The benefits and value to the potential users

Consumers can get materials, supplies faster, save time, more beaches can be covered for baywatching.

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# APPLICATION OF ACOUSTIC OSCILLATIONS FOR THE PREVENTION AND TREATMENT OF BOVINE MASTITIS

Joris Vėžys, Algimantas Bubulis, Vytautas Jūrėnas, Antanas Sederevčius, Vaidas Oberauskas, Kristina Musayeva

Kaunas University of Technology Lithuanian University of Health Sciences Veterinary Academy

### **Solution area**

Food, Environment, Engineering

### **Description of the work**

A new technology and device has been developed. That allows cows to recover from mastitis ecologically using only low-frequency vibrations but without the use of antibiotics. A mechanical vibration device developed by KTU and LSMU researchers is mounted on the DeLaval Harmony milking machine, which, when milking, excites low-frequency oscillations on the cow's udder and analyzes input parameters such as the electrical conductivity of the milk and the amplitude of the oscillations. Our technology and device allow cows to recover from mastitis ecologically without the use of antibiotics, using only low-frequency vibrations. The developed device prototype has an integrated algorithm that allows it to adapt to each object (cow) individually. By analyzing the input parameters, the device is able to adapt the frequency and duration of the ultrasonic radiation depending on the feedback data. The initial studies performed are very promising, but they are currently insufficient and a proper assessment of the therapeutic effect can only be established by further studies.

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Our technology and device allow cows to recover from mastitis ecologically without the use of antibiotics, using only low-frequency vibrations. The initial studies performed are very promising, but they are currently insufficient and a proper assessment of the therapeutic effect can only be established by further studies.

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

Mastitis in milk causes physical, chemical and microbial changes with pathological changes in the udder glandular tissue. Each form of mastitis causes not only reduced milk production but also poor quality, making milk unfit for consumption by both humans and the dairy industry. Bacterial contamination of mastitis milk makes milk unfit for human consumption. Also, after taking the antibiotics that are currently needed to treat mastitis, the milk may not be used immediately, it is necessary to wait until it is eliminated from the animal body, and at that time, the milk must be emptied, which is very uneconomical.

Four Debalance motors (vibrators) were mounted on each teat of the DeLaval Harmony milking machine, and low-frequency vibrations were excited in the cow's udder. A 2D dynamic model of the vibration system was developed, and the frequency response of the vibrator-milker was analytically solved and experimentally verified. The calculated and experimentally obtained oscillation frequency characteristics in the horizontal and vertical directions are close. The test values of the first-order resonant frequency of the vibration system in the horizontal (X) direction are 23.5 - 26.5 Hz, the resonant frequency of the theoretical analysis is 25.0 Hz, and the relative error is 6%. The test values for the first-order resonant frequency of the vibration system in the vertical (Y) direction are 37.5 to 41.5 Hz, the natural frequency of the theoretical analysis is 41.0 Hz, and the relative error is 8.5%. The developed vibration system is set to an operating frequency of 25 Hz, at which a higher amplitude and lower vibration damping are obtained. Also, this frequency can be slightly adjusted by the controller according to the monitored parameters. Uterine temperature studies of cows were performed in healthy cows (n-15) using an infrared thermal imager FLIR T450sc during the milking process. The results show that using 25 Hz vibrations for up to 8 minutes (while milking continues), the temperature rose by about 1.5oC, and the temperature of the cow's udder without vibrations rose by only 0.5oC. This indicates that the vibrations activate blood flow to the cow's udder.

### Novelty of the work

The developed system is the subject of a patent application of the Republic of Lithuania, as low frequency vibrations have not been used for the treatment of bovine mastitis so far. The closest analogue is a device developed in Israel in 2018, but they use a higher frequency, and the device is portable, making it difficult to use because it takes extra time to treat the animal. Our design is integrated and requires no additional work. Also, the animal is not exposed to this device precisely during milking, but between milkings, and our novelty is that the apparatus must be operated only for a very short time, i. while milking is in progress.

Mastitis is the most common disease, causing significant economic losses to dairy cattle due to reduced milk yield, changes in milk composition and quality, unrealized commercial milk, treatment and veterinary costs, and increased levels of forced slaughter. In Poland and Lithuania, mastitis affects 20-50% of the total number of dairy cows. Due to udder diseases, an average of 10.05% of cases are discarded in Lithuania every year. of all culled cows (J. Milerienė, 2020). The impact of mastitis on daily life is shown by data on financial losses in many parts of the world. It was observed that in 2018. In Poland, the financial loss due to reduced milk yield due to subclinical mastitis alone was around  $\in$  360 / cow during lactation, while the loss of milk during clinical mastitis ranged from 300 kg to 1000 kg. In Lithuania, an average of 650 kg of milk is lost from one cow during lactation, which is more than 100 euros / cow and about 38 million cows. Euro / country.

In Scotland, the annual loss from mastitis was £ 140 / cow. In the United Kingdom, the total economic cost of mastitis ranged from € 100 million to € 120 million. during lactation (Swami et al. (2017), Kumari et al. (2018), Cobirka et al. (2020). both with the dairy industry, which is unable to produce quality dairy products from purchased milk.In most cases, fresh unprocessed milk is insufficient because its chemical composition is far from normal.Al altered milk composition and pathogenic microorganisms are dangerous to human health. the sanitary aspect must also be taken into account.In addition, it should be emphasized that mastitis is a major threat to the welfare of dairy cows.This disease causes abnormal behavior in cows (eg udder pain and edema, lack of appetite, macroscopic changes in milk).

Recently, in order to ensure the health, longevity and high quantitative and qualitative production of dairy cows, not only cow housing technologies are being modernized, but there is a growing interest in reducing the number of mastites in the dairy herd. The use of non-invasive methods ensures the

welfare and health of animals. By applying the effects of acoustic vibrations to the mammary glands, it was possible to reduce the incidence of subclinical mastitis in the herd of dairy cows, and it was possible to develop a more effective treatment of clinical mastitis using antibiotics and acoustic vibrations in the complex.

Once the positive research results are confirmed, the developed methodology and equipment will be improved and, after more detailed research, applied to the treatment and prevention of human mastitis.

### The benefits and value to the potential users

The developed device prototype has an integrated algorithm that allows it to adapt to each object (cow) individually. By analyzing the input parameters, the device is able to adapt the frequency and duration of the ultrasonic radiation depending on the feedback data.

The udder and teat have an extensive network of blood vessels and capillaries through which blood flows to and from the udder. Vibrations affect the efficiency of the milking process and increase the risk of mastitis. A mechanical vibration device developed by KTU and LSMU researchers is mounted on the DeLaval Harmony milking machine, which, when milking, excites low-frequency oscillations on the cow's udder and analyzes input parameters such as the electrical conductivity of the milk and the amplitude of the oscillations. Devices of two designs have been developed, the initial one, which was only a pilot, and the final model, which was printed on a 3D printer and has an ergonomic design, is adapted to the milker and does not prevent the milker from using the milker itself. The system can adjust the vibration frequency and operating time according to the measured parameters.

Mechanical vibrations induced in an artificial model of a cow's udder during milking with real animals spread through the teats to the entire udder and cause physiotherapeutic effects, activate physiological processes, increase udder surface temperature (measured in 15 animals using a FLIR thermal imager), improve blood flow to mammary gland tissues, thus reducing SLS (somatic cell count).

# CONSTRUCTION AND ARCHITECTURE

## LightMirror

Dimitri Ionescu, Aleksandra Bulanova, Anna Zharkova UAB Saulės šildymo architektūra

### Solution area

Environment, Raw materials, Engineering, Health

### **Description of the work**

LightMirror is developing reflective panels to bring sunlight and reduce heating needs in hospitals and care homes.

Inclined reflective panels at the edge of the roofs redirect sunlight to another building. Natural light becomes a controllable asset for architect, and the main benefits are free solar gains and an increase in well-being.

The physical prototype is accompanied by a 3D GIS mapping study and a thermal study of the buildings concerned. The goal is to place the reflective panels optimally and to have data on the solar gains received after the installation.

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

There is some evidence that daylight exposure can affect post-operative outcomes in patients and, consequently, that daylight should be considered in hospital design. The importance of the amount of daylight in a patient's room indicates an impact on patients' length of stay. Still, the absence of daylight in hospitals is huge. 68% of the hospital rooms don't receive any sunlight during the year. This leads to high energy costs for heating and lighting of the building. LightMirror products can help you bring more light and save money. The idea is to install inclined reflective panels at the edge of the roof to redirect sunlight to the first floors of another building. Natural light becomes a controllable asset, and LightMirror products can help you to reduce energy needs by 10-30%.



### Novelty of the work

Compared to the usual thermal renovations, the system requires very little intervention on the existing building. The installation is rapid and does not destabilize the building's thermal envelope. During the construction work, the hospital is functioning normally. To achieve a 15-20% energy reduction in the building, LightMirror will cost 50 times less than classical insulation. The additional value of sunlight in the hospital is that it enhances the well-being of people living and working in it.

LightMirror is applying for 13 patents and will build patents family around them.

### The benefits and value to the potential users

Having natural daylight in healthcare buildings:

- will lower the energy cost of lighting and heating
- reduce the patient stay and enhance the process of healing
- reduce the stress and anxiety of the healthcare workers





### FUTURE OF EPD

Marius Tamošiūnas, Rapolas Levickas, Kasparas Vėberis, Paulius Šinkūnas, Dominykas Vencius, Mintarė Paplauskaitė Group supervisor: Lina Šeduikytė

Kaunas University of Technology

### Solution area

Environment, Engineering, Raw materials

### **Description of the work**

The aim of the work is to create a web page that analyses the information and calculations provided by the EPD (Environmental product declaration) in order to raise awareness of the reduction of  $CO_2$  footprint among the construction sector. The alternative to the proposed product development project is a web page – a database – which would host and enable users to access the service in real time. The basic concept of the product, i.e. the EPD declarations hosted in a database and published on the website, is similar to the idea used by competitors, where interested parties can access and analyse the published EPD declarations without interruption. However, it is important to underline that the value proposition to potential customers is intended to be created by providing additional functionality and the possibility to compare EPD declarations against each other according to the selected filtering guidelines.

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

EPD databases that are available right now, has only one function, that storages declarations as PDF files only available for humans to read. This type of data storage allows to only look at a few files at the same time, which it makes hard to compare them. Some construction companies are interested in creating a system, which allows you to easily compare different EPD declarations and even to determine where you can find the closest products to lower transportation expenses and reduce the amount of pollution. Every company that makes some sort of construction materials can put their EPD's on the site. It means that this kind of comparison system covers a lot of users. While it is not required to create such declarations in many countries, we hope that in the near future there will be laws that makes it mandatory. Our future depends on a healthy planet and organizations like European Green Deal could also help our cause.

### Novelty of the work

Through consumer analysis (interviews with construction companies) we saw an opportunity to create something that is not currently available on the market, and the interest shown by the companies in this idea suggests that there is a need for such a product in order to reduce  $CO_2$  emissions in the construction sector.

### The benefits and value to the potential users

In construction, EPDs are used to reduce  $CO_2$  emissions: architects, engineers and designers can use EPDs to select the most sustainable materials, while for manufacturers, EPDs allow them to optimise and more accurately monitor their product's  $CO_2$  footprint.

NATURAL SCIENCES AND MATHEMATICS

## SELF-CLEANING SOLUTION FOR SOLAR CELLS

Simas Račkauskas, Mindaugas Ilickas, Rasa Mardosaitė, Mantas Marčinskas Group supervisor Simas Račkauskas Kaunas University of Technology

### Solution area

Environment

### **Description of the work**

The self-cleaning nano coating (SCNC) is designed for solar cells and windows to reduce cleaning costs and increase efficiency. It is an innovative product that increases the amount of electricity generated by solar cell, which directly increases profits or improves the payback of a solar power plant. This coating reduces the price of electricity generated for consumers-producers, so the coating itself pays off during the first year of use. The SCNC coating also effectively reduces cleaning costs, the method used has no analogues on the market because the cleaning uses several properties at once, so it is cleaned from both organic and inorganic materials, and additional electrostatic protection against dust can be used. In addition to the advantages mentioned, the coating is also an environmentally friendly product due to the production method and the reduced need for detergents. The SCNC coating also protects against harmful ultraviolet rays, and prevents birds from hitting shiny surfaces. SCNC coating can be applied not only to the surfaces of solar cells but also to facades, windows or other glass surfaces.

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

Under real conditions solar cell efficiency decrease by 15% a month due to dirt. Older solutions, such as cleaning personnel or robots are not cost effective.

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The SCNC coating uses nanoparticles, which have a high hydrophobicity, for this reason the surface automatically cleans itself due to dripping water droplets, which together remove dust and other dirt. The coating can also be multifunctional: reducing glare and adsorbing harmful UV rays, which increases the efficiency of the solar cell.

SCNC can be coated by an efficient spray coating method on any surface, no harmful or rare substances are used during production or coating, the materials used are not expensive, therefore a competitive price for SCNC coating can be offered.

