SASYR Symposium of Applied Science for Young Researchers

1st Symposium of Applied Science for Young Researchers

BOOK OF ABSTRACTS 2021

2Ai APPLIED ARTIFICIAL INTELLIGENCE LABORATORY
CeDRI Research Centre in Digitalization and Intelligent Robotics
ADiT-LAB APPLIED DIGITAL TRANSFORMATION LABORATORY
IPCA INSTITUTO POLITÉCNICO DO CÁVADO E DO AVE
ipb INSTITUTO POLITÉCNICO DE BRAGANÇA
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Editors

Florbela P. Fernandes
Research Centre in Digitalization and Intelligent Robotics (CeDRI)
Instituto Politécnico de Bragança

Pedro Morais
Applied Artificial Intelligence Laboratory (2Ai)
Instituto Politécnico do Cávado e do Ave

Pedro Pinto
Applied Digital Transformation Laboratory (ADiT-LAB)
Instituto Politécnico de Viana do Castelo

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Welcome

SASYR, the first Symposium of Applied Science for Young Researchers, welcomes works from young researchers (master students) covering any aspect of all the scientific areas of the three research centres ADiT-lab (IPVC, Instituto Politécnico de Viana do Castelo), 2Ai (IPCA, Instituto Politécnico do Cávado e do Ave) and CeDRI (IPB, Instituto Politécnico de Bragança).

The main objective of SASYR is to provide a friendly and relaxed environment for young researchers to present their work, to discuss recent results and to develop new ideas.

In this way, it will provide an opportunity to the ADiT-lab, 2Ai and CeDRI research communities to gather synergies and indicate possible paths for future joint work.

We invite you to join us on 7 July and to share your research!

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Virtual Reality as a Tool for Post-Stroke Upper-Limb Rehabilitation

Diogo Pereira[1], Duarte Duque[1], and Vítor Carvalho[1]

2Ai – School of Technology, IPCA, Barcelos, Portugal
{ddpereira,dduque,vcarvalho}@ipca.pt

Abstract

Every year 15 million people suffer from stroke. About half of the survivors have their motor skills negatively impacted by this, having to resort to long-term rehabilitation in order to regain motor function. However, this rehabilitation is boring and monotonous, and its effectiveness decreases overtime. Virtual Reality (VR) serious games try to fix this problem by creating fun and interesting scenarios for patients to recover in [1–3].

The main goal of the SmartHealth project is to help in the rehabilitation of post-stroke survivors with motor deficiencies of the upper limbs by using VR games and their ability to easily create any type of scenario. This project has five main steps: literature review; asset and 3D model creation; development of the alpha version, with testing; improving on the alpha version using the results obtained and deployment to the VR kit; and, finally, testing with real patients.

A systematic review using the guidelines provided by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) was developed with the objective of obtaining information on good practices and problems that might show up during the development of this project. For the game development, Unity is the choice, with the VR headset being Quest 2 by Facebook. The patient will interact with the game using their hands; these being tracked using Quest 2's capabilities. In-game the patient will see a representation of their body, that will try to mimic their movements. They will then be asked to perform a variety of exercises according to what was prescribed by their therapist. It will be possible to change different options about these exercises in a room for the therapist.

It is expected that gamifying this rehabilitation will improve the user's motivation and entertainment, increasing the rehabilitation's efficiency, and thus decreasing recovery time. Currently, an early prototype is being developed, it is capable of tracking a path created by the therapist moving the controller, the patient then follows that path with the help of a robot, this being repeated as many times as the therapist prescribes. The next phase of this project is to developed interesting environments and exercises that are capable of being customized to each patient, linking the game and the robot, and developing a control room for the therapist.

Keywords: Virtual Reality · Serious Games · Rehabilitation · Stroke · Upper Limb.

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Virtual Reality on the Diagnosis and Treatment of Schizophrenia: First Approach

Andreia Mendes[1], Duarte Duque[1], and Vítor Carvalho[1]

2Ai – School of Technology, IPCA, Barcelos, Portugal
{ddpereira,dduque,vcarvalho}@ipca.pt

Abstract

Serious games are games designed to fulfil a serious goal. These games are already used in several ways, such as learning aid for children (e.g., mathematical games), or the practice of physical exercise (e.g., football). Virtual reality (VR) technology is a type of technology that puts the user in a virtual world, with the use of VR glasses and controllers that detect the movements of the hands and head. Using VR grants the user a feeling of immersion and presence on a "new level". VR has been evolving rapidly, being already used in several video games (e.g., Beat Saber, Minecraft...), as well as, in some cases, used for simulation of specific situations and environments for training (e.g., aircraft navigation simulation). However, the use of VR as a means of therapy is still a little studied topic, partly because the technology has a much faster evolution than the testing and approval period of the scientific community [1–5].

