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UNIVERSITY OF MEDICINE, PHARMACY,
SCIENCE AND TECHNOLOGY
OF TARGU MURES

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AIR QUALITY ASSESSMENT INSIDE THE ORTHOPEDICS-TRAUMATOLOGY DEPARTMENT

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Background: In the Targu Mures County Emergency Clinical Hospital, indoor air quality is monitored in the operating rooms, out-patient care rooms, and wards. The overall levels of air pollutants are increasing.

Objective: The objective of this paper is to evaluate the air quality inside the different compartments of the Orthopedics- Traumatology I Department and to compare it with air quality indices in other departments of the hospital.

Material and methods: With the support of air quality sensors connected to a uRADMonitor SMOGGIE device, between March 1 and 15, 2023, we prospectively measured the air quality in the different compartments of the Orthopedics-Traumatology Department: ward, emergency room, out-patient care room, operating room. These areas are located on different levels of the hospital: ward on the 3rd floor, emergency room on the ground floor, out- patient care room on the 1st floor, operating room on the 2nd floor. It was assessed particulate matter <2.5 mm in diameter (PM2.5), carbon dioxide (CO2), volatile organic compounds (VOCs) and nitrogen dioxide (NO2) concentrations. It was evaluated the effectiveness of the intervention between orthopedic compartments that use air purifiers and those that do not use such devices.

Results: The general concentrations of CO2, VOC and PM2.5 in the Orthopedics-Traumatology I ward were significantly higher than those in the out-patient room. Indoor air quality was worst during periods of low temperatures when the heating system was operating. In spaces that use air purifiers the concentration of PM2.5 is lower.

Conclusions: The medical staff, as well as the patients, are frequently exposed to indoor air pollution in the Orthopedics-Traumatology I Department. Therefore, in these areas of the hospital, it is necessary to adopt health-related strategies to protect against indoor ambient air pollution.

Keywords: orthopedics-traumatology, volatile organic compounds, nitrogen dioxide, carbon dioxide

DETECTION OF CLOTS IN HEMATOLOGY TUBES BY ULTRASONOGRAPHY

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Background: Blood clot formation in hematology samples is a common occurrence in medical laboratories. Even a small clot in the sample tube can disrupt the accuracy of hematological investigations. Hematology analyzers can signal the presence of a clot during sample aspiration, but there are cases where tubes containing microclots may not be detected by the analyzer, leading to unreliable results.

Objective: The aim of the study is to create a setup to detect the presence of blood clots using ultrasonography. In addition to detecting blood clots, the setup should be capable of measuring the volume of the blood sample to confirm correct blood collection.

Material and methods: To ensure homogeneity of the hematology tube before ultrasound scanning, a stand was created. The ultrasound scanning head was mounted vertically on a small platform that holds the tube support. The transducer is placed in a way that it touches the bottom of the tube after it is placed in the holder. The platform was secured on the axle of a stepper motor, which was driven by an Arduino module. The stepper motor performs a 0 to 130 degree up-down rotation 10 times to ensure sample homogeneity. The GS200i laboratory ultrasonographic echoscope was used for signal generation and acquisition in mode A, using a 4MHz transducer. The A-scan, together with trigger signals gathered from the echoscope, were acquired using the same Arduino module, where they were further processed.

Results: Six sample tubes were prepared for measurement: three containing only water with different volumes, and three containing water with a rosin clot of varying dimensions. The clot was detected immediately after the last down-to-up movement was finished, where we measured a small amplitude moving from right to left. From the signal amplitude, we calculated the volume of the clot. In samples containing only water, the system did not detect any amplitude change. By measuring the time elapsed until the highest signal amplitude, we were able to calculate the exact volume of liquid in the sample tube. **Conclusions:** Using a clot scanning device as part of the preanalytical process for hematology sample tubes could be a beneficial approach for ensuring high-quality results. Although, using ultrasonography gel between the transducer and sample tube could pose challenges in routine laboratory workflows. Further research is needed to find ways to address this issue and make the use of clot scanning devices more feasible in practical settings.

Keywords: blood clots, ultrasonography preanalytical, hematology results

ULTRASONOGRAPHY AS A "REAL TIME" COMPONENT OF MODERN MINIMALLY INVASIVE PROCEDURES IN PHLEBOLOGY

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Background: Minimally invasive medical and surgical procedures in phlebology are the future of many diagnostic and treatment protocols. Ultrasonography is a non-invasive procedure performed "real time" and can be recorded for further analysis and evaluation. It allows highly accurate visualisation of both the morphological features being addressed and the minimally invasive instruments introduced into the body under visual control

Objective: The objective of this paper is to demonstrate the usefulness and development prospects of ultrasonography in minimally invasive medical and surgical procedures.