### Novelty of the work

SCNC coating is designed for solar cells, has no analogues, ecological and cheap materials are used, the coating methods do not require complicated processes. The coating can be applied on already installed solar cells, thus reducing their cleaning costs and increasing the amount of energy generated.

### The benefits and value to the potential users

SCNC coating for solar cells effectively reduces cleaning costs and increases the amount of electricity generated. The coating can also protect against harmful ultraviolet rays and from impact of birds on shiny surfaces. This coating can be applied not only to the surfaces of solar cells but also to facades, windows or other glass or non-glass surfaces.

K T U

**ELICĖJUS** 

Mantas Vičius, Mykolas Kalmatavičius, Aleksej Kurilčik, Doc. Dr. Vilija Dabrišienė



### Solution area

Digital solutions, Interactive and creative society

### **Description of the work**

elicėjus is a learning platform that creates a personalized learning pathway for every student.

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

It has been known since the 1980s that personalization in teaching is an essential method for achieving the highest results. However, a tool that would allow schools to scale personalized instruction in traditional classes of 20-30 students still does not exist. We aim to solve this with elicejus.

### Novelty of the work

elicėjus is the first learning platform to make it scalable for every student in a school to learn at their own pace.

### The benefits and value to the potential users

Every student – except those with severe intellectual disabilities – is able to achieve the highest levels of achievement in all general education subjects. Unfortunately, we do not see this in reality, because the traditional education system forces everyone to learn at the same pace. Personalized education – the best way to ensure the highest results – works the other way around: it allows each student to learn at the right pace until they reach

the highest grade. The platform elicėjus will allow the application of personalized education even in the largest classes. elicėjus is suitable for individual learning both at school and at home. User testimonials: https://youtu.be/ zWW4wQ6K88k







INFORMATION TECHNOLOGIES

### FLASH SCHEDULER

Lalith Chandran Senapathi Kaunas University of Technology

### Solution area

Digital solutions

### **Description of the work**

This app makes an appointment for you so you don't have to book an appointment on your own wasting precious time, finding perfect time slots that suit you, confirming the appointment, without leaving your seat on your comfortable phone, etc. like hassles.

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

For the residents of Lithuania, we know how our system works but we don't have the time to assign an appointment nor we can hire a personal assistant to book an appointment for us. The case is entirely different for the foreigners, as we are completely new to this environment, and we don't know how your system works as ours was completely different so to familiarise ourselves with rules and regulations FLASH SCHEDULER app helps you by introducing the person with the terms and conditions and how does any organization from as small as a barber shop to a fully developed 5-star restaurant how it works, etc.

Service providers are also target group, as to create a business we need sellers with a commodity and buyers.

### Novelty of the work

There are no competitors, except google booksy who are at a larger scale and its working and business model are entirely different except for the core idea and business strategy and the booksy was founded by a Polish entrepreneur in Poland, since locals of their country know how the system works but not the foreigners and we are build up of what the major problems of the



app Booksy faced as a foreigner in a new country and FLASH SCHEDULER show how the Lithuanian shops works and how you should come to visit them like wearing a mask, timing, age limits, etc. while these are mostly not shown on the booksy app as it was made with EU residents population use alone in mind when compared to my app FLASHSCHEDULER'S open policy of including all types of people request/opinions when factoring and selecting a service to book an appointment.

### The benefits and value to the potential users

FLASH SCHEDULER app solves this by scheduling an appointment for you without wasting your time trying to contact the service provider. It gives all the data about the service provider like date and day of availability, types of service provided and its total cost, etc.

Before booking the appointment you will be shown a small tab with the major rules and regulations (mostly covid restrictions) for any services like hospital, pub, etc. With one click of a search, we can find all our favorite things from the app.

The price for any service is the same and we will make sure about that by talking in person and confirming it for both locals and foreigners. Reviews made by any person should only be accepted if they have already taken services from that business organization as a customer only.

There will always be an English translation at least and adding other languages through the next updates as soon as possible. There will also be customer care where you can ask us about your needs and we will reply to you within 1 to 2 working days as soon as possible after getting the reply.

If you mention before booking an appointment that you're disabled, you will be given more importance.



DONE

### **CSGOTricks**

Lukas Vileikis

### Solution area

**Digital solutions** 

### **Description of the work**

CSGOTricks is a platform dedicated to the problems of the players of the popular game Counter-Strike: Global Offensive (frequently shortened to CS:GO.) The game has a couple of game modes – one of the most popular ones being competitive where 5 players compete against other 5 players in a "Counter-Terrorist vs. Terrorist" kind of scenario in a map chosen by the player once starting the game. Since there are a lot of maps in the game, and, consequentially, a lot (millions) of players, there's ought to be a lot of problems. CSGOTricks acts as a platform for the players of the game that identifies their problems with the help of numerous search engines, and then, makes video and blog-based tutorials on how exactly to solve those problems in a funny way at the same time doing everything at scale.

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

The game is a first-person shooter featuring guns, grenades, gun skins, and similar things – CSGOTricks solves problems related to the game. Problems entangle multiple areas including grenade-throwing issues of multiple kinds (flashbang, smoke, and explosive grenade issues), wallbangs (shooting through walls), jumping issues, issues related to how to get across the map faster, how to keep being invisible to an enemy, etc. – basically how to be a better player and gain an advantage over your opponents.

With its unique hybrid blog and video-based tutorial approach, CSGOTricks has taught over a million players to date.

### Novelty of the work

CSGOTricks is a platform that helps people solve issues related to the game with the help of multiple mediums – primarily focusing on blogging, TikTok, and YouTube. While there are guite a few of YouTube channels focusing on the game, there are almost no platforms that combine both blogging and video content. The YouTube channel also posts much more frequently than those already existing on the market (5-10 times a day compared to 1-3 times a week), all of the content is SEO-optimized from top to bottom providing it an advantage from all sides (reach, accessibility, scale, etc.), and also, the content related to the work is provided to people in such a manner that's both encouraged by YouTube and other competing platforms (TikTok, etc.) and easy to access for users.

### The benefits and value to the potential users

Users (players of the game) identify their problems (How to throw grenades at an X spot on a specific map? How to neutralize enemies without them even noticing?, etc.) by searching for them - CSGOTricks solves those problems at scale. Compared to other similar solutions, CSGOTricks solves more issues in one day than some other platforms do in a week.


# **FUN FORBIDDEN**

Airidas Janonis, Eligijus Kiudys, Martynas Girdžiūna, Miglė Zdanavičiūtė

Kaunas University of Technology Moonleaf Studio

#### **Solution area**

Interactive and creative society, Digital solutions

### **Description of the work**

Our proposed solution – Fun Forbidden – gives users the opportunity to immerse themselves in a fantasy steampunk-based world where the player has the possibility to interact with a variety of different virtual objects. The main goal is to explore this mysterious world, discover and solve puzzles, combine different objects together and invent things. By performing a wide variety of object combinations, players can discover certain activities that improve their critical thinking, creative thinking, reaction time, and even some of their physical skills.

Education in VR can be feasible in even more different and interesting ways – for instance, this technology offers opportunities to experience something unnatural or even dangerous, without any serious risks or consequences.

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

We are still learning things through text, video, and audio formats, which does not always allow for a fully immersive and interactive learning experience. This often leads to students being less productive, or even unmotivated to perform certain tasks. To make learning more fun, inspiring, and engaging, we want to introduce Virtual Reality educational environments.

## Novelty of the work

Gamified education virtual reality environments.

### The benefits and value to the potential users

Users will be able to improve their critical thinking, creative thinking, reaction time, and even some of their physical skills by discovering and solving the encountered challenges.



# HALVE

Airidas Janonis, Miglė Zdanavičiūtė, Eligijus Kiudys, Martynas Girdžiūna, Gantas Liutkus

Moonleaf Studio

### **Solution area**

Interactive and creative society, Digital solutions

### **Description of the work**

A large spirit was accidentally split into two minor spirits. After splitting up, their fragments were scattered across the world. Help these spirits find their way in a vast, puzzle-based fantasy world while simultaneously working together to overcome different challenges and unravel their destiny.

Main game features:

- Explore four moody, atmospheric chapters that are filled with fantasy elements;
- Collect soul fragments and gain different spirits characteristics;
- Simultaneously guide two spirits to solve puzzles and challenges.

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

The game provides users an additional option to spend their free time.

#### Novelty of the work

The main gameplay loop consists of simultaneous two characters' movement.

#### The benefits and value to the potential users

The game provides users additional options to relax and spend their free time in a fun and entertaining way.









Martynas Šiškauskas, Mantas Banevičius

# REESON

# Solution area

Interactive and creative society, Digital solutions



# **Description of the work**

Void Prison is a fast paced, endless arcade twin stick shooter game that puts you inside of an ever shrinking ring. Survive by fighting emerging enemies around you and don't get consumed by the void. Complete achievements to unlock new skins and powerups and get on top of the leaderboards!

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

We invested a lot of time into the architecture for the game to work on as many platforms as possible and support different input types like controllers of the newest consoles. These solutions allow us to expand the product to broader markets and save on development time down the line. We also analyzed similar games in the industry and improved on existing game mechanics to make the game even more fun.

### Novelty of the work

Combination of unique game mechanics create new ways to experience an already very popular twin stick shooter genre of video games.

# The benefits and value to the potential users

Entertainment value of experiencing a fun and unique game that will keep you on the edge of your seat for hours.

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

GETFAST

# **GETFAST** – SOFTWARE FOR LAST MILE **DELIVERIES (SAAS)**

Andris Mažuolė, Audrius Banys, Simonas Šulskis MR "Orselis"

#### Solution area

**Digital solutions** 

#### **Description of the work**

GETFAST – the first Lithuanian courier management platform – software as a service, operating on the principle of an online program, which allows you to efficiently manage your couriers and control all delivery processes in real time. GETFAST the solution is tailored for cafes, restaurants, food and other subscription businesses selling fruits, vegetables and other fast-moving goods (FMCG). The platform can also be used by other businesses that need to manage their own couriers and deliveries themselves. The platform consists of few parts:

- 1 Online control panel for couriers and deliveries. Businesses can use the GETFAST courier management platform to manage their own couriers and deliveries, plan and optimize deliveries according to their business needs, monitor and control all processes and resolve problems in real time. And they can do it in one convenient control panel.
- 2 Courier mobile app. The GETFAST Partner mobile app for couriers, which allows couriers to see and perform their assigned deliveries. Using the app, the courier can interact with an unlimited number of business customers of their choice.
- 3 Business needs and courier search bulletin board. For businesses looking for their own couriers, we have created an innovative bulletin board where you can upload an ad to a wide network of GETFAST independent

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couriers and get offers to work together from those interested. In this way, the business finds couriers that meet its needs, and couriers find the business customers and working conditions they like. www.getfast.lt

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

- Excessive commissions for food delivery platforms. By managing couriers and deliveries yourself, our solution saves up to 40% on delivery costs (depending on business needs and specifics).
- Broken connection between business and customer. Our solution helps to create and maintain a connection between a business and its customer, as a courier who works with a particular business becomes a representative of that business.
- Unfaithful couriers. Our solution helps a business find and work only with loyal couriers that meet its needs. The collaboration between business and courier is long-term, not one-off.
- Losses without accounting / loss of circulating packaging. Using our solution, digitization of accounting and control of circulating containers (for food subscriptions, etc.).
- Courier search problem. On our platform (a specialized courier search bulletin board with an extensive network of independent couriers), businesses can find couriers that meet their needs.
- Individual working conditions for the courier. In the GETFAST platform, the courier chooses which businesses he wants to cooperate with, which orders to deliver, and what schedule to work with. He also agrees directly with businesses on remuneration and other working conditions. In this way, the courier becomes an entrepreneur providing courier services.

#### Novelty of the work

After researching the global market, we noticed that there is no solution so strongly focused on the food industry that can offer businesses to manage their own couriers and deliveries and at the same time help them find the right couriers on one platform.

#### The benefits and value to the potential users

By managing their own couriers, the business gains autonomy from all logistics and food delivery platforms, has the ability to personalize deliveries acU L

cording to their needs and has full control over the entire delivery process. Logistics costs are also reduced. Working in this way results in a closer and warmer connection between the business, the courier and the customer (improving the customer experience), better collaboration between the business and the courier, meeting the needs of both parties.





# **DIGITALIZATION OF MUSEUMS**

Saulius Krugliakovas, Miglė Musteikytė, Rapolas Kutka, Mantas Kvederys, Justas Čiapas, Dmitrij Zubko

Kaunas University of Technology

#### Solution area

Digital solutions, Interactive and creative society

### **Description of the work**

There is a clear case that young people in our society are not interested in visiting traditional museum experiences – which is exactly the issue our product is trying to solve by digitalization museums' exhibits.

Our product uses QR codes to easily provide a visitor with a detailed description of each exhibit along with panoramic images where applicable. Future plans include trivia questions about the displays to further encourage the visitor to engage with the museums' exhibits.

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

The main focus of our project is to solve the problem of digital accessibility of museums and their exhibits. Not only are some displays hard or impossible to access and inspect physically, some also lack proper descriptions in the first place. By providing both educational, visual and interactive content with our product, we intend to improve every digital native's experience with any participating museum's exhibition.