Studies comparing the use of VR in patients with schizophrenia and volunteers without any psychiatric disorder in various social, memory and spatial navigation exercises, demonstrated tendency-negative performance in patients with schizophrenia due to lack of motivation, when compared to volunteers without psychiatric disorders. Continued exposure to these exercises also revealed positive improvements in test performance and quality of life on patients with schizophrenia. This demonstrates that it is possible to use VR as a diagnostic and therapy tool for schizophrenia [2,5]. VR can provide easily accessible realistic exercises and environments for therapy and testing, as well as supervising and recording data about the patient, which can save a lot of resources when compared to creating and fine-tuning exercises to each patient in real life.

The goal of this project is to develop a serious game using VR to undertake therapy and/or diagnosis for schizophrenia patients. The specific requirements that will specify the game are currently being evaluated. Patient interaction will be recorded to allow the game a continuous development and patient engagement. The game will make use of the Oculus Quest 2 device, since it is wireless and easy to use, as well as it supports hand tracking. The game will consist of two main environments: A home environment and a city environment, where the player will be tasked with performing day-to-day tasks and have its performance evaluated. The game development process will receive input from a medical team, and later be tested on patients with schizophrenia and further fine-tuned.

Keywords: Virtual Reality · Serious Games · Schizophrenia .

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Inclusive Mobility Solution for Visually Impaired People using Google Cloud Vision

Joana Gonçalves[1] and Sara Paiva[2]

Instituto Politécnico de Viana do Castelo, IPVC, Portugal
joanagoncalves@ipvc.pt,sara.paiva@estg.ipvc.pt

Abstract

Mobility in cities is of particular and growing importance nowadays due to the demographic increase and the existence of people with reduced mobility, as is the case of visually impaired people. Of the various situations where mobility represents a challenge, obtaining the notion of positioning, at times when the person loses track of where he is and becomes disoriented, can be extremely useful and a way to contribute to greater autonomy for this segment of people. This paper proposes a visual positioning system using the Google Cloud Vision API. The architecture includes a mobile application that captures an image via the mobile phone and sends it to a backend server that makes use of Google Cloud Vision to recognize the image, which may consist of text, logos or landmarks. A route in Braga was chosen to test the implemented solution. The obtained results prove the adequacy of using this solution to be adapted in a real scenario.

Keywords: Visually Impaired People · Mobility · Inclusive Mobility · Outdoor Positioning · Image Recognition.

WALKTOGETHER – Mobile Application to Enhance Blind People Accessibility

Tiago Castro[1], J.C. Silva[1], and Marisa Pinheiro[2]

[1] Polytechnic Institute of Cávado and Ave, IPCA, Portugal
[2] INESC TEC - Institute for Systems and Computer Engineering, Portugal
a18821@alunos.ipca.pt,jcsilva@ipca.pt,marisa.f.cardoso@inestec.pt

Abstract

Each person is used to getting to and from places daily without a feeling of disorientation. That is not blind and visually impaired people's case. The testimonies of the difficulties that blind and visually impaired people face every day when they get around is the basis for this project. It intends to lessen some of those difficulties, like mobility problems, difficulties when asking for assistance, or simply, socializing problems. The main goal of this project is to help blind and visually impaired people when facing orientation and mobility problems, allowing them to ask for assistance from volunteers through a mobile app. Thus, by establishing contact via mobile phone, audio, video and sharing of GPS location, the volunteers who are nearby can be automatically contacted in order to assist physically someone who may need help. In the future, there is an intention to conduct a heuristic evaluation, allowing for metrics elaboration so that the usability of the developed device can be assessed. Subsequently, questionnaires/surveys will be carried out with the support of ACAPO Association. In order to improve the solution, the mobile app will be evaluated through the answers given by a group of blind and visually impaired people object of the survey.

Keywords: Blind people · Mobile application · Accessibility · Volunteering.

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Finite Element Modeling of a Permanent Magnet Synchronous Generator for Wind Energy Conversion Systems

Dalila Mosko Koslinski[1,2], Ângela Paula Ferreira[1], and José Fabio Kolzer[2]

[1] Research Centre in Digitalization and Intelligent Robotics (CeDRI), Instituto Politécnico de Bragança, Bragança, Portugal
[2] Universidade Tecnológica Federal do Paraná, UTFPR, Brasil
a42389@alunos.ipb.pt,apf@ipb.pt,josefabio@utfpr.edu.br

Abstract

The concern with the environment and the mandatory reduction of fossil fuels dependency have encouraged the search for sustainable energy conversion systems. One of the sources that has been highlighted is the wind energy, either in low power applications and also in large wind off-shore turbines.

Wind energy is intermittent and speed-variable, from which conversion systems should accommodate this specification to increase the energy capture. The synchronous generator, decoupled of the grid frequency, is a good solution. In addition, the use of permanent magnets allows more efficient generators with small dimensions than their counterparts [1].