Material and methods: We will present the echogenic puncture approach to superficial veins in endovenous laser treatment (endolumenal photo-thermoablation with 1470 nm diode laser) of varicose veins of the lower limbs, respectively echogenic sclerotherapy (intravenous injection of a sclerosing agent - Etoxysclerol) of varicose bundles. For the visualization of anatomical elements and instrumentation related to minimally invasive procedures we used linear transducer ultrasonography machine (8-10 MHz) in Doppler Duplex and B-mode. Theoretical documentation and practical registration were performed in the operating room, Angio Center for Vascular Medicine, Târgu Mureș.

Results: We conducted an analysis of 50 clinical cases with varicosity of the lower limbs. Each individual patient was previously investigated by Duplex Doppler ultrasonography, with mapping of the deep and superficial venous system, creating a schematic map for minimally invasive therapeutic compliance. We recorded and analyzed procedures with ultrasonographic guidance. We documented the evolution of resolved cases and compared with data from the literature in the field. In all cases we used linear transducer (10 MHz). Ultrasound-guided puncture approach was performed in all cases (100%). Ultrasound fiberoptic (laser) guidance was performed in every patient, stepped vein approach was required in three cases (6%) due to the sinuous trajectory. Echogenic puncture sclerotherapy of varicose bundles was performed in all cases without incidence (100%).

Conclusions: 1. Ultrasonography is the main "real time" component indispensable in minimally invasive procedures. 2. Ultrasonography ensures the accurate and safe performance of modern minimally invasive techniques applied in phlebology. 3. It is

a non-invasive procedure that is easy to perform and can be repeated as needed without risk. 4. Ultrasonographic guidance in the cases studied was 100% successful compared to the empirical clinical approach, with 82% accuracy.

Keywords: ultrasonography, ultrasound guiding, minimal invasive procedures

EXTERNAL DEFIBRILLATOR WITH AUTOMATIC SYNCHRONIZATION USING THE LATEST TECHNOLOGIES IN BIOSIGNAL ACQUISITION

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Background: Ventricular fibrillations are the most common cardiac rhythm abnormalities and can endanger the patient's life. Restoring normal rhythm is primarily achieved with the help of an external defibrillator, preferably using a biphasic waveform.
Objective: The aim of the study was to create an external defibrillator that acquires and processes the ECG signal obtained from a biosignal simulator, then discharges a biphasic truncated exponential (BTE) wave during the QR interval.
Material and methods: The device consists of two main parts: an ECG acquisition board and an electrical discharge board. To acquire the ECG signal, an Arduino board was used in tandem with a MAX30001 development board. An Arduino code was written to process the ECG signal and display both the processed signal and impedance values obtained from the FLUKE Prosim 3 biosignal generator. The device uses the last five detected QRS intervals to predict the sixth QR segment and trigger two discharge commands via two digital pins. The first discharge signal generates the positive biphasic truncated exponential (BTE) wave, while the second generates the negative wave. To ensure safety, the discharge energy is kept at a magnitude 100 times lower than the typical energy levels used in defibrillation. A table is used to determine the charging energy for the energy storage capacitor (ESC) and calculate the discharge time based on known correlations between patient impedance and discharged energy. The ESC charging magnitude and discharging circuit are organized in a H-bridge using IGBT transistors and are simulated in the Infineon SPICE environment for different patient impedances.
Results: The system was tested using the Fluke Prosim 3 patient simulator, which generated various ECG waveforms ranging from 60-200 bpm, with or without artifacts. The system successfully detected the QRS complex and triggered the discharge on the next predicted QR segment. The energy storage capacitor (ESC) was discharged through a 0-580 ohm rheostat, which was also used to simulate the patient's impedance. The measured time and energy were in accordance with the values in the implemented table.
Conclusions: The developed setup successfully acquires and processes ECG signals, generates discharge profiles based on patient impedance and delivers the required energy according to the implemented table (100x lower for safety). It has been tested only on healthy ECG signals. The setup can be used to study various

discharge signals, gain a better understanding of biomedical signal processing and generate different discharge profiles.