This additionally is intended to attract younger audiences and excite them for the cultural and historical riches museums all across the country have to offer, thereby attempting to solve the issue of the current generational disparity in demand for such cultural experiences.

# Novelty of the work

This project is unique in that it has the potential to enhance every Lithuanian museum's digitalization and innovation, which are critical steps to attracting younger audiences.

Various Lithuanian museums already have similar programs, but almost all of them have a fairly limited scope: They often only focus on individual museums, and they mostly only feature static text content, such as descriptions for exhibits.

Our product adds significant value by also offering panoramic photos, audio recordings of exhibition descriptions and trivia questions while providing a consistent platform for any Lithuanian museum to integrate with.

# The benefits and value to the potential users

By focusing on a more familiar and modern medium, we aim to reinvigorate the younger generations' interest in traditional museum experiences, to broaden their horizons, and to educate them along the way.

# HIGH-PRESSURE CLEANING ROBOT FOR INDUSTRIAL APPLICATIONS

Dominykas Baranauskis Group supervisor: Agnius Liutkevičius Kaunas University of Technology

#### Solution area

Food, Digital solutions, Engineering

#### **Description of the work**

During this work, an industrial high-pressure washing robot was created. The robot and the control system were developed with the intention of its use for various equipment and surface cleaning operations in industrial food factories. This robot is completely autonomous – it automatically switches on, goes to the specific place, and starts cleaning operations. The robot has electric wheels that ensure the smooth movement of the device, as well as sensors that are responsible for detecting the line on the ground and coordinate the direction of movement. When the robot arrives at the stopping place, the valve is activated, and the water starts to flow through the hose. After that, the robot starts the cleaning operation according to the assigned program.

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

Nowadays production automation is the one of the key elements of the development of modern industry. As in other areas, this process is also being implemented in food factories. Due to the type of products produced there, the requirements for cleanliness and hygiene are extremely strict, so it is important to apply safe and efficient cleaning method. Appropri-

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ate cleaning agents and devices ensures that any possible accumulation of allergens, contaminants or other undesirable particles or compounds is impossible. The cleaning of the slaughterhouse premises and equipment is usually carried out by factory staff or by an external company. This type of work is classified as moderate physical category. Also, the washing process takes place under non-traditional work safety conditions, which leads to increased risks to workers' health. It is also important to appreciate that the process of washing premises and equipment can take about 8-12 hours a day. All in all, considering the importance of the quality of this cleaning process, risk-increasing working conditions and the costs to the company, it would be worth entrusting this work to an automated system.

### Novelty of the work

Similar cleaning machines can be found on the market, but the developed robot differs in certain features such as mass, ability to be battery powered, user interface capabilities, resistance to moisture and dirt, the number of movement axes of the high-pressure head, permissible working conditions.

#### The benefits and value to the potential users

Such high-pressure cleaning robot could replace about 2-3 employees. The washing operations performed by the robot probably would not take less time than the one performed by a human, but considering that this work takes 8-12 hours a day, using this system would reduce the likelihood of errors due to the human factor, such as fatigue, forgetfulness.

# WoodStalk

Mantas Indrašius, Augustinas Košys

#### Solution area

Defence, Environment

#### **Description of the work**

An autonomous, remote & distributed surveillance system based on the analysis of the audiovisual observations.

Several use-cases:

- 1 Home Security.
- 2 Security of a construction site.
- 3 Security of domestic animal fence.
- 4 Surveillance of illegal activities in forests & the border.

The system is being designed as modular. Some examples fo possible accessories:

- 1 Fire sensor.
- 2 ZigBee & Z-Wave protocol.
- 3 4G or Wi-Fi connectivity.
- 4 Wi-Fi access point.
- **5** Long range transmission of audio-visual signals.

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

- Processing of audio and visual signals using Machine Learning (ML) to reduce the amount of user notifications and false alerts.
- High-throughput data streaming using radio on various landscapes and natural barriers.
- Ensuring the system is energy-saving and autonomous all-year-long.
- The system is being designed to be working in mesh configuration.
- The modular system design.

## Novelty of the work

Surveillance market is fairly stagnant and offers very similar products in capabilities and user experience. We aim to reiterate it and offer a more flexible, really smart and "plug-and-forget" approach to surveillance.

### The benefits and value to the potential users

- Protection of the property and area.
- Observations of nature (birds, animals etc.).
- Very easy installation on any items (i.e. birdhouses), plug & play.
- The system connects to existing surveillance systems as well as Smart Home installations.

# MODEL-BASED SMART HOME MANAGEMENT

Marius Grybauskas Group supervisor: Dr. Jaroslav Karpovič Kaunas University of Technology

#### Solution area

Digital solutions, Engineering

#### **Description of the work**

With the growing popularity of smart home systems, there is a growing demand and interest in smart devices. However, current systems use scripts that are difficult to describe and visually obscure. Systems based on this principle are difficult to manage and modify according to user needs. The aim of this work is to propose a methodology for creating a fully automated, model-based smart home management system that can be scripted and executed through a charting tool.

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

Smart home management systems cannot be programmatically modified at the user's discretion (because manufacturers do not allow this). Also, classically created scripts are not quick to understand because it is a data set without any visual representation of how and by what principle it works. No system has been developed to fill this market gap or even offer a methodology to implement this system for smart home developers. Providing such a methodology could lead to greater interest in the use of diagrams as a script execution tool by smart home system developers and users. U L

# Novelty of the work

To offer developers of smart home systems a methodology for developing a smart home system based on open source models.

### The benefits and value to the potential users

Using diagrams to create scenarios would reduce the time it takes to create and comprehend scenarios, as diagrams are a visual representation of a scenario whose entire course and options are clearly presented. The open source platform could also provide additional opportunities for system developers to improve the system.

# EVALUATION OF DEEP LEARNING METHODS FOR ESTIMATION OF FOOD PORTION VOLUME AND NUTRITIONAL VALUE

#### **Yusef Savid**

Kaunas University of Technology

Solution area

Digital solutions, Engineering

#### **Description of the work**

Counting macros and calories has always been a tedious task for most individuals. There are many tools, apps and methods used to estimate caloric intake of users, only issue is most of them are manual i.e., require the user to input the mass of different aspects of their meals. With the re-emergence of Artificial intelligence due to the availability of more computationally powerful devices, it makes sense to use tools which utilize AI and more specifically deep learning to estimate volume and later estimate caloric value of food portions. This isn't a simple task, nevertheless, many approaches are being created (and have been created) to utilize deep learning in this sphere. The final product/deliverable is a smartphone app where a user can with the help of a smartphone's camera estimate calorie content as well as other nutritional facts of food items that are within the frame of a smartphones camera.

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

The estimation of calorie content of food items.

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# Novelty of the work

A full system that integrates all aspects of the estimation of food volume as well as calorie and macro nutrient content using a smartphone app.

# The benefits and value to the potential users

A more automated method of estimating calorie content of food items compared to manual food logging/entry and volume measurement.



# LaundryWala – ON-DEMAND LAUNDRY SERVICE ANDROID APPLICATION

Armaan Mollah Supervisor: Rytis Maskeliunas Kaunas University of Technology



LAUNDRYWALA, QUALITY AND SAFE LAUNDRY. DELIVERED AT YOUR DOORSTEP. WE CARE FOR YOUR CLOTHES AS MUCH AS WE CARE ABOUT YOU.

Solution area Digital solutions

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#### **Description of the work**

LaundryWala – On-Demand Laundry Service Android Application connecting the services of local laundry houses to the general population allowing the smooth rendering of laundry services to be ordered from this application, cost-effectively saving time.

The application prototype automates the process of placing an order on the application and assigning it to a laundry house. Laundry Houses assign these orders to couriers for them to picked up and dropped off. The application allows a customer to place an order using PayPal or Google Pay Wallet and to order different types of services on the application like apart from clothes, like the washing of carpets and rugs, delicate jackets, and duvets. It also allows one to order by Kg and add requirements for drying and couriers as well. The application allows real time courier tracking of orders and order status updates.

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

Students and working individuals that move to Lithuania face the problem of not being able to access laundry services at home. The reasons for this may vary. Students living in dormitories have their laundry rooms on different floors, and more often than ever, the laundry rooms are overflowing, or the washing machines in these rooms are not working. This causes such students to access external laundry services in and around their areas. Individuals who reside in private rental houses sometimes do not have a washing machine provided for them and, as a result, also need to access external laundry house services.

Many of the laundry houses in Lithuania do not have a website let alone an application for people to access their services. Their advertisement is mostly through pamphlets and advertisements on websites online. As we know, the greater population does not access websites to order services online, it is done mostly through applications. These laundry houses most of the time cannot afford to develop a website or application to host their services online.

This gives an idea that the need of such an application can solve the issue and bridge the gap between two mutually dependent problems.

The easy registration on the application and the automated system of placing a laundry order and having it collected and delivered at home can significantly benefit both the consumer and the provider of the laundry service. The monetization of the application does not have to be different from the rates of the different laundry houses so it does not change the rate of getting laundry done in the market making this an idea to be taken forward into the future. The ease of accessing a service almost always increases the demand for it. Such an application will not only attract people with laundry needs but also companies and enterprises requiring large bulks of laundry to be placed on the application.

#### Novelty of the work

The analysis of the similar systems in the market shows the presence of such laundry service delivery systems in multiple locations in the UK, Germany and India but the absence of such systems in Lithuania. This is a first of its kind idea to avail Landry services online in Lithuania.

#### The benefits and value to the potential users

- Provide Home delivery laundry service.
- Automate registering and communicating between users, customers, and laundry houses.

- Provide Safe and quality laundry and many services like dry cleaning of carpets, heavy jackets, coats, blazers, suits, and bedsheets.
- Prospects of the application on success would allow companies to access these services for daily loads and provide more job opportunities for couriers, as in Bolt and Wolt.

REFRESH MAP Kleboniškis	Forest Park	LaundryWala	LaundryWala
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T		Hello, Courier	Order History



# SPEAK LITHUANIA

Narmin Aliyeva, Marius Raskevicius, Mykyta Tsygankov SPEAK Lithuania



# **Solution area**

Interactive and creative society, Digital solutions, Environment

# **Description of the work**

SPEAK connects migrants, refugees and locals through community-led language and culture exchange experiences. People sign up on mobile app or web platform to learn or to help others learn a language and then they are brought together in groups that meet in 12 sessions of 90 minutes either online or offline.

SPEAK promotes the organic emergence of inclusive communities where newcomers and locals meet to share their culture and develop meaningful bonds by providing the platform and support for individuals to facilitate informal language learning environments and host community events.

Webpage: www.speak.social

### Mobile App:

- Android: https://play.google.com/store/apps/details?id=social.speak.dev. SPEAKConversationMobile
- iOS: https://apps.apple.com/pt/app/speak-language-learning/id15507 79206?l=en

# Technical or other problems that are solved with the work

According to the International Organization for Migration, the number of international migrants has been growing over the past 20 years, reaching 281 million in 2020. In Lithuania, the number of foreign residents has never been higher, with more than 100K in the past 4 years. For any person leaving

their country, whether to fight for a better life or to flee a war scenario, the problem of integration arises upon arrival in the destination country.

SPEAK fights against the social exclusion of migrants and refugees caused by social barriers, discrimination, and anti-migrant rhetoric. Many integration policies fail from the beginning due to their incomplete vision of this complex challenge. The sociocultural integration needs to be understood and worked in each of its causes – thus a holistic approach is required.

With over 50K registered refugees from Ukraine in Lithuania, SPEAK Lithuania is set to play an important role in helping them to integrate into their new communities.

#### Novelty of the work

SPEAK is a community-led project where locals and migrants actively participate in the solution. By making migrants and refugees ambassadors for cultural dialogue, it gives them the opportunity to share the value they bring and develop.

SPEAK increases impact through its technology. The experience is delivered and organised through mobile app or web platform, where technology enables efficiency by managing all processes (payments, registration, materials, etc.), reducing manual work and giving scalability to the project. However, the group meetings all take place in groups, given the importance of face-to-face interaction.

#### The benefits and value to the potential users

At SPEAK everyone can apply to learn or to help others learn languages and cultures: locals who want to learn new languages and connect with different cultures, and newcomers who are in the process of adapting to a new city. SPEAK uses the motivation and need that people have to learn a language to bring together people of different contexts in an informal environment, where they stand as equals, with a high probability of creating strong and meaningful relationships.

This online platform provides not only the opportunity for these people to connect, but also access to language learning materials, challenges between sessions, training, and community-organized events.

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# ABSTRACT MUSIC – CONTENT BASED MUSIC RECOMMENDATION USING DEEP LEARNING

Milita Songailaitė, Tomas Krilavičius, Justinas Dainauskas MB "Abstract music"

#### Solution area

Digital solutions, Interactive and creative society

#### **Description of the work**

Various technological changes and the ever-increasing digitization of information have forced the music industry to move gradually from physical recordings and live performances to the online space. These changes made online streaming services, such as "Spotify," "Soundcloud," and "Deezer," increasingly popular during the last decade since they offered convenient cost-free music listening to their users. However, this also lets the amount of available online content increase rapidly. For instance, "Spotify" alone offers customers a selection of more than 70 million songs, supplementing this selection with 60,000 new pieces each day. In order to deal with vast amounts of data, companies use music recommendation algorithms. The algorithm we are creating works differently than any standard algorithm implemented in music streaming apps. The main idea of this algorithm is to extract possible audio features from the song and recommend music according to them. For instance, several sound processing methods let us extract the melody of an audio signal; other methods let us capture the signal's exact tempo and beat occurrences. Having these features extracted, we can let the user decide what makes his guery song unique and what kind of recommendations they want. Our system would give the user complete control over the style of music they want to get recommended.

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

The music recommendation system we are creating solves the problems that arise from the vast amounts of online music content. It gives a user a fully controlled recommendation according to their specific taste.

### Novelty of the work

Several new features have been introduced in our system. First of all, as mentioned before, the user can choose what specific features describe his recommendation taste the best. Users can get recommendations according to the melody, different tempo or rhythmical elements, overall loudness of the signal, and several more. This ability also introduces recommendations by only a tiny section of a song, not the whole song. For instance, if the user liked a specific melody, clip, beat, etc., from the selected song, in our system, it is possible to cut out that particular part and get recommendations only according to it.

# The benefits and value to the potential users

Using our system, the users get a chance to discover more unusual songs. Most of the time, the recommendation systems implemented in popular music streaming apps recommend new music which many other users like. Our system would let them discover different types of music since the recommendations do not depend on any popularity or music novelty measures. Instead, the recommendations are purely based on the input song's audio signal characteristics.

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# LEARNING BY DOING: A SKELETON CASE

Pranas Jaruševičius Supervisor: Prof. Tomas Blažauskas from the KTU VR Lab Kaunas University of Technology

#### Solution area

Interactive and creative society, Health

#### **Description of the work**

The project is a simple VR game in which the subject is tasked with completing a human skeleton from scattered bones around the ground by picking them up and placing them in the correct spot. Placing the bone in the incorrect spot counts as a mistake and returns the bone to its original position, so the player may try again. If the player doesn't know what the bone is, he may use a scanner tool or other "help items" to get more information. The game keeps track of the time, mistakes, and how many times "help items" were used.

The game is played directly through the browser using VR goggles, and if it is hosted as a SCORM package through Moodle, can automatically record the results as if a test was being taken, streamlining the grading process for educators and providing a new enjoyable way for their pupils to experience the learning material.

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

There are currently few instances of educational VR games having integration with popular Learning Management Systems (such as Moodle) – they are usually meant to be played as standalone titles or are already fully integrated into their own custom systems, and are unable to be used elsewhere. This project serves as a proof of concept for VR integration in Moodle, though the process may not be streamlined as of yet.

### Novelty of the work

The game is lightweight, exported in HTML, uses WebXR technology and packaged in SCORM, so it can be played through the browser without down-loading, has integration and automatic feedback with various SCORM-supporting LMS, and can be used as a template to create other games of similar style and scope.

### The benefits and value to the potential users

The game is meant to be used as a more interactive learning/teaching or testing tool than traditional media, specifically aimed for kinesthetics, who learn better by manipulating objects or experiencing things by moving their whole body. Currently, there is a noticeable lack of such media – this game is intended to help fill that gap.



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# iTrain – EDUCATIONAL GAME FOR DIRECT CARE WORKERS DEALING WITH STROKE SURVIVORS

#### Andrius Paulauskas

Kaunas University of Technology

#### **Solution area**

Health, Interactive and creative society

#### **Description of the work**

An innovative game for this project will be designed to work around the standard ineffectiveness of traditional learning approaches for direct care workers dealing with stroke survivors. iTRAIN foresees the required amount of usable data so the game runtime, complexity and intrusiveness will be modeled and designed from the ground-up around the requirements and needs indicated by direct care workers and experts in the field.

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

The amount of people who have suffered a stroke are increasing and this, in turn increases the demand for stroke survivor care. Majority of care givers are relatives with no prior experience in caregiving. For this reason it is important to find ways on how to pass down practical knowledge of care. Serious educational video games are a great learning tool for this. These games are casual enough so that all kinds of people can easily play them and have a context that provides educational value. Our game aims to be just that – an application that can teach caregivers in an interactive an innovative way.

### Novelty of the work

Interactive education.

### The benefits and value to the potential users

Users have the ability to effectively learn in an interactive environment.





# IMAGE CLASSIFIER FOR TETRAPAK CATEGORIZATION

Grigošaitis Matas, Vaičius Dovydas, Govardhan Seshasayee Group supervisor: Roshini Giriprakash Das

Kaunas University of Technology

#### Solution area

Raw materials, Engineering, Food

#### **Description of the work**

Our solution is heavily inspired by Taromatas, a recyclable bottle deposit system with monetary rewards for recycling. Our solution is a recyclable tetra pak sorting system using image recognition.

The prototype for our solution would consist of an Image classifier, a sorting equipment, a weighing machine and 2-3 different boxes. We have implemented an image classifier using a Convolutional Neural Network. The algorithm logic was chosen from one of the four best algorithms for image detection in the Artificial Intelligence domain.

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

One of the most difficult but rewarding waste management actions was the introduction of the deposit system in Lithuania in 2016. The deposit system means that with every beverage packed in glass, plastic bottle or in a can, a buyer pays a little deposit on top of the beverage price (0,1 Eur in Lithuania). After the beverage has been drunk, the package can be returned to the automated bottle collection machine. These machines can be found in every supermarket larger than 300 m<sup>2</sup>. The deposit system has remarkably improved recycling rates of bottles and cans. Data from 2018 suggests that 92% of all packaging released to the market has been returned for recycling.

Already in the Lithuanian parliament there are talks to expand amendments to the Law on Packing and Packing Waste Management.

In 2018 "Tetra Pak" pledged support for the EU plastics strategy. The company announced that they will work with industry partners to ensure that by 2030, recycling solutions are in place for all components of beverage cartons so they can be fully recycled across Europe. The whole European Union is focusing more and more towards recyclability and circular economy. Our solution could help the recycling institutions to reach this goal.

#### Novelty of the work

Most of the existing sorting methods for recycling use a barcode scanner to scan the barcode on the packaging which then sends requests to the database to check if the package is recyclable or not. This method has been adopted by many supermarkets. However, there are drawbacks to this method which includes:

- 1 Preparing a huge database of packages' barcodes.
- 2 Either lacks information on what types of recycling method or contains the information on what types of recycling method is supposed for the package that expands the already existing database horizontally.
- **3** Whenever new products are included, the database expands.
- 4 Anyone who wants to adapt this method, needs to start by adding thousands of their products into the database.

With advancing technologies, not only can recycling be done easily but also in a more data efficient way. There are two things you can find on all the products packaging: the barcode and the recyclable logo. Since the barcode method of sorting is not easily scalable, the next thing that can be used for sorting are the recyclable logos. The advantages of using recyclable logos are:

- 1 There are only handful of recyclable logos;
- Each recyclable logo contains information of what the packaging is made of;
- **3** These logos can be easily detected for their distinct features using image detection.

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### The benefits and value to the potential users

The potential users are the citizens who want to help in recycling daily waste. With Lithuanian government encouraging more recyclability of products in the country after reaching 8th place in EU for recycling more than 45% of municipal waste. We believe that our solution is a good step in moving towards a greener future. It is also important to mention that our vision is shared goal of Lithuanian municipality and the tetra pak recyclability goals for 2030.



ΚTU

ELECTRICITY, ELECTRONICS AND ENERGY

# BOLDR – SUSTAINABILITY MEETS DESIGN

Madiyar Ablyazov, Toma Paro, Justas Alekna

#### Solution area

Environment, Digital Solutions

#### **Description of the work**

Boldr has developed a range of easy-to-use products, supported by an app ecosystem that helps users reduce their energy consumption and save money. At Boldr, we see the future of the heating and cooling industry to be electric due to the continued decarbonisation of the electric grids. Thus, we have focused on developing electric solutions for the modern consumer.

We are introducing two flagship products:

- KELVIN delivers a new standard of electric infrared heating (low wattage) backed by a powerful smart home app that helps you save money and live more sustainably.
- 2 FARA A compact electric heater with an iconic design that raises the bar for flexible home heating with an add-on option for smart functionality that unlocks a host of intelligent and energy saving features.

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

Consumers are overspending on their heating as a result of archaic heating technologies that were poorly designed and are difficult to operate. These technologies are often not environmentally friendly and are becoming less so with every passing year. Given that heating can account for up to 60% of the total energy billin an average household (of which 35% is often wasted), at Boldr we aim to impact this market. We are working to reduce the impact on the environment and every single cent a user saves in energy is good news for pocket but also the planet as well.

The Boldr team has a strong knowhow in e-commerce and D2C sales in the smart home/IOT sector. D2C through e-commerce allows Boldr to build a strong and reputable brand with early adopters and to position itself as a leading start-up in the smart home environmental sector. The team also already has established relationships with leading online marketplaces across the globe, including Glaxus, Stackcommerce and an invitation to the Amazon Launchpad programme, which seeks innovative brands that have growth potential on Amazon. Finally, Boldr will place its products in traditional retail in the EEA & North American markets. The Boldr team also has existing relationships with retailers in the UK and an overall experience in putting products on retail shelves.

Boldr is developing an ambitious B2B business model that goes beyond the traditional distribution network for heating, cooling and water. We leverage the highly crowded energy market and plant to work with energy/utility companies directly in distributing our products to the end consumers. In addition, our B2B route to market is through property management companies in the residential and tourist sectors where energy management and smart home directly impact margins and prices (AirBnB, Booking.com). Finally, we are building local distributor and installer networks for Boldr by partnering with solar panel sale and installation companies, as well as large heater and AC installer companies who have cornered existing local markets and are looking for up-sell products.

#### Novelty of the work

KELVIN uses infrared heating technology to heat your home. Unlike traditional, convection radiators that heat the air, infrared heaters heat objects directly. By not relying on convection heat, a KELVIN can heat a space with up to 30% less energy than traditional electric heaters. This heating technology is further complimented by the Boldr app, which puts you in control of your heating and spending from the comfort of your phone. You can have full control of your home heating wherever you are. Thanks to our constantly evolving software, your KELVIN improves with time and gives you the tools to waste 30% less waste. A better experience with every update.

FARA – with the latest generation of ceramic heating, Fara swiftly and effectively heats up your surrounding environment. The iconic and contemporary velodrome design ensures compatibility with any interior setting, meaning Fara finds a home on any surface. Smart app features and voice assistant
integrations instantly upgrade your heating experience to new levels of convenience and cost efficiency (helps waste 30% less energy). Equipped with all-encompassing safety features and crafted with flame retardant materials, it is an ideal choice to keep your environment comfortable and safe.

#### The benefits and value to the potential users

Boldr products help users save money and live more sustainably. Good for the wallet and the planet.







### CONTINUOUS SUBSTRATE DOSING DEVICE FOR AUTOMATION OF BIOTECHNOLOGICAL AND CHEMICAL PROCESSES

Arnas Survyla, Lukas Zlatkus, Deividas Masaitis, Benas Kemėšis, Renaldas Urniežius Kaunas University of Technology

#### Solution area

Engineering

#### **Description of the work**

We present a developed dosing system that ensures accurate and stable supply of solution (dosing liquid) to the vessel. The main active part of this system is the peristaltic pump, which is responsible for maintaining accurate rotational speed. The scales that are connected to the pump ensure accurate system operation. The system implements different control algorithms that allow the user to select the desired fluid supply dynamics. The device can be adapted to a variety of processes that require accurate fluid supply and monitoring.

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

The main challenges in biotechnological processes in industry are maintaining the exact concentration of glucose in the bioreactor, monitoring the cell status and recording it. In order to maintain an accurate glucose concentration, it is necessary to reliably supply the glucose solution to the bioreactor U L

without interruption. Also in the chemical industry, mixing several reagents at the same time is a problem to ensure the exact supply ratio. Therefore, this dosing system is suitable for given examples to do precise work.

#### Novelty of the work

The device has the great feature of delivering the dosing liquid with high accuracy and achieving the desired result by several delivery methods that are integrated in the peristaltic pump. Even a single peristaltic pump, without additional equipment (electronic scales), can reach the supply solution setpoint with a small error.

#### The benefits and value to the potential users

Accurate dosing of the liquid ensures a higher efficiency of the product in both biotechnology and chemical processes. It also allows the user to dispense the liquid sterile, evenly and accurately.



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### TWO WAY CHARGING STATION MODEL

Tautvydas Pilelis, Kasparas Elzbutas, Agnė Rauluševičiūtė, Eglė Janušaitytė, Kornelija Magylaitė Group supervisor: Doc. Dr. Marius Saunoris Kaunas University of Technology

#### Solution area

Environment, Digital solutions, Engineering

#### **Description of the work**

This model demonstrates bidirectional charging that can be used in electric vehicle infrastructure. With the increase in the number of electric cars, there will be a shortage of electricity in the future. Electric car batteries can store large amounts of electricity, so if a charged electric car isn't being used, it could return the stored electricity to the grid, reducing electricity shortages.