The target machine to be exploited in this work is a permanent magnet synchronous machine (PMSM), direct driven and connected to a DC grid using a three-phase diode bridge rectifier, previously designed and proposed in [2], and an inverter.

The machine topology is a three phase radial flux PMSG, with NeFeB magnets located on the rotor surface, 3kW, 170V(DC), 350 rpm, 12 poles, designed and built for use in low power wind energy conversion systems [2].

Keywords: Wind Generation · Permanent magnet synchronous generator.

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Detection of Atypical Patterns - A Machine Learning Approach

Júlio Castro Lopes[1] and Pedro João Rodrigues[2]

[1] Instituto Politécnico de Bragança, Bragança, Portugal
[2] Research Centre in Digitalization and Intelligent Robotics (CeDRI), Instituto Politécnico de Bragança, Bragança, Portugal
a39965@alunos.ipb.pt,pjsr@ipb.pt

Abstract

Throughout the present work, some methods were tested in order to perform the rejection of patterns not contained in the training group (atypical), i.e. patterns for which the model was not trained to recognize. Supervised Classification algorithms are only trained to recognize and classify certain patterns, those contained in the training group. Therefore, these will incorrectly classify unknown patterns by default, causing unwanted results.

In previous work, the main approach for the development of models capable of recognizing these patterns was the use of a Variational Autoencoder (VAE). In order to validate the effectiveness of the VAE, a Convolutional Neural Network (CNN) was also tested in the execution of the referred task. Since the VAE as presented to be more effective in the detection/rejection of atypical patterns, several conventional Machine Learning techniques, using features extracted from the CNN were also tested.

This work aims to propose a much faster solution by only using conventional feature extraction methods, such as Haralick features, Local Binary Patterns (LBP), and Histogram of Oriented Gradients (HOG). Some interesting results were obtained, demonstrating that using traditional feature extraction methods is a viable option for achieving the goal of this work.

Keywords: Machine Learning · Atypical Patterns · Feature Extraction.

Data Acquisition and Conditioning System for a Wearable-based Integrated Biostimulation

Leonardo Sestrem[1], Wellington Maidana[1], and Paulo Leitao[1]

Research Centre in Digitalization and Intelligent Robotics (CeDRI), Instituto Politécnico de Bragança, Bragança, Portugal
leonardo.oliveira@ipb.pt, maidana@ipb.pt, pleitao@ipb.pt

Abstract

Wearable technology has a wide range of applications, e.g. gaming and medicine. In medical wearable systems, the muscular data is collected by biopotential measurements called electromyography, which recording the electrical activity of the skeletal muscles. This abstract describes the signal acquisition and conditioning system for a wearable-based muscle electrostimulation that uses dry electrodes of titanium thin films. The proposed system employs Bluetooth Low Energy to transmit the acquired signals to an mobile application in a smartphone for later visualization and analysis by the clinical team.

Keywords: Wearable, Dry electrodes, Electromyography, Functional Electrical Stimulation, Bluetooth Low Energy.

Smart System for Medication Deblistering and Dispensing

João Pinto[1,2], João Vilaça[1,3], and Nuno Dias[1,4]

[1] 2Ai – School of Technology, IPCA, Barcelos, Portugal
[2] jfpinto@ipca.pt,jvilaca@ipca.pt,ndiasipca.pt

Abstract

Non-adherence to medication has been a serious health issue, leading to lower therapy results and possibly even death. According to [3] one of the largest non-adherence causes was a complex drug regimen. To ease this issue, the researchers evaluated the use of a calendar blister pack with successful results.

Nowadays, electromechanical devices make medication consumption simpler, having compartments where pills can be stored before being fetched and dispensed [1]. Current dispensers, however, still have limitations: Stored pills need to be replaced when the medication plan changes, requiring caretaker's or user's interaction, with the long and repetitive task of deblistering medication. Deblistering medication exposes the active agents to environmental factors such as humidity which lead to degradation of its potency. Also, the lack of multi-user support and low modularity makes treatment of two or more patients only possible with multiple dispensing devices, which is expensive and cumbersome.

The presented solution is the development of a smart modular deblistering system, capable of storing and deblistering any blister pack. This system will be based on the premise of keeping the medication inside the blister until it needs to be dispensed, keeping it safe from any environmental factor or cross-contamination. Upon selection of a certain medication, the system would fetch the stored blister and the needed pills would be extracted from the blister automatically. By providing the exact amount of pills on time, while keeping the remaining in the blister, not only the proposed system reduces the work caretakers have to do; but also protects pills against degrading factors to which they are exposed on conventional systems.

Similar to features of the device present in [2], the proposed smart device will be capable of wireless communications allowing access to the internet enabling caretakers and users to interface with it from anywhere. The existence of a built-in screen will guide users though the process of authentication and dispense along with the possibility of a mobile app where medication effects can be monitored through the patient's feedback.