Keywords: defibrillation, ECG, biosignal, discharge

MANAGEMENT OF DIABETES THROUGH DIET USING INTERACTIVE GRAPHICAL USER INTERFACE

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Background: Diabetes mellitus (DM) is a chronic disease that affects both adult and pediatric patients, characterized by insulin resistance and the development of hyperglycemia, with obesity and a sedentary lifestyle being significant risk factors. **Objective:** The aim of the study is to develop an interactive program that will assist DM patients in closely monitoring their blood glucose levels, insulin dosages, dietary regimen and calorie calculations, routine tests, physical activity levels, and ultimately in generating periodic progress reports.
Material and methods: The device contains software with the capacity to store demographic patient data for daily monitoring of food intake, blood glucose levels, and reminder for insulin administration if necessary. The study was conducted on two sedentary adolescent patients diagnosed with DM. The study spanned two weeks, during which the device was used throughout the day. Selecting the food type from the system menu, generated suggestions for substitutions, if necessary, the number of calories, and the number of macronutrients for the selection made, and warned patients about any potential risks they may be exposed to. The HMI (human-machine-interface) software displays food images and macronutrient values on a capacitive touchscreen when patients select their desired food items from the device's memory. It also generates graphs based on glucose levels and physical activity data to facilitate comprehensive condition management. **Results:** It was observed that the patients were able to maintain consistent glucose levels and experienced a significant improvement. Additionally, it was found that the patients became aware of the importance of nutrition and gave up unhealthy food choices, opting instead for healthier food options.
Conclusions: These results suggest that dietary intervention can be an effective strategy for improving the health of patients with glucose problems and promoting a healthy lifestyle. The results obtained in this study show that the interactive device developed can be a valuable tool for managing DM. Patients can gain a better understanding of how their lifestyle affects their health. However, it is important to consider that this study was conducted on a small number of patients over a limited period, so further research is needed to validate the results and evaluate the long-term effects of device use.

Keywords: hyperglycemia, sedentary lifestyle, human-machine-interface, diabetes mellitus

MECHATRONIC SYSTEM FOR ORTHODONTIC CLASPS CREATION

Ștote Claudia-Iulia[1], Bordianu Georgiana, Albert Zsolt Barabas[1]

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Background: Orthodontic clasps are anchoring elements required in mobile orthodontic appliances, forming a stable and secure point of support. In the absence of these clasps, the functionality of the orthodontic appliance may be affected, which can compromise the approach to patient cases. **Objective:** The aim of the study is to build a mechatronic system able to automatically bend orthodontic wire based on predefined models. Currently, the only way to create orthodontic clasps is through a manual process. Given the variety of models, technology can be used to assist technicians by automating the process of creating the clasps using an automatic device.

Material and methods: The system was composed of a Straightener for straightening and removing the initial curvature of the orthodontic wire; Feeder, which pulled the wire from the coil into the Straightener, and pushed it towards the Bender; Bender, which was responsible for bending up to ±130 degrees with a minimum radius of 1 mm on the Y and Z axis according to the selected model. All movements were performed using stepper motors. The program for motor control had been developed on an Arduino interface.

Results: The distances, the angles, and the coordinates were measured manually on a gypsum model and entered into the software that controls the motors. A low-complexity clasp model was chosen, and it was repetitively created five times by both the device and two technicians, a beginner one and an experienced one. We evaluated the minimum, average, and maximum time required for creating a clasp, as well as its quality. For this purpose, we used a numerical scale from 1 (least suitable) to 5 (most suitable). The results showed that the average time of the device was 28 seconds, the time required by the first technician: 17 minutes and 20 seconds, and the time required by the second technician: 4 minutes and 15 seconds. The quality of the models created by the first technician was on a scale of 3, by the second technician: scale 4.5, and by the device: scale 4.

Conclusions: The automatic system can reproduce the chosen model with the same fidelity as an experienced technician, but in a much shorter time. The disadvantage is the additional time required to create the program for the model, but this device can become an indispensable companion in orthodontic laboratories.

Keywords: Orthodontic clasps, Mechatronic system, Automation

DEVELOPMENT OF A SIMULATED INDUSTRIAL PROCESS CONTROLLED WITH PLC

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Background: Industrial processes are essential in the production of goods and services, and their control is vital for obtaining quality products and reducing costs and risks. An efficient way to control an industrial process is through a programmable logic controller (PLC), which is an industrial automation solution. The development of a simulated industrial process controlled with a PLC is a complex process that involves creating a PLC control system, integrating it into the industrial process, and simulating it to test the functionality and effectiveness of the system. This process can be used to improve existing industrial processes or to develop new processes.

Objective: Within this process, the PLC is programmed to monitor and control various aspects of the process, such as temperature, pressure, liquid level, or rotation speed. PLC programming involves defining a list of instructions to control inputs and outputs and make decisions based on them.

Material and methods: The material and method for developing a simulated industrial process controlled with a PLC involves the following steps: Identification of the needs and objectives of the industrial process - in this phase, the needs of the industrial process are established, and the objectives and performance requirements of the control system are identified. Design of the PLC control system - this phase involves the design of the PLC control system, including the selection of PLC components, sensors, and actuating devices. The programming language to be used in the PLC is also decided upon. Programming of the PLC - this phase involves programming the PLC to control the industrial process according to the requirements established in the design phase.