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

By using the electricity stored in the electric vehicle battery, the resulting instantaneous electricity shortage is improved and the electricity consumption balance is improved.

#### Novelty of the work

The model of two way charging is presented.

#### The benefits and value to the potential users

Electricity balancing, an opportunity to make extra income.

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Technorama

### **3D FOOD PRINTER**

Laura Kaziukonienė, Jesus Manuel Barragan Ferrer, Rokas Jašinskas, Raminta Buzienė, Deividas Zelickas

"UAB GELD BALTIC" (DBA Super garden) Kaunas University of Technology

#### Solution area

Food, Health, Engineering

#### **Description of the work**

The 3D printer is designed for real-time printing of BITES snacks. Just insert a cartridge with the recipe for the selected BITE, and you will be able to enjoy that delicious snack. 3D printer cartridges have a long shelf life and printing in real-time lets you enjoy a fresh snack whenever you want. You can choose one that meets your current needs: an instant energy snack, a detoxing snack, or just a sweet and super tasty bit of fruit.

This is food innovation which disrupts the idea of food creation. It was created in collaboration with Kaunas University of Technology scientists.

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

This food 3D printer creates an opportunity to produce healthy snacks from freeze-dried food powders instantly. The developer team was focused on food waste and healthy snacking problems. As a result, there was created a 3D printer which can print healthy snacks from lyophilized food. Because of the highly effective production process, the low percentage of waste during raw material lyophilization and extra-long shelf life of freeze-dried food reduces the food waste problem. So, the science team merged both these solutions into one place and got a unique problem solver. Technorama

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#### Novelty of the work

Super Garden and the KTU science team created a unique 3D printer which is capable of printing patented healthy snacks – BITES. There is no identical 3D printer which would be able to print food from freeze-dried powder and cacao butter. This printer there is used a unique combination of various food processing technologies in a relatively small scale final printing machine.

#### The benefits and value to the potential users

Potential users get the ability to produce healthy and functional snacks according to their individual needs. This 3D printer is ideal to change coffee machines in huge offices or vending machines in public areas. With one touch you can get functional BITES, made without any additives and conservants. This is easy, healthy and conveniant snacking solution.



### FERROELECTRECT MATERIALS AND DEVICES FOR ENERGY HARVESTING APPLICATIONS

Chandana Ravikumar Group supervisor: Vytautas Markevičius Kaunas University of Technology

**Solution area** 

Food, Health, Engineering

#### **Description of the work**

Energy harvesting from environment is a huge tool to facilitate the Internet of things market. Piezoelectricity allows one to harvest the energy found within moving objects to provide a sustainable and cleaner future. The kinetic energy found in moving machines like stone cutters and lawn movers is abundant to be converted to usable electricity with the help of vibrational piezoelectric energy harvesters. Recent investigations revealed that the Piezoelectric effect is created in cellular Ferroelectrets like Polypropylene(PP), it is internally charged by micro plasma discharges within the voids of the polymer and when external electric field is applied, the polarity of these engineered dipoles switches alternately showing piezo and pyroelectric properties. This material is commonly used in disposal cups and food packaging. The significant difference between cellular Ferroelectrets and traditional piezoelectric polymers like Polyvinylidene fluoride (PVDF) is that the former has approximately 10 times higher piezoelectric coefficient than the later. This means for an acceleration of 9.81 m/s<sup>2</sup> force on this material, generates up to 50µW power output. This power generated depends mainly upon the material's piezoelectric coupling, internal and external factors like internal resistance and ambient temperature etc. There is an enormous potential for progression of cellular Ferroelectret-based piezoelectric energy harvesters so with enough funding and research conducted in this area, soon we can find portable Ferroelectret generators powering our electronics and IoT devices.

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

The major issue one is that the quantity of electricity produced is so small, so unless vast installations were set up, it simply would not have the strength to power our latest gadgets.

The final issue is that up to now, many of the starting products needed to produce the piezoelectric materials are toxic and difficult to work with.

#### Novelty of the work

Regarding IoTs applications, the efficiency has immensely upgraded, though the product features remain the same, the progress in extremely low power sensing and computing has boosted the efficiency and thereby the power consumption of IoT devices have drastically dropped. With this change happening for the first time in history, it is actually feasible to tap into this appreciable energy available in our surroundings to power such electronic devices.

Discovered only 10 years ago, Polypropylene Ferroelectret and its potential applications in the field of energy harvesting is not explored enough. This work aims to find investigate, design and build to an energy harvester device based on polypropylene Ferroelectret to produce energy more than the present best commercial energy harvesters available. Piezoelecticty will become another weapon which we can use to reduce our reliance on fossil fuels and to derive the energy we need.

Technorama

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#### The benefits and value to the potential users

- Substitute energy instantaneous energy harvesting serves as an alternative to battery and power cables
- Environment friendly-Their disposal poses an environmental hazard since batteries contain chemicals which are harmful to environment and human.
- Raw materials-It is root level project made of raw materials like polypropylene and steel core.

- Promotion of IoT. The tapped energy from environment not only enables self-reliant electronics but also gives a chance for addition of newer features in IoT applications.
- Sustainable energy development. This Ferroelectret based piezoelectric vibration energy harvesting idea for powering wireless sensor networks and low power electronic devices can foster the growth of sustainable energy development and cut down the use of conventional energy sources.
- Saves money. Conventionally 99% of sensors installed are powered by batteries that can provide them with the energy they need on average only for three years, it is estimated that on average, replacing a single-sensor battery costs around 200 euros. Energy harvesting saves the cost of expensive battery replacement.
- Saves manpower. With battery powered sensors, within a span of three years, a person must come to each sensor and replace the battery so that it can continue to operate. However, access to these sensors is mostly difficult or even dangerous. The use of energy harvesters can avoid the problem of maintenance all at once.



**Block Diagram of Vibration Energy Harvestering system** 



### SMART AIR QUALITY SENSOR

Evaldas Katilius, Augustinas Babarskas, Povilas Bendinskas Kaunas University of Technology

#### **Solution area**

Engineering, Environment, Health

#### **Description of the work**

These days, due to the continuously rising number of vehicles, expansion of the industry – outdoor and indoor air gets more polluted with various volatile organic compound gases (COX, NOX, etc.), which can result in serious health problems: headaches, breath trail irritation, central nervous system damage and so more. This is when air quality sensors come to help – this device helps to analyze surrounding air by obtaining data from a digital gas sensor and temperature and humidity sensor. Acquired data from sensors is transferred to the user's phone in real-time. In this way, the air quality sensor informs the person that the surrounding area is polluted and suggests leaving the area to prevent any possible health problems. This device is portable, easy to use, and easily can fit in any pocket. User can connect to this device via BlueTooth with the mobile phone's add-on mobile app and have an opportunity to monitor surrounding air parameters quickly.

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

This sensor can identify pollution and, in this way, protects the user from possible danger.

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#### Novelty of the work

By using digital gas, humidity, and temperature sensors, this device can analyse surrounding air. Data is sent via BlueTooth to the user's mobile phone to inform about dangerous gases.

#### The benefits and value to the potential users

The device is easily portable, easy to use, informs about the possible risk of inhaling dangerous fumes and gases and might save from health problems.





### THE DESIGN AND INVESTIGATION OF A CURVILINEAR ADDITIVE PRODUCTION SYSTEM BASED ON INDUSTRIAL ROBOT ARM

**Liudvikas Milkintas** 

Kaunas University of Technology

#### **Solution area**

Engineering

#### **Description of the work**

While most 3D printers are commonly considered 3D printing devices because they print three-dimensional objects, because of the layering that divides an object into parallel planes, conventional printers should actually be called 2.5D. A curvilinear printing system is being developed that avoids the printing of support structures, improves the surface quality and mechanical resistance of printed objects, and could be considered a true 3D printer. Such a system could be applied to the construction sector (printing objects of complex geometry), medicine or even the space industry (printing houses on other planets or rockets). During the work, first the mechanical and electronic components were selected, then the additive production system was designed. The system was implemented using the industrial robot arm ABB IRB 120 and other 3D printer components. The study of the system began with printing in a single plane, then moving to multi-plane and finally to curvilinear. All printed samples were compared with 3D printer samples, their geometrical parameters and surface quality were examined. U L

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

The curvilinear printing system could avoid the printing of support structures (excess material is printed during the support structure printing, which is subsequently removed, the surface quality of the printed parts and support structures in the contact areas is poorer, and parts may be damaged during removal), also mechanical properties could be improved.

#### Novelty of the work

The first companies in the world to use such systems were established in 2015-2017. However, such a system does not yet exist in Lithuania.

#### The benefits and value to the potential users

- Multi-plane printing is not possible with conventional 3D printers, which can improve both the mechanical resistance and surface quality of printed objects.
- Large format printing.



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### PRESSURE-VOLUME CONTROLLER

Eidenis Kasperavičius Supervisor: dr. Dangirutis Navikas Kaunas University of Technology



Solution area

Engineering

#### **Description of the work**

Before designing various engineering structures (buildings) for a particular location, it is necessary to do an analysis of its soil. During the process, the mechanical parameters of the soil are determined, e. g., the relationship between load and stress, behavior under changing pressure or volume, and shear resistance. In order to obtain results which correspond as closely as possible to the actual parameters at the test site, one of the requirements is reliable laboratory equipment capable of recreating these conditions in the sample with required accuracy and repeatability.

The developed system can maintain constant pressure during the test, monitor and store necessary data. It consists of a computer with proprietary software – the main control device; microcontroller to maintain the sample conditions; sensors, which are connected to the microcontroller and measure water pressure in the chamber around the sample (cell pressure), at the top (pore pressure) and at the bottom (back pressure); motor with a screw-nut drive, which changes the volume of the cylinder while rotating – increases or decreases the water pressure.

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

Constant water pressure, maintained in a saturated soil sample, allows engineers to determine its mechanical parameters and the suitability for upcoming construction projects. Thus, budget spent on soil tests before making any designs can reduce the overall cost of the structure and improve its safety.

#### Novelty of the work

Pressure-volume controllers currently available in the market are mostly old, bulky, less mobile or not affordable to the professionals who need such equipment. This device improves on all these aspects, while still performing all necessary functions and being highly configurable.

#### The benefits and value to the potential users

The potential primary users (civil engineers and researchers) benefit from the increased safety and decreased costs of the structures they design while spending a smaller part of their budget on testing equipment. As a result, they provide the same benefits for their clients.



### PROTOTYPE OF A WEARABLE ELECTRONIC SYSTEM FOR MONITORING CHANGES OF HUMAN BODY HYDRATION LEVEL

Rimvydas Eitminavičius, dr. Andrius Rapalis, dr. Saulius Daukantas, Karolina Jančiulevičiūtė, prof. Vaidotas Marozas

Kaunas University of Technology

#### Solution area

Health, Engineering

#### **Description of the work**

Monitoring hydration level changes in the human body is relevant to specific groups of people (e.g. athletes, military, construction workers, drivers, agricultural workers, and the elderly). Conventional methods for assessing hydration levels are not suitable for continuous monitoring due to the use of laboratory tests, e.g. blood, and urine. The system designed in this work is designed to assess the level of human hydration by the bioimpedance method between hands. Bioimpedance analysis is a non-invasive and rapid method of estimating the amount of water in the whole body. Because human water is divided into extracellular and intracellular parts, when measuring bioimpedance, the alternating current propagates differently through these two parts, as the walls of human cells form a capacitive element that changes the current path to high frequencies. A pilot study showed that the prototype is capable of measuring hydration level with an error ranging from -3,25 to 5,29%. The system prototype could be further optimized and miniaturized so that it would be possible to implement it into wearable devices.

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

When you lose just a few percent of your body weight due to lack of water it can lead to a reduced cognitive function, alertness, or training performance. As a result, dehydration is a dangerous problem. On average people in USA drinks only 1.8 glasses of water a day, instead of 8.5 glasses. There are many tests that can be used to detect dehydration, but many of them are not suitable for continuous monitoring. For example, blood analysis methods are very accurate but invasive, which causes inconvenience to repeat the test multiple times. Urine test results are delayed and not suitable for continuous monitoring due to infrequent urination. Body composition scales are most commonly used to assess hydration levels at home, but this is not the most convenient method. Therefore, there is a need to develop a new wearable hydration level assessment system for rapid and accurate measurements.

#### Novelty of the work

Currently, there are no dedicated and clinically valid wearable hydration monitoring systems. This work with our know-how is one step closer to the first medical grade wearable hydration monitor.

#### The benefits and value to the potential users

By monitoring hydration levels during various physically demanding activities, people can prevent diseases and other problems caused by dehydration (e.g. reduced cognitive function, alertness, or training performance as well as fatigue and overall dizziness).

### NOVEL MICROBIOME-BASED THERAPEUTICS FOR MENTAL HEALTH

Šarūnas Bačiliūnas, Anna Chwalibóg

Solution area

Digital solutions, Health

#### **Description of the work**

Integral Solutions is a biotechnology start-up that positions itself as a onestop shop for mental health solutions. The company aims to change how mental disorders are being treated and introduce a new integral approach to mental health. The products and services that the company will be introducing to the market include psychobiotics, psychedelics, diagnostic services and digital tools for improving mental health. The first product the start-up is focusing on is the next-generation psychobiotics developed using CRISPR genome engineering. Psychobiotics are live bacteria that, when ingested in appropriate amounts, confer mental health benefits as a result of interacting within the gut-brain axis. Psychobiotics affect the central nervous system and its related functions via neural, neuroendocrine, immune, and metabolic pathways.

The company's aim is to genetically engineer selected psychobiotic bacteria strains, so they would produce more neurotransmitters, short-chain fatty acids (SCFAs), and anti-inflammatory cytokines, all of which play an important role in neuroplasticity, cognitive functions, mood and motivation.

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

The world is experiencing a global mental health crisis. Mental and behavioral disorders are the leading causes of disability worldwide. They are estimated to cost the global economy 6 trillion dollars per year by 2030. Focus on prevention and early intervention on mental health disorders is not being adopted and patients are receiving treatment often only when serious symptoms occur, like overdoses, suicide attempts, or violent outbursts. The COVID-19 pandemic produced significant implications and negatively affected many people's mental health and wellbeing. New solutions are needed as never before.

With our solutions, we aim to help people suffering from depressive and anxiety symptoms, as well as those who are healthy, but want to increase their well-being on a daily basis. The products under our development will support individuals and their closest environment, but also increase their productivity as employees, positively affecting the global economy.

#### Novelty of the work

Our proposed work is beyond the state of the art, and demonstrates a strong innovation potential. Its impact would be significant.

Psychobiotics niche is still a very young and novel field of research, but it's gaining a lot of attention over the past few years. There are start-up companies and university spin-offs that are using genome engineering in the microbiome field to treat different diseases, yet we would be pioneers tackling mental disorders with such kind of innovation. Our developed bacteria strains will be patentable and would be a strong asset for the company.

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#### The benefits and value to the potential users

We will offer products and services with a holistic and personalised approach to our clients. Our developed solutions will positively affect all human health, without causing disturbing side effects, that current treatments often have. Our products will increase our customers' well-being, work performance, and generally, the quality of their lives. Our offered solutions will be easily accessible, convenient, user friendly and effective.

### PULSETTO

Vitalijus Majorovas, Povilas Sabaliauskas

UAB Pulsetto

#### Solution area

Health, Digital solutions

#### **Description of the work**

Pulsetto – Effortless, easy to use, safe and fast way to lower stress, anxiety and improve sleep. We are developing wearable device and app (vagus nerve stimulator).

The vagus nerve is the longest nerve of the autonomic nervous system, as well as the longest and most complex of the cranial nerves. Consider it as a massive, meandering network of over 100,000 fibers.

Stimulating the vagus nerve increases its activity, resulting in a drop in heart rate, an increase in HRV (heart rate variability), and the activation of the parasympathetic nervous system. This makes you calmer, less stressed, less anxious and results in better sleep.

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

Put it on your neck and forget it! Lower stress, less anxiety just with 4 minutes stimulation a few times per day.

No one is immune to the effects of stress, regardless of their age, gender, ethnicity, or religion.

- 8 out of 10 people are stressed
- One-third of the population has anxiety
- 48% of people have sleeping problems caused by stress

High stress and poor sleep are two main indicators for mental health problems.

#### Novelty of the work

Pulsetto – Only one vagus nerve wearable device on the neck region (more accurate and user friendly stimulation). Beside that, we are creating mobile app which will give user possibility to regulate stimulation intensity, choose specific stimulation program, leave a feedback and etc. Together (app+device) will create unique synergy in order to get results fast and effortless.

#### The benefits and value to the potential users

- Lower stress, less anxiety, better sleep.
- Targeting USA, B2C customers, consumer electronics in the beggining, later on – FDA and medical device.



### Cropland.lt – ORGANIC AND HIGH QUALITY FOOD PRODUCTS WITH WHOLESALE PRICES (B2C MARKET)

Raminta Augustėnaitė, Aurimas Mazūras

#### Solution area

Food, Health, Digital solutions

#### **Description of the work**

Cropland.It is the first membership based organic food eStore in Lithuania. This platform is created for B2C market, where non business customers can find and selected wide variety of high quality eco, bio and healthy products, which are collected from both local Lithuania suppliers and suppliers from all over the Europe. The membership based e-commerce platform is an opportunity for customers to avoid high prices and buy high quality products and avoid high prices. This idea would help to eliminate price differences between products of mass production and organic food.

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

According to Eurostat (2022), Lithuanians on average spend 20.3 percent of their income on food. During year 2021 prices of food in Lithuania grew more than 10 percent (retail price). As we know organic food in Lithuanian market has even higher prices. This tendency marks that organic and higher quality food can be affordable only for customers, who have higher incomes. Cropland.It offers a solution that will help reduce the price difference between simple and higher quality products, in order to enable everyone to buy higher quality food products without any additional charge and eat health-

ier. Another problem that we are trying to solve is to increase consumers' awareness of a healthier diet. Over the last decade, the nutritional value of mass-produced food has become poorer, leading to an increase in the range of nutrients (supplements, vitamins) for well-being and strengthening immunity in people's lives. Therefore, the mission of Cropland.It is to provide an opportunity to purchase quality and nutritious products without any additional charge, and eating healthier food would help supply the body with a larger amount of nutrients. We offer a choice of food, healthier alternatives that would suit even those with limited food tolerance: no added sugar, no gluten, vegan, etc. Our vision is a selection of the highest quality products in one place at the lowest market prices. Reducing the price between organic and healthy products for everyone who wants to live a healthier lifestyle.

#### Novelty of the work

A unique project in Lithuania and other European countries. During the prototyping process (6 months) we reached 200 unique platform users. The idea was communicated for more than 5000 people and the revenue for 2021 years was 50 K.

#### The benefits and value to the potential users

Opportunity to buy the highest quality food products at the lowest market price and find all products in one place, because Cropland. It founders ensure and take care of the selection of a healthy goods basket. A good job is also done with each membership – each bought membership is becoming a gift to a large family. This additional project came with cooperation with the "Association of Large Families in Lithuania".



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### 3DMedix – SMART INTRAVENOUS INFUSION MEASURING DEVICE



Kristupas Suslavičius, Laurynas Mažeika, Rokas Janavičius

Lithuanian University of Health Sciences

Solution area

Health, Engineering

#### **Description of the work**

Drip monitor that tracks drip parameters and ensures that nurses and patients get informed when the parameters changes. By using drip monitor nurses can save time and do other more important tasks. This way the medical sector can save up money by preventing overworking the nurses and the whole staff. If problems occur with the IV system, it increases patient care. With COVID in mind, we can increase the prevention of other airborne diseases by having nurses visit such patients less. By alerting the nurses when needed, the device allows them to do other tasks in the meantime and at the same time prevents airborne disease spread. A drip monitor also helps to avoid accidents where catheter function is disrupted or affected by the patient itself. This way the overall drip efficiency can be achieved.

It is important to mention that our device is required not only in the hospital but also in retirement homes or for those that want to have an IV drip at home as well. It may also be used in surgical departments, where postoperative infections are common. By alerting nurses when needed, they can administer the doses accurately, thus hoping to have a decrease in postoperative infections. It may also help to treat dehydration, blood transfusion, and other illnesses more accurately. As a feature IV monitor helps not disturb patients at night when they are resting and healing but the infusion has to be checked.

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

This problem mainly affects hospitals/nursing homes and patients.

- Hospitals/nursing homes: key reason an ageing population, which tends to lead to older workers and the increasing cost of labour, which reduces the possibility of providing quality services. To resolve that, hospitals should try to optimize the remaining staff's work to reach cost optimization. As time passes, the need for medical staff aiding devices is increasing as one of the solutions to the mentioned problem.
- Patients: The old method of monitoring puts the patient at risk of anxiety, infection, or even death because the procedure is rarely monitored. During COVID it may result in the spreading of the disease. The solution could provide better care for patients.

#### Novelty of the work

- Compared to the most common non-automated method in the world, our device solves all of the above problems for the patient, the nurses, and the hospital.
- Compared to the 5 new devices that are mentioned above, our device uses a different type of technology – tracks sound waves, which is ~2 times more accurate, with 67% less energy consumption, and is 2 times cheaper than IRS by itself. In terms of features, compared to the first three devices, ours tracks the flow time, the volume, and allows us to monitor these parameters in real-time from any location. Compared to the first 3 competitors, our device additionally tracks the remaining drip volume, time and is wirelessly rechargeable.

#### The benefits and value to the potential users

We are developing a device that:

Helps patient:

By sending real-time data to a phone or computer, the device will inform nurses if there are any changes, thus reducing the risk of infection, and U L

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the indication of how much time is left before the end of the procedure will reduce the anxiety of the patient.

Helps nurses:

The device allows staff to directly monitor the drip parameters, so there's no need for constant visits. This allows staff to carry out more important tasks, reduces fatigue, and lowers the risk of disease transmission.

Helps hospitals:

The device will help to optimize the nurse's time, which will save the hospital money and maintain its reputation.



### NeuroEna – GIVING THE POWER OF MOVEMENT FOR PEOPLE WITH NEUROLOGICAL DISABILITIES

Lukas Arlauskas, Viktorija Lileikytė, Olga Skirmantė Vasiljeva, Ugnė Glinskytė, Antanas Ramanauskas

Kaunas University of Technology

#### **Solution area**

Health

#### **Description of the work**

We are creating an exoskeleton, designed to help people with hyperkinetic movements disorders such as dyskinetic cerebral palsy, and other patients suffering from tics and chorea. We are designing the solution in the way that electromyography (EMG), gyroscope and accelerometer sensors would be planted all over the exoskeleton and the inputs will be passed to the artificial neural network to process and determine if the movement is valid or not. If our exoskeleton decides that the movement is not valid, it will try to suppress the movement from happening by inducing opposite force through stimulating the antagonist muscle via neuromuscular electrical stimulation. The garment should be adaptable to various sizes and we understand that not every patient might suffer from the hyperkinetic movements equally, so we decided to design the exoskeleton in a way that would be modular so the excess parts manufacturing would be reduced as much as possible. We have received support from MITA and currently are in the development and testing of our hardware.

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

It solves the hyperkinetic movements disorders for the patients so that they could live their normal lives.

#### Novelty of the work

The novelty is that hyperkinetic disorder would be tracked by artificial intelligence and therefore there would be no need for calibration with physicians. The combination of Al driven detection mechanisms and Al controlled functional electrical stimulation is what allows the solution to be powerful and unique Also it is important to mention that NeuroEna is the ultimate solution which includes the non-restriction of patients mobility and lets the patient set it and forget it.

#### The benefits and value to the potential users

Reduced social awkwardness, better overall physical state, better physical balance, no weird jerky movements.

# GLUTEN INDICATOR

Prakseda Mineikienė, Žydrūnas Gajauskas, Tadas Tracevičius, Dr. Rasa Pauliukaitė

#### Solution area

Food, Health, Digital solutions, Mobility, Interactive and creative society

#### **Description of the work**

In Europe an estimated 1-3% of the population have the celiac disease & people who are gluten-sensitive actually could be about 40%, same in USA. While people consume gluten contained products, even the smallest amount of gluten causes the disease to get worse: dramatic weight loss, vitamin deficiencies, chronic pain, diarrhea, fatigue, indigestion, bloating, facial rash, and so on.

Our main goal is to create an effective, simple and available to public electrochemical biosensors for the monitoring of gluten in the food, therefore people could feel safe.

We will be adapting already verified biosensor platform for glutamate detection and using various technics to work with gluten.

Our device would solve the disadvantages of competing products, such as:

- 1 slow response due to the presence of gluten we will make it 10X faster and save people time and discomfort with gluten;
- 2 using disposable capsules we will not use them, therefore people will save money. This is giving us a significant competitive advantage not only in the Baltics or Europe, but worldwide.

Our IoT device will share the sensor data with a mobile device by connecting "Bluetooth".

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

Gluten intolerant people are avoiding to eat in the public places: restaurants, cafes, schools, even kindergardens.

Moreovere they are avoinding to travel. So they are always stress if they need to eat outside the home.

Our product directly solves the health problems of the target group & helps to avoid many unpleasant symptoms.

The gluten indicator NIMA Partners are currently on the market. The biggest disadvantage of this device is that it is used with capsules & the testing can take 6 to 20 min. and longer. We believe that the gluten indicator should be comfortable, easy to fit in a pocket or handbag, and commonly used to provide a quick response to the presence or absence of gluten in a meal. It is necessary for society. We seek, that adults and children, who do not tolerate gluten could feel safe & calm, could live comfortably and full-fledged life: go to the public places while not being afraid to eat food there.

Our IoT device will share the sensor data with a mobile device by connecting "Bluetooth", and sent information (testing results, catering place) to the cloud. This could create a unified consumer system for identifying catering places where gluten-free food can be obtained.

#### Novelty of the work

The current technology readiness level is TRL 5. The proof is stated in partners FTMC (Center for Physical Sciences and Technology, Vilnius, Lithuania) publication "A strategy to Employ Polymerised Riboflavin in the Development of Electrochemical Biosensors" (for reference DOI: 10.1002/elan.201700218).

The technology was tested in a relevant environment. PRf film was applied in development of glutamate and hypoxanthine biosensors using appropriate oxidases as recognition elements.

We will be adapting already verified biosensor platform for glutamate detection and using various technics to work with gluten. Gluten biosensor will be a completely new product on the market.

#### The benefits and value to the potential users

Innosensus Gluten Indicator opens the way for a person to live a full-fledged life, therefore there will be no complex to use gluten biosensor in the public

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places. Prevent the progression of celiac disease (since the only cure for this disease is a gluten-free diet) and prevent the unpleasant sensations of gluten intolerance while eatinganywhere, anytime.

#### Our gluten indocator - UNIQUE VALUE PROPOSITION:

- An effective: provides a quick, within seconds response (10X faster) to the presence of gluten in a meal;
- 2 Convenient: easy to fit in a pocket or handbag (with a needle-sensor that connects to a smartphone via Bluetooth);
- 3 Non Challenging: reusable, simple, not medical device.

2022- 04- 27 POVILAS \_GRICAS L GLUTEN-LIKE A P PEOPLE I BUYIN CHECK DESEASE GEVTEN MAKE SVR KEIST INNOSENSUS 15 MISTER TO CHECK A SWGLE GREAD CRUM CAN TAKE KEAUSIMAI : FOR A COUPLE OF DAYS SOMEBODY OVT AR REIKIA BRAND ? A GLUTEN-FREE LIPE , PEOPLE PEEL LIVING COLEMPELE MA , HAVE MORE ENERGY AR SENSORIUS TO WORK WITH : HAC BUTI SAUGOMA TURI SALAPS SOLIDS , SAUCES (DANGTELIS ?) PEANUT ALLERCHEN ANE WORSE THAN CELIAC



### SPORT ON THE SPOT

Gintaras Stankevičius, Rokas Miliūnas, Gilbertas Stankus, Domas Jakubauskas, Mindaugas Markauskas, Domas Senkus Kaunas University of Technology

#### Solution area

Health, Interactive and creative society

#### **Description of the work**

"Sport On The Spot" stops are for people who want to enjoy various sports activities without having to buy and carry sports equipment. Sports facilities, filled with various sports equipment that you don't have, can be found at basketball, football, volleyball courts and other sports or leisure venues. At the stops, people would find balls, rackets and other sports equipment they want and need. Borrowing inventory will be easy and simple – all you have to do is present an electronic student card, Lithuanian student card or city card to the station, choose the desired inventory and shortly one of the doors open with the inventory lent to you now you can go, have fun and actively spend your free time.

Our goal – to increase physical activity in our society and to get people used to spending free time in a fun and productive way. We believe that with our idea, this goal is achievable.

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

In these difficult times, we face low levels of physical activity. According to the study of WHO 2020-11-26, more than 80% of the world's adolescents are physically inactive. This does not bypass Lithuania either. According to a 2017 survey by the Ministry of Health of the Republic of Lithuania, the amount of in-active people amongst the population has risen to 51%, and in 2020, according to a survey conducted by the Institute of Hygiene, only

about 13.6% of children are physically active after school (spend at least 60 minutes playing sports). The problem lies in the lack of necessary tools for sports, e.g. rackets or jumpers.

Our idea solves several problems at one time: it involves individuals into physical activity without the necessity to buy required equipment.

#### Novelty of the work

Our project in sports and leisure field with it's purpose will be new, because at this moment there are vending machines that sell sportswear, but does not lend sports equipment.

#### The benefits and value to the potential users

Clients can play/exercise amateurishly without the necessity to buy or carry required equipment.



### DeltaSim – THREE DEGREES OF FREEDOM MOTION PLATFORM PROTOTYPE

Martynas Loveikis Kaunas University of Technology

#### Solution area

Engineering

#### **Description of the work**

With the rapid growth of the entertainment industry's largest gaming sector, advances in technology in recent years have drawn the attention of everyday people to this trend and its emerging potential. In order for the user to create a sensory experience including vision, hearing, touch, and a vestibular sense, the simulation space provides access to an artificial world that is completely controllable. Computer software modeling allows a person to interact with the artificial three-dimensional visual and other sensory environments that are revolutionizing the industry today. The virtual world can be reached with discoveries such as virtual reality goggles and costumes, motion control joysticks, and platforms and countless other devices. Parallel manipulator mechanisms are often used for the aforementioned motion platforms. They can position more accurately, have higher speeds, are more rigidly controlled, and weigh less compared to serial manipulators. Despite the fact that parallel platforms have a limited working area and are more complex in construction, they are among the most popular among motion platforms. Due to the possibilities of different types of construction and the fact that in order to experience the most realistic feeling of the simulated space, it is necessary to simulate the movements as accurately as possible. It is in this project that a platform of three degrees of freedom for a parallel manipulator-type movement is realized.

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

This prototype implements a widely adaptable three-degree motion platform with a simple design using easily available servo motors with encoders.

#### Novelty of the work

The advantage of this prototype over similar motion platforms currently on the market is that it provides a more affordable simulator for consumers. Transmits three degrees of freedom movements and has a wide selection of simulated games, due to the large amplitude of movement.

# The benefits and value to the potential users

With the rapid development of VR technology, motion platforms are helping to become even more immersed in the virtual world. For players looking to physically experience the sensations that gaming triggers, this platform is able to convey the sensations of rising, falling and swinging forward, backward and sideways.



# EXER GALE – EXPERIENCE LIKE NO OTHER

Ugnius Malūkas, Edvinas Danevičius Kaunas University of Technology

#### Solution area

Digital solutions, Interactive and creative society, Health

#### **Description of the work**

Exer Gale is an ethical Virtual Reality (VR) metaverse for VR light and nongamers that increases the degree of immersion, has unique gameplay, and encourages an active lifestyle while addressing physical and mental health issues. This experience is designed together with medical professionals to get the best out of movements used in VR active gaming.

The product focuses on creating a VR experience where people can socialize, challenge themselves or friends by overcoming various tracks, exploring beautiful surroundings, or using meditation to find mental peace. As a result, users of this product can have physical and mental positive change. The product focuses on creating a VR experience that consists of four main features: socializing, challenging yourself or others, exploring beautiful surroundings, and meditating. As a result of using this product, individuals can have physical and mental positive changes.

In this app, you will not find NFTs as the creators of this product believe the NFT is a hoax of the new technology era. In addition to this statement, Exer Gale is considered an ethical metaverse because it integrates ethical ways of monetizing the product.

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

Conducted surveys and analyses showed that even though the number of VR users is growing, many of them stop using these devices because the

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current VR games become repetitive, boring, and the experience devolves after some time. Subsequently, the VR technology enables the possibility to actively spend time through physical movements, however, only a few VR apps utilize these benefits.

### Novelty of the work

Technology novelty:

- 1 Increased VR gaming degree of immersion (through the dynamic & tangible environment, player's physical movements & multiplayer)
- **2** Use unique VR game mechanics (flying and swimming) to play differently than other VR games
- **3** Escape reality by exploring an immersive dynamic environment (most VR games are played on standing in one position in the virtual world)

Novelty for people:

- 1 a positive effect on physical and mental health;
- 2 a preventive measure to avoid disease;
- 3 active leisure;
- 4 assistance in dealing with lack of mobility;
- 5 positive effect on body weight regulation;
- 6 tension and anxiety control.

### The benefits and value to the potential users

The product helps users to have a physical and mental positive change through four modes: socializing, challenge, exploration, and meditation. The socializing and meditation modes emphasize mindfulness, meanwhile, the challenge and exploration – motivate to move physically. The sum of all these benefits gives a user a sense of comfort.



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# **GEIGER** @ KTU

Karolis Šventoraitis, Emilis Radlinskas, Venkatesh Elayaraja, Leonid Mina, Saulė Kulvinskaitė, Lukas Kamarauskas, Dominykas Kandrotas, Aryan Murli, Mantas Pupkevičius, Group supervisor: Benas Gabrielis Urbonavičius

Kaunas University of Technology

#### Solution area

Interactive and creative society, Digital solutions

#### **Description of the work**

In the current times of constant change and uncertainty, society can be affected by many factors, some of which often end up causing fear that stems from ignorance. Radiation safety is one example of this, as it is a ongoing source of tension.

The Geiger @ KTU device developed by our team is designed to increase the awareness of the academic community regarding ionizing radiation and radiation safety. The device provides a real-time indication of the dose rate of the radiation background in  $\mu$ Sv/h using a classical detection system based on a Geiger counter. The display used to present the data is mounted on a special mobile stand, thus making this background radiation dose rate measuring instrument easily transferable to different rooms or locations. There are no other such devices available in Lithuania for localized measurement and indication of background radiation levels.

The device can also be used for research purposes, as the background radiation level recorded at different points in time is stored in the device's memory and its trend is displayed on the device's screen.

The software and hardware allow the development of a swarm of such devices to monitor background radiation levels over an extended area using the Internet of Things principles. U L

All original components and software of the device are based on open source principles. The models for 3D printing and the software are available on the project's GitHub space.

One of the devices was officially unveiled and is running 24/7 in the lobby of the second floor of the Faculty of Mathematics and Natural Sciences, Studenty str. 50.

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

The device raises public awareness towards the radiation protection and draws attention to issues related to this field.

#### Novelty of the work

It is the first product of its kind in the country to allow real-time localized monitoring and visualization of radiation background in public places.

#### The benefits and value to the potential users

It draws public attention to the importance of radiation protection and the existing radiation background at the site where the device is installed.



# TÁBULA RÁSA | AN INNOVATIVE MARKETPLACE FOR TEACHERS WWW.TABULARASA.LT

dr. Rasa Mardosaitė MB Tabula rasa projektas

#### Solution area

Digital solutions, Interactive and creative society, Environment

#### **Description of the work**

Sharing is caring – this is the background of TÁBULA rása innovative edtech idea for Lithuanian teachers.

www.tabularasa.lt is an online marketplace for Lithuanian teachers to buy and sell (share) their original digital educational materials. With a goal of expanding the database of Lithuanian digital learning materials, www.tabularasa.lt is created as an online space (e-platform) for Lithuanian teachers to easily join their community and continuously upload their own or buy and download digital learning materials from their colleagues. We control the content with the categorisation: there are more than 600 categories in this platform prepared according the latest Lithuanian education curricula.

As www.tabularasa.lt wants to make an impact on educational innovations and modernized national teaching strategy, we are seeking to discover powerful insights hidden in our data. We are monitoring and analysing teachers, as consumers: metrics such as products, registrations, sales, user experience indicators or purchasing habits can be analysed for the first time in our educations system. For example, we already have 5,000 registered users, there are more than 1,500 products loaded on the platform and they have

been downloaded 52,000 times. Our data shows the tendency for teachers in Lithuania to be very interested in sharing and paying for digital learning materials. We strive for sustainability and environmental awareness in order to achieve a Zero Paper policy in our idea. By enabling the community-based sharing of digital files, we can greatly reduce the use of excess paper in the teaching process.

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

There are the number of underserved needs (problems) of our customer segment, i.e. Lithuanian community of educators (teachers, tutors, lectors, students, parents):

- There is no inspiring sharing place (hub) for Lithuanian teachers, to share their digital learning materials that they have already prepared and used in their class;
- There is a lack of Lithuanian modern & digital learning materials prepared and available 24/7;
- Lithuanian teachers feel they are earning not enough money in their professional field;
- Lithuanian teachers lack of self-confidence to use digital tools;
- Preparation of new digital learning materials is a time consuming process for teachers.

In addition to the marketplace, users of the e-platform receive attentive customer service and tips on how to digitize content, increase sales, define copyright, and provide layout / design assistance.

We strive for sustainability and environmental awareness in order to achieve a Zero Paper policy in our business model. By enabling the community-based sharing of digital files, we can greatly reduce the use of excess paper in the teaching process.

#### Novelty of the work

www.tabularasa.lt is an edtech social innovation Start-up. TÁBULA rása is the first national online marketplace & community (hub) for teachers based on Lithuanian curricula, where local educators can share digital learning materials between each other. The platform can reduce the level of stress between educators and allow them to generate additional incomes.

As www.tabularasa.lt want to innovate and modernize national teaching strategy, we are seeking to discover powerful insights hidden in our data. We are monitoring and analysing teachers, as consumers: metrics such as registrations, sales, user experience indicators or purchasing habits can be analysed for the first time in our education system. For example, we already have registered 5,000 users, 10% of whom are creators who sell their own digital products. There are more than 1,500 products uploaded on the platform and they have been downloaded 52,000 times. Our data shows the tendency for teachers in Lithuania to be very interested in sharing and paying for digital learning materials.

#### The benefits and value to the potential users

Our value proposition is:

- 1 to be an online marketplace based on Lithuanian curricula, where local educators can share (sell and buy) original digital learning materials between each other:
- 2 to let educators earn extra money in their professional field;
- **3** to expand the database of Lithuanian digital learning materials;
- 4 to allow educators save their time without developing new digital learning materials on a daily basis;
- 5 to reduce the initial level of stress between educators.



# COMPRESSION FULL LEG SLEEVE WITH ADHESIVE STRIPES TO INCREASE ENERGY EXPENDITURE DURING PHYSICAL ACTIVITY

Ana Černiavskaja, Kristina Ancutienė, Vilma Juodžbalienė

Kaunas University of Technology Lithuanian Sports University

#### **Solution area**

Health, Digital solutions

#### **Description of the work**

Athletes carefully choose sportswear, considering not only the design, comfort characteristics, but also its impact on physical performance during workout. Using adhesive technology in clothing designed to be worn for sports, exercise, and outdoor activities creates resistance to certain movements, which can increase energy expenditure during physical activity.

Graduated compression full leg sleeve with polyurethane adhesive film stripes was designed with the aim to increase energy expenditure performing exercises involving a squatting action. Virtual garment simulation using digital 3D prototyping software and cyclic tensile testing have shown that the use of adhesive polyurethane stripes increases the tensile strength of the material several times over. Each movement of the leg increases the involvement of the muscles against the strength of the adhesive stripes and improves the performance of the workout. While graduated compression improves blood circulation, reduces limb swelling and fatigue during and after workout, ensures quicker post-workout recovery.

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Making physical performance more efficient can contribute to preventing diseases caused by lack of physical activity. Compression full leg sleeve with adhesive stripes is suitable for individuals of all physical fitness levels and could contribute to higher energy expenditure.

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

Leisure inactivity and sedentary behavior at work and at home cause a decrease in physical activity and can lead to higher rate of heart and other diseases. People can increase energy expenditure in their daily activities by using sports and leisure clothing that increase calorie burning.

Techniques to increase muscle engagement and make training more effective by adding weight panels or attaching elastic bands are widely used among athletes. This type of resistance suit is difficult to wear for ordinary people during daily workout. Compression full leg sleeve with adhesive stripes can increase muscle engagement and workout intensity by creating resistance to movement. This type of garment is more comfortable to wear and can be used not only during workouts but also in everyday activities such as housework, walking with the dog, gardening, etc.

### Novelty of the work

- Sewn sports and leisure garment with adhesive stripes. Mostly graduated compression garments with areas of different stretch are produced using knitting technology but not reinforced with adhesive stripes.
- Resistance sports and leisure clothing for everyday workouts, comfortable to wear for ordinary people of all levels of physical preparation.
- Using adhesive technology for designing resistance sportswear and activewear to increase energy expenditure.
- Use of 3D virtual prototyping in product development process to improve compression properties and analyze tensile load during exercise.

### The benefits and value to the potential users

- Athletes and sports enthusiasts can improve training efficiency and achieve better results in less time.
- Ordinary people can have a more efficient workout and higher energy expenditure in daily activities.

- Overweight and obese people can use it for weight losing and more efficient calorie and body fat burning during a workout and daily routines.
- Patients during rehabilitation after illness or injury while having problems with pain or movement, can use it to achieve physiotherapy goals faster by doing exercise more effectively.



Compression Full Leg Sleeve with Adhesive Stripes to Increase Energy Expenditure during Physical Activity

Kompresinė blauzdinė su klijuotinėmis juostomis siekiant padidinti energijos sąnaudas sąnaudas fizinės veiklos metu

> Adhesive polyurethane film stripes / Klijuotinės poliuretano plėvelės juostos Knitted fabric / Megztinė medžiaga



Gaminio deformacijų žemėlapis išilgine ir skersine kryptimis



# BIORENEWABLE PHOTORESINS FOR NANOIMPRINT LITHOGRAPHY

Justinas Jaras, Auksė Navaruckienė, Edvinas Skliutas, Jurga Jeršovaitė, Mangirdas Malinauskas Group supervisor: Jolita Ostrauskaitė

Kaunas University of Technology Vilnius University

#### **Solution area**

Engineering

#### **Description of the work**

In this work, a team of chemists and physics developed a series of photoresins composed of biorenewable materials and tested them by a microtransfer molding ( $\mu$ TM) technique, or nanoimprint lithography, for making replicas. Samples of these biorenewable materials can pe photopolymerized and their mechanical properties can be adjusted. By just changing one's component's quantity we can make our sample hard or flexible. Similar products like this can be used for strengthening construction materials, in medical use for bioimplants or used as memory shape polymers for various applications which requires flexibility like marine propellers. Nanoimprint Lithography – versatile technique for nanofabrication of a wide range of micro- and nanostructures and devices. It offers the ability to fabricate nanostructures that exhibit vertically aligned nanoarrays and nanopatterns, precise control over size and geometry, and form nanostructures attached to a bulk support. The main advantage of the  $\mu$ TM technique is its fast, easy, and inexpensive, yet accurate reproduction of various 2D or 3D objects from nanoscale to macroscale. The

use of resins composed of biorenewable materials in nanolithography is still limited, but it is very encouraged toward use of more environmentally friendly materials. Moreover, photocuring is also a green energy source alternative to traditional synthesis, and it practically emits zero waste.

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

Synthetic petroleum-derived photoresins are replaced by environmentally friendly photoresins composed of biorenewable materials. Moreover, the ability to form micro- and nanopatterned structures with novel features and properties that have a high potential in a wide range of applications is offered. Nanoimprint litography is much more efficient technology than other litography techniques. For example, photolithography requires expensive aparatus and resin prices are big. Electron flow lithography is also expensive technique requires a lot of time and qualified personel.

#### Novelty of the work

The creation of photoresins from biorenewable materials with novel features and properties for environmentally friendly nanofabrication technique – nanoimprint lithography.

#### The benefits and value to the potential users

This is beneficial for production single-disposal or short-term usage of micro- and nanopatterned structures like microfluidic circuits, marking signs for packaging, and holograms for authorization security applications. It offers a sustainable route for exploiting biorenewable materials to replace established commercial photoresins applied in stamping technologies that are already being scaled up for cost-efficient everyday use.



# **F-36 ANTI-DRONE SYSTEM**

Rokas Stankus, Žygimantas Gaidauskas

MB Sprendimai pramonei

Solution area

Defence

#### **Description of the work**

F-36 counter drone system designed for drone detection, verification, and neutralization. Anti-drone system based on visual object tracking, detection and moving object recognition. System works full automatic and manual modes. Website – f36.lt

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

The anti drone system protects the airspace of mass crowd events, sports events or even military objects from drone attack or spying. This system can deactivate the drone while it does not reach the target.

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Technorama

#### Novelty of the work

Products with only video recognition is the new in the market, most of competitors are in the prototype stage.

F-36 is unique because of:

- Sky tracking solution it uses only high resolution and wide angles cameras to detect moving objects.
- All in one turret recognition, tracking and jamming system.
- Requires only Ethernet and 110/230VAC connections.
- Control through WEB application.

### The benefits and value to the potential users

In autonomous mode F-36 can detect and deactivate drone automatically. No need to pick up the manual jammer to deactivate drone.



### KAIP



Karolis Žukauskas, Michele Marchi, Darya Maniuk, João Borges Group supervisor: João Santos

Aveiro University Kaunas University of Technology

#### Solution area

Environment, Digital solutions, Interactive and creative society

#### **Description of the work**

KAIP is an app that would teach people about the consequences of not recycling. This app will also have the possibility to locate the recycling bins and centres in the Kaunas region as well as be able to ask questions in our discussion platform.

KAIP app would explain the basics of recycling and composting to the population of Kaunas. One of features, the games, would incentivize children to play and install the app and would be teaching them important information that most of their parents do not acknowledge, just yet. The discussion platform is useful to connect users. The food waste share platform would not only help a lot of farmers but also the local economy because industrialized fertilizers would no longer be that needed.

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

We solve the issues regarding, recycling, composting, and learning (teaching one another). The issue is meant to the households in the Kaunas region but can be spread to local farms and the cities in general. With the creation of this prototype, we would be able to understand the bigger doubts of the population about this issue (recycling and sustainability). U L

#### Novelty of the work

Teaching people how to care for our earth. This prototype will provide not only the adults to learn more about sustainability and recycling but also for kids to start learning something while playing games in our sub-platform for recycling games. Even though there is plenty of recycling games on the market, our app is the first to add both fun and learning material in an interactive way.

#### The benefits and value to the potential users

They can not only learn more about recycling, but they can ask questions on the app's form and answer, creating a loop of teach-learn. Sharing some ideas and opinions to get closer to a better future.

### **KaunARtic**

Kabilan Anbazhagan, Narmin Aliyeva, Prithivi M'samy, Girinath Anandhan, Lukas Arlauskas Kaunas University of Technology

#### Solution area

Digital solutions, Environment, Mobility, Interactive and creative society, Health

#### **Description of the work**

The project area of focus is augment reality in urban spaces and to generate cash flow for future public infrastructure development. It utilizes the existing art hotspots around a city and creating new hotspots in urban area by introducing 3d augment reality, these art features added to the urban space generate cash flow by using the concept of Non fungible token system (NFT). The profit from the sales of NFT would benefit the artist, KaunARtic and the government whose share would in turn fund the development and create new public infrastructure like bicycle lanes, pedestrian pathways, seatings area, viewpoint etc. Solving the connectivity and accessibility issues in existing urban fabrics also it gives solution to the issue of generating public funds for public infrastructure and creates new landmarks with low investment and less intrusive development into the urban space. This brings in the government to work in crypto environment which would benefit their adaption to the system and regulate laws in favor of crypto currency.

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

It solves public infrastructure issues by generating cash flow, and work around existing infrastructure and hotspot of a city. It increase accessibility, archives and promote new artistic works. V T V

#### Novelty of the work

This method of business model is new, and there are very few not so similar model to compare and evaluate cause it involves NFT which is a recent concept of business, added along with the factor that digital art works are being physically related.

#### The benefits and value to the potential users

It benefits the users in terms of a value investing opportunity since it adds a unique feature of being the NFT showcases in urban places and to work for a good cause of developing a city. It also benefits the users of public infrastructure, giving more access, landmark and connectivity.

# PANDORA'S BOX: AN OPEN-SOURCE DATA ANALYSIS TOOL

Danguolė Kalinauskaitė, Milita Songailaitė, Justina Mandravickaitė, Dovilė Kuizinienė, Akvilė Landaitė, Paulius Savickas, Monika Briedienė, Tomas Krilavičius

Vytautas Magnus University MB Lingo data

#### Solution area

Defence, Digital solutions, Engineering

#### **Description of the work**

Pandora's Box is an open-source data analysis tool that combines visual analytics and network analysis techniques. The solution is intended to help efficiently automate such processes as data sorting, ranking, relation detection, visualization, etc., using data filtering, visual analytics, and network analysis methods. Pandora's Box works as a tool for cyber security and enables multi-level analysis of the relations between data from different sources.

We illustrate the functionalities of the solution using the case of Lithuanian offshore business data, namely, companies and individuals found in offshore documents, as one of the instances of how Pandora's Box can be applied for supervision and monitoring of financial space to automatically detect the relations between different entities. As such, the tool would be valuable for the organizations that are interested in identifying various business relationships. However, given that it is an early prototype, it can be developed, expanded, or adapted for the analysis and visualization of different data, regardless of the language, using data augmentation. Moreover, the functionalities of the solution can be expanded including more levels of data analysis, different data sources or data attributes. One of the cases illustrating other adaptations of Pandora's Box is the detection of one country's relations with

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those that are unfriendly to it and the identification of the dynamics of those relations. The final solution should be based on artificial intelligence.

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

One of the main problems data analysts face these days is large amount of data and many available data sources with different structures and different logic of data presentation. This has led many data analysts to inefficient work: a lot of work needs to be done manually in order to prepare cases for analysis, because existing solutions for data processing are not able to analyze data in specific languages, such as Lithuanian. Given that data analysts usually work with messy data, it takes a long time to prepare data for analysis, which makes the process inefficient. Our solution allows to automate different stages of data processing and analysis.

#### Novelty of the work

In contrast to other solutions most of which work only for English language, Pandora's Box is applicable to Lithuanian language, therefore it can be used for Lithuanian data. Moreover, data augmentation could be used to adapt the tool for applications in different areas and languages as well. To the best of our knowledge, there is no other such universal open-source data analysis solution with similar broad scale of its possible applications.

#### The benefits and value to the potential users

Ability to detect invisible relations, quickly identify relevant actors and their activities, visualize such relations, actors, organizations, flows, etc.



# **TECHNORAMA'22** OVERVIEW

TECHNORAMA is the traditional exhibition-contest organized by Kaunas University of Technology (KTU), which has been bringing together innovators students, science representatives, and new technology enthusiasts - in one place for two decades.



#### Number of TECHNORAMA 2022 solutions in thematic area



Notice: one solution can fall in several categories of thematic areas



#### Technological readiness level of TECHNORAMA 2022 innovations

2022

### Let's contact:



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