Keywords: Medication Deblistering · Pill dispenser · Artificial Intelligence · Safety · Modular.

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A special acknowledgment to the Applied Artificial Intelligence Laboratory (2AI) for providing access to all conditions for the development of the project.

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AI-Based Eletronic Nose for Predictive Maintenance

André Giesteira[1] and António H. J. Moreira[1]

2Ai - School of Technology, IPCA, Barcelos, Portugal
a14168@alunos.ipca.pt,amoreira@ipca.pt

Abstract

Predictive maintenance aims to monitor as well as predict when failures will occur through various sensory elements inserted in industrial equipment. In this way, it is possible to schedule the necessary intervention in a timely manner. Currently there are several predictive maintenance methods already developed, such as fluid analysis, abnormal vibration management, among others [2].

The proposed system aims to leverage the advantage of combining tinyML (tiny Machine Learning)/AI (Artificial Intelligence) machine learning techniques to enhance anomaly detection using gases/odours analysis to detect lubrification deterioration and similar issues in CNC machines. Similar methods capable of detecting gases / odours were already explored [1], based on the classification of odours, monitor the deterioration of lubricating oil and consequent loss of lubricating characteristics in machines.

To achieve such a purpose, it is necessary to study the sensors that best cover the desired gases (CO2, NOx, NO2), as well as the best machine learning method to be implemented (RNN, LSTM, AutoEncoder). Then, the output result from the model prediction/classification will be send from the device wirelessly to an external database. Once the device is built, to proceed with its validation it will be necessary to create an odor dataset. For this, virgin lubricant oil data will be collected as well as in different states of its life and the system trained to classify for normal and abnormal state in laboratory environment. It will then be validated in an industrial environment.

The technology to be developed aims to offer a new predictive maintenance system to broaden horizons and thus, together with the various existing methods complement the most diverse areas using a natural human like capability such as smell.

Keywords: Predictive Maintenance · Embedded System · tiny Machine Learning · Odour Identification.

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Optimized route recommendation system for visually impaired people based on OTP and OSM

Catarina Costa[1] and Sara Paiva[1]

Instituto Politécnico de Viana do Castelo, IPVC, Portugal
cvitoriacosta@ipvc.pt,sara.paiva@estg.ipvc.pt

Abstract

Visually impaired people (VIP) face several challenges when it comes to perform regular daily mobility tasks in urban environments. Although several applications already exist to guide citizens to desired destinations, most of them don't take into consideration specific needs of VIP such as the most adequate streets. This study proposes an optimized route recommendation system for VIP based on OpenStreetMaps (OSM) and OpenTripPlanner (OTP) in order to return the most adequate path, considering several criteria, with the final purpose of promoting a greater level of independence and autonomy to this segment of people. OSM is an open-source collaborative mapping project with the purpose of creating a free and editable map for everyone to use and cooperate. For that, it provides an extensive list of tags that everyone can add to places (streets, underground stations, etc). Those tags include traffic light signals in a crossing road, tactile pavement, stairs, points of interest, ramps, indoor and outdoor information, among others, that in this project were used as criteria for recommending the most optimized routes. OTP, on the other hand, is an open-source multi modal software that provides route information about passengers and transportation network. The proposed route recommendation algorithm receives the current location and desired destination as inputs received from a mobile app, which are submitted to OTP that retrieves all possible paths. Then, using an OSM file with the annotation of the various streets, with the list of weights of the most relevant tags for VIPs. The weight of each route is calculated, with the path with the greatest weight being returned, which represents the path that has a walking path with better features relevant to VIP. Such a solution has the potential to provide an easy and suitable solution for VIP users to walk safely and gain more independence in the scope of urban mobility.

Keywords: Urban Mobility · Crowdsourcing· Visually Impaired People.

Robotized Automation Systems For Industry Supported By Integrated Quality And Environment System Management Solutions

Teresa Araújo, Martinha Pereira, and Estela Vilhena

2Ai – School of Technology, IPCA, Barcelos, Portugal
a16200@alunos.ipca.pt, mspereira@ipca.pt, evilhena@ipb.pt

Abstract

In the current economic environment, the path to success for organizations is more demanding than ever and managers are faced with increasingly complex problems. With the main objective of creating competitive advantages and achieving sustainable development, organizations implement different Management Systems, including Quality Management Systems (ISO 9001) and Environmental Management Systems (ISO 14001). The emergence of the High-Level Structure across all ISO standard, in a way, facilitates the arising of integrated systems. The "PDCA Cycle" also allows an organization to ensure that its processes are adequately resourced and managed and that opportunities for improvement are determined and implemented. This article is the result of a project developed in a company, which presents a wide range of solutions for robotized automation systems. Its main objective is the definition and implementation of ISO 9001:2015 and ISO 14001:2015, in order to reach new markets and in this case other type of clients. The organization was analysed, and a Quality Management System was structured based on its three main principles: Process Approach, PDCA Cycle and Risk-based Thinking. The Process Approach was also applied to the Environmental Management System. In the latter, significant environmental aspects were identified, as well as applicable legislation and other requirements, its Environmental Policy was also formulated. In short, the implemented Integrated Management System will allow a logical and systematic management approach that will translate into strategic management and operational decisions, which will allow a greater projection of the company in the global market.

Keywords: Quality Management Systems, Management Systems,Management Systems, Robotized Automation Systems.

An Architecture using Ray to Distribute Tasks in a Federated Testbed Platform to Reduce Machine Learning Training Time

Diogo Teixeira[1], Silvestre Malta[2], and Pedro Pinto[2]

[1] Instituto Politécnico de Viana do Castelo, IPVC, Portugal
[2] ADiT-LAB, Instituto Politécnico de Viana do Castelo, Viana do Castelo, Portugal
diogoteixeira@ipvc.pt, smalta@estg.ipvc.pt, pedropinto@estg.ipvc.pt

Abstract

Machine learning algorithms are used in multiple contexts and scenarios and, generally, the larger the volume of data presented to the algorithm, the greater the probability that it will make the correct decision or improve accuracy and precision. However, a high volume of data will also require time to train. In particular scenarios where real time actions are needed, e.g. in cyberattacks detection systems, long training times may imply time periods when a system is vulnerable.

The Machine learning tasks can be executed sequentially in one unique server or, simultaneously and on multiple servers to reduce the training time. Thus, federated testbed platforms, such as Fed4FIRE+ [1] (a free, scalable and feature-rich platform), and task distributed execution tools, such as ray [2].

This research aims to propose an architecture to distribute and schedule tasks with ray using Fed4FIRE+ resources to reduce the training time spend in machine learning algorithms training. The architecture will comprehend multiple servers connected in a cluster in Fed4Fire+, where the master will be responsible for distributing the tasks to the other servers. This architecture is envisioned to support the training process of multiple datasets using different machine learning models, particularly oriented to foster the learning process of cyberattacks detection systems.

Keywords: Machine Learning · Multitasking · Distributed · Training Time.

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An Advertising Overflow Attack on Android Exposure Notification System Impacting COVID-19 Contact Tracing Applications

Henrique Faria[1], Sara Paiva[1], and Pedro Pinto[1]

Instituto Politécnico de Viana do Castelo, IPVC, Portugal
henriquefaria@ipvc.pt,{sara.paiva,pedropinto}@estg.ipvc.pt

Abstract

The contact tracing mobile Apps are one of the many initiatives to fight the COVID-19 virus. These Apps use the Exposure Notification (EN) system available on Google and Apple's Operating System (OS). However, contact tracing Apps depend on the availability of Bluetooth interfaces to exchange proximity identifiers that, if compromised, directly impact the effectiveness of these Apps [1].

This paper discloses and details the Advertising Overflow attack, a novel internal Denial of Service (DoS) attack targeting the EN system on Android OS devices. The attack is performed by a malicious App that occupies all the Bluetooth advertising slots in an Android device, effectively blocking any advertising attempt of EN.

The impact of the disclosed attack and other internal DoS-based attacks, namely Battery Exhaustion and Storage Drain, was tested using two target smartphones and other six smartphones as attackers. The results show that the Battery Exhaustion attack imposes a battery discharge rate 1.95 times superior to the baseline. Regarding the Storage Drain, the storage usage increased more than 30 times the baseline results. The results of the novel attack reveals that a malicious App is able to block the usage of Bluetooth advertising by any other App by any chosen time period, canceling the operation of the EN system and compromising the efficiency of any COVID's contact tracing App based on EN.

Keywords: Denial of Service · Exposure Notification · COVID-19.

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A New Concept of a Handheld Ultrasound Guidance for Medical Training

Simão Valente[1,3], António Real[1], João Gomes Fonseca[1], Helena R. Torres[1], Estevão Lima[2], Pedro Morais[1], and João L. Vilaça[1]

[1] Instituto Politécnico do Cávado e do Ave, IPCA, Portugal
[2] Life and Health Sciences Research Institute, ICVS, Portugal
[3] spvalente@ipca.pt

Abstract

Ultrasound (US) is a first-line medical imaging modality that is used for a wide range of medical indications. Despite their known advantages (e.g real-time capability, low-cost, radiation-free), US images are affected by speckle noise and artifacts, requiring specific medical training to handle the probe and to evaluate the acquired images [2,3].

For the reasons presented above, ultrasound is a technology that takes a long time to learn, presenting a high learning curve to apprentice physicians. In this project, we are focused on the development of a multi-platform US simulator that can be used in medical education to accelerate the learning curve in probe handling and interpreting US images [1, 4].

The proposed solution consists of a physical portable mock-up probe and a software application that allows the estimation, in real-time, of 2D US images of specific anatomy according to the physical probe's orientation and pressure. The portable probe has an Inertial Measurement Unit that sends the pose's information to the application via wireless, reslicing a template 3D volume of the anatomy according to the pose and generating the 2D image. Moreover, a silicone-based pressure sensor was attached to the probe tip to measure the force applied by the operator and to mimic the influence of the tissue's compression by the probe in the image generation process.

The proposed system was evaluated in terms of precision and accuracy of the orientation estimation strategy, and linearity of the pressure sensor. The orientation precision tests were performed recurring to a robot with 7 degrees of freedom (KUKA LBR iiwa). The orientation accuracy of the sensor was compared to a commercially available electromagnetic system, NDI electromagnetic system (Northern Digital, Inc., Waterloo, Ontario, Canada). The pressure sensor response was evaluated using a compression testing machine with a load cell of 10 kN (AGS-X, Shimadzu, Kyoto, Japan). Our preliminary results indicate that the probe has a precision of 0.3223^{o}, an accuracy of 3.6439^{o}, and the pressure sensor has good linearity (R=0.9989). Overall, the developed portable probe showed potential to be used for medical training.

Keywords: Serious Games · Ultrasound Simulator · Real-time · Medical Training

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Intelligent System for Real Time Monitoring of the Head Pose of Newborns

João Gonçalo Pereira[1], Helena Torres[1], Fernando Veloso[1], Bruno Oliveira[1], Pedro Morais[1], and João L. Vilaça[1]

2Ai – School of Technology, IPCA, Barcelos, Portugal
a14172@alunos.ipca.pt,{htorres,fveloso,boliveira,pmorais,jvilaca}@ipca.pt

Abstract

Deformational plagiocephaly (DP) is an asymmetrical distortion of an infant's skull that affects 1 in 5 newborns, with an even higher prevalence in prematurely born infants (38%). Besides cosmetic concerns, newborns with deformities can also experience development delay [1].

Currently, it is accepted that one of the major causes of DP is a preferential head positioning. Thus, the goal of this project lies in the development of an intelligent system to monitor newborn's head pose and to automatically generate alerts when needed.

The system will be composed of an RGB camera, an intelligent system capable of determining the head pose in real time and an app that will show all essential data as well as alarms to reposition the baby.

To develop an intelligent monitor system, it becomes necessary to create datasets of the subject of study. Thus, it will be developed a synthetic setup for data collection, where an engine will simulate the head rotation in a mock model. Subsequently, a neural network will be trained to identify facial landmarks on the baby's face and later the head pose estimated from the spatial relation between all landmarks. Concerning the head pose estimation, it relies on the identification head rotation based on the spatial relation between multiple head landmarks. Due to possible occlusion of some landmarks, the method will be trained to predict the head pose from a subset of all landmarks.

The final software will be validated in a new mock model, working as a proof of concept of the accuracy and feasibility of the described methodology, which may improve the current clinical practice. Overall, it is expected that the proposed software could promote smart self-monitoring of head development, preventing possible pathologies.

Keywords: Deformational plagiocephaly · Head pose · Artificial Intelligence · Deep Learning.

Acknowledgments

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Health and Safety in Teleworking: Risks and Benefits in the context of the COVID-19 pandemic

Maria Cláudia Silva[1], Mariana Carvalho[1], and Estela Vilhena[1]

2Ai – School of Technology, IPCA, Barcelos, Portugal
a18680@alunos.ipca.pt,{mcarvalho,evilhena}@ipca.pt

Abstract

The COVID-19 pandemic significantly transformed the work environment of many individuals, who started working at home, in teleworking. [1]

Until this moment, this theme was little explored in the Portuguese market. Therefore, companies were not properly prepared and informed to teleworking manage, this posed several risks for teleworkers. Literature and empirical studies suggest that this form of work can have consequences for the balance between workers' personal and professional lives [2] . The main objective of this study is to identify and evaluate the risks and benefits of teleworking in health and safety in the context of a pandemic.

Regarding the methodology adopted in the development of the work, the author will apply an instrument (Copenhagen Psychosocial Questionnaire) that allows obtaining a set of rigorous results, which will be analyzed and interpreted later [3]. It is expected that the questionnaire will be answered between the 1st and the 30th of June by companies in the private and public sector that worked in teleworking in a situation of pandemic of covid-19.

As result, it is expected to understand the impact that teleworking had on the personal and professional lives of workers, as well as to evaluate and analyze the psychosocial risks to which these workers are subject.

Keywords: Health and Safety in Telework · Risks and Benefits · Covid-19

Acknowledgments

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Psychosocial Impact of The Covid 19 Pandemic on Biomedical Laboratory Scientists in Portugal

Vera Campinho, Estela Vilhena, and Filipe Carvalho

2Ai – School of Technology, IPCA, Barcelos, Portugal
a19578@alunos.ipca.pt

Abstract

Nowadays, the COVID-19 pandemic has highly impacted in our society, particularly the healthcare professionals not only at the physical level but also in which regards to the psychosocial aspects [1]. Psychosomatic symptoms related to anxiety and depression have been increasingly reported, as well as sleep quality loss and other consequences on regarding virus infection and transmission fear [2].

Biomedical Laboratory Scientists are a particularly exposed group due to the daily contact with a high number of potential infected biological samples and the high number of professionals involved in sample collection and analyses. This study aims to characterize the psychosocial risks of the COVID-19 pandemic on this group of professionals acting in Portugal, its quantification, and its correlation with sociodemographic and socio-professional conditions.

An exploratory study is employed including data collection and statistical analysis. Data collection is based on the Copenhagen Psychosocial Questionnaire - COPSOQ II, medium version, adapted and validated to the Portuguese population [3]. The targeted professionals work in the public and private sectors from Portugal. The survey it will be implemented using the Google forms and a convenience sampling.

Data analysis is centered on the understanding of COVID-19 psychosocial impact under a prevention vision. By assess psychosocial risks, and by identifying the most relevant pandemic psychosocial risk factors on this professional group, preventive measures are provided/suggested. Thus, in the pandemic context of COVID-19, psychosocial risks take on increased relevance, both because of the dimension that COVID-19 assumed, and because of its longevity.

Keywords: Biomedical Laboratory Scientists · COVID-19 pandemic · Psychosocial risks · Psychosocial risk factors

Acknowledgments

This work was funded by national funds, through the FCT – Fundação para a Ciência e Tecnologia and FCT/MCTES in the scope of the project UIDB/05549/2020.

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Tiny AI Predictive Motor Anomaly

João Ferreira[1] and António H.J. Moreira[1]

2AI - School of Technology, IPCA, Barcelos, Portugal
a13291@alunos.ipca.pt,amoreira@ipca.pt

Abstract

Predictive maintenance in industrial terms has become a subject of high relevance in Industry 4.0, more specifically around the area of the Internet of Things (IoT), the same is true with the use of energy harvesting techniques in several areas for low energy systems. However, as it is necessary to process a huge number of samples from different sensors to analyse the operation of the equipment making this supervision process dependent on high performance processing systems for the implementation of machine learning techniques.

With the proposed research, it is intended to develop a predictive maintenance system, using the development board ESP32. Where readings will be taken of features associated with typical industrial AC motor anomalies through several sensors, e.g. sensors for vibration, sound, and magnetic field [2, 4], together with the framework TensorFlow lite micro we intended to create an embedded predictive alert system at the edge. Finally, to extend the lifetime of the proposed system, we intended to study/identify and implement energy harvesting techniques that perform best using the energy sources available (e.g., vibration, temperature, magnetism) [1, 3], we must also consider that these systems provide only small amounts of energy.

The validation of the system at the laboratory level will be done with a 3D printed load coupled to the engine that facilitates the distribution of weights to simulate anomalies, the investigation of energy harvesting will focus on the study of energy generated by the different techniques. The expected result of this project will be an embedded system capable of monitoring, analysing, and making predictions of malfunctions/failures to reduce any losses to companies related to maintenance areas. Complementing with energy harvesting techniques, it is intended to interconnect wireless sensors with a predictive maintenance system and increase the life of equipment to create an autonomous system with low (or none) maintenance.

Keywords: EdgeAi, · Energy Harvesting, · Predictive Anomaly · Ai in Maintenance · Industry 4.0.

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Program for Solid Waste Management System in Água Grande

Celmira Afonso Dias, Esser Jorge de Jesus Silva, and Mario João Freitas Sousa Basto

2Ai – School of Technology, IPCA, Barcelos, Portugal
a11215@alunos.ipca.pt

Abstract

In recent years, society has increased the production of products, which are quickly exchanged for others, of a perishable and increasingly fragile nature, where they produce and consume more. [1]

When not managed, inspected and monitored, waste generates major environmental impacts and in accordance with the Action Plan for Integrated Urban Solid Waste Management in São Tomé and Príncipe 2011-2016 [2], operations carried out in dumps/landfills are practically limited to depositing garbage/waste and incinerating them in the open air.

As the islands of São Tomé and Príncipe are small, the difficulties of waste management are increased for reasons, among others, the lack of adequate structures, trained technical staff, the high cost of specific transport for the treatment of waste, associated with the lack of means of public awareness [3]. In the context of solid waste generated in Água Grande, the lack of resources in waste management is the main constraint in the country. Given this situation, it is necessary to prepare an action plan for solid waste management with the objective of analyzing the solid waste management system in Água Grande.

This investigation fits into an essentially quantitative methodological paradigm, which consists of a systematic process of collecting observable and quantifiable data based on the observation of facts, events and phenomena through the administration of a questionnaire survey to citizens and data controllers of waste in the district.

This study aims to identify existing policies and programs for the collection, treatment, forwarding and disposal of solid waste, describe the current situation of solid waste management, characterize the existing infrastructure in the study areas, and propose improvements if necessary. to the waste management operation. Therefore, as a proposal for improvement, it is intended to present: a monitoring tool that allows managing data collected such as the amount of stored, transported and final waste; measures to be adopted for waste reduction (optimization strategies, waste reduction, and improvement of the waste collection process).

The results will be obtained in the data processing and analysis phase, thus allowing to verify and identify which entities are responsible for the treatment of waste in the capital and to analyze the level of knowledge of the population regarding the treatment of waste. Based on the current result obtained, it was found that 61.2% of the population considers the selective collection of waste important, 77.7% of the population does not separate it.

Keywords: Solid Waste · Waste Management · Waste Treatment · Recycling · Incineration

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Real-time Monitoring and Controlling of Internal Parameters for Smart Buildings

Elias Junior Biondo[1], José Lima[2], Thadeu Brito[2], and Alberto Yoshihiro Nakano[3]

[1] Instituto Politécnico de Bragança, Bragança, Portugal
[2] Research Centre in Digitalization and Intelligent Robotics (CeDRI), Instituto Politécnico de Bragança, Bragança, Portugal
[3] Federal University of Technology - Paraná: Toledo, Paraná State, Brasil
a49138@alunos.ipb.pt,{jllima, brito}@ipb.pt,nakano@utfpr.edu.br

Abstract

Health risks caused by air contamination have become increasingly worrying, especially when it comes to indoor air quality (IAQ), where there is a lot of concentration of gases such as carbon monoxide (CO), carbon dioxide (CO_2) and volatile organic compounds (VOC), and it is where people spend the most part of the day. With that in mind, this article presents a research that is being done in the area of intelligent building automation, which aims to develop an IAQ monitoring and control system using internet of things (IoT) technology. For this, some sensor modules will be connected, such as the BME680 and the AMBIMATE MS4, to the ESP32 microcontroller that will send the collected information to the monitoring and data storage platforms using the Message Queuing Telemetry Transport (MQTT) data exchange protocol through of the Node-RED online tool. With this device, in addition to being able to monitor the internal parameters of the environment where it is installed, it will be possible to detect any adversity that may arise in the place and providing autonomously an output signal that can trigger an actuator capable of stabilizing the system, that is, without the need for any human action.

Keywords: internet of things · IAQ (indoor air quality) · environmental monitoring.

ECG Monitoring System for Atrial Fibrillation Detection Based on an Android Mobile Device

Gabriel Saatkamp Lazaretti[1], Pedro Henrique Borghi de Melo[1], and João Paulo Ramos Teixeira[1]

Research Centre in Digitalization and Intelligent Robotics (CeDRI), Instituto Politécnico de Bragança, Bragança, Portugal
{lazaretti,pedromelo}@alunos.utfpr.edu.br,joaopt@ipb.pt

Abstract

This paper proposes the implementation of a electrocardiogram (ECG) monitoring system for R peak (heartbeat) detection and Atrial Fibrillation detection. The system consists of a signal acquisition step performed by the BITalino® HeartBIT BT platform. The acquired signal is transmitted to a smartphone using Bluetooth communication. The algorithm is responsible for detecting the R peaks of the acquired ECG signal and run a machine learning model based on a Long Short - Term Memory (LSTM) neural network to perform Atrial Fibrillation detection. The implementation of such an algorithm in an Android environment can be done with tools such as MATLAB Coder® application, Android Studio® and the Java Native Interface.

Keywords: ECG Monitoring System· Atrial Fibrillation Detection· Android Device ECG Processing

Wireless in-ear monitoring device for COVID-19

Claudino Costa[1], António Moreira[1], Vitor Carvalho[1], Pedro Morais[1], Demétrio Matos[1], and João Vilaça[1]

2Ai - School of Technology, IPCA, Barcelos, Portugal
{cbcosta,amoreira,vcarvalho,pmorais,dmatos,jvilaca}@ipca.pt

Abstract

The world is facing health, economic and social crisis due to COVID-19. This outbreak is affecting the entire population but is particularly damaging to more vulnerable social groups, such as the elderly, disabled and those with chronic diseases. With the saturation of healthcare centres, medical care was transferred to people's homes requiring remote monitoring of health status [1].

The "HowMi" project aims to acquire features focused on the needs of COVID-19 and other respiratory pathologies, by integrating them into an innovative, and integrated system already in place. The status of health and well-being shall be monitored, by continuously measuring the temperature, heart rate and level of oxygen saturation in the blood and with the collection of biomedical data and health questionnaires, allowing early detection of emergencies, preventing disease progression and hospitalizations due to exacerbations.

The proposed wearable shall incorporate an oximeter and heart rate sensor (