Results: To provide the results obtained by developing a simulated industrial process controlled with a PLC, the control system objectives and performance criteria established in the design phase must be specified. Generally, the control system objectives are to improve efficiency and reduce errors and defects in the industrial process. The results obtained by developing a simulated industrial process controlled with a PLC include: Precise control of the industrial process - the PLC can control the industrial process with high precision, thereby minimizing errors and defects in the industrial process.

Conclusions: In conclusion, the development of a simulated industrial process controlled with a PLC is a complex and important process for improving industrial

processes. This process involves PLC programming, integration into the process control system, and simulation to verify its functionality and effectiveness.

Keywords: PLC, JavaScript, Node-RED, Simulated process

EVALUATION OF INTENTIONAL TREMOR USING SEMG

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Background: An intentional tremor is a type of tremor that occurs during voluntary movements, such as reaching for an object or writing. It is also known as an action tremor or kinetic tremor. Intentional tremors are typically characterized by rhythmic oscillations of a limb or body part during purposeful movements. The tremor may be mild and barely noticeable or severe enough to interfere with daily activities. It is often exacerbated by stress, anxiety, or fatigue. Intentional tremors can be caused by a variety of factors, including neurological conditions such as multiple sclerosis or Parkinson's disease.

Objective: The aim of the study is to use surface electromyogram (sEMG) to record muscle activity, which can be used to assess intentional tremor. These objectives include: identifying and locating the muscles involved in tremor, measuring the degree of muscle activity, assessing the severity of the tremor and monitoring the progression of the tremor.

Material and methods: To evaluate the intentional tremor using sEMG, the AD8232 frontend was used. The AD8232 is an integrated signal conditioning block for ECG and other biopotential measurement applications. It was designed to extract, amplify, and filter small biopotential signals in the presence of noisy conditions, such as those encountered in clinical environments. sEMG signals were acquired from five muscles: Flexor Carpi Radialis (FCR), Flexor Carpi Ulnaris (FCU), Extensor Carpi Radialis Longus (ECRL), Extensor Carpi Radialis Brevis (ECRB) and Extensor Carpi Ulnaris (ECU) from the left forearm using five Bitalino EMG modules. The modules were arranged in on a flexible bracelet for comfortable use. The signals were processed using Bitalino MCU module and sent via Bluetooth to a PC where they were plotted using OpenSignals software. Each signal was named according to muscle abbreviation. The presence of motion and its motion frequency, amplitude, and duration were recorded and further analyzed.

Results: sEMG signals from the left forearm of a healthy subject were acquired from FCR, FCU, ECRL, ECRB and ECU muscles. The subject was instructed to perform different wrist movements, mimicking intentional tremor with different frequency and intensity. Evaluating the resulting signals we could measure the frequency, intensity and motion pattern of the studied muscles. **Conclusions:** This paper proposes an approach to analyze the muscles involved in intentional tremor and their parameters, including frequency, intensity, and pattern. The findings of this study may prove useful in measuring the effectiveness of treatments for

intentional tremor.

Keywords: intentional tremor, sEMG, biosignals

THE IMPORTANCE OF CAPACITY MANAGEMENT TO ENSURE PRODUCT QUALITY IN AN INDUSTRIALIZATION PROJECT

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Background: The quantity and quality of products is influenced by various factors which may be related to the companies' internal decisions or customers requests. The flexibility of the modern world and the uncertainty after the pandemic have also influenced the agreements between the companies (supplier-company-customer). How is this correlated with the process of manufacturing? When a random company wins a contract with a specific customer and in there it is mentioned some defined quantities necessary/year then that company digs deeper internally and finds the right machines and methods to achieve those quantities. All should be fine but as mentioned before there is a flexibility written down in the agreement even if there is mentioned a fixed/maximum quantity requested. This flexibility is defined as a percentage which can be above or below the fixed volume in one year. As an example, it can be: 30% more. This increase of volume will make the company which produce find other ways to deliver the requested amount. They are struggling to push the people, to improve the machine OEE, to improve the process flow and why not to use some other equipment after checking with the customer. But all of these may have a direct impact on the quality of the products because at that moment the focus is switched from quality improvement to the output improvement/increasing.

Objective: The purpose of this analysis is to demonstrate that the capacity of a production line is a very important aspect for every company and may have influence on the quality of the products. Also the other topic which is considered as an objective is that a very new project should be defined in such a way that can provide the same flexibility in terms of capacity as the flexibility of the product volumes.

Material and methods: The analyze is being done by using a real example from an industrialization project. The data will be presented using graphs. Program used for timeline representation: Microsoft project.

Results: Higher scrap rate due to efforts in increasing the output. Better understanding of the importance of having flexibility in terms of capacity item.

Conclusions: Capacity issues have a big influence on the quality of the products and the same on the motivation/mood of employees.

Keywords: capacity, quality, management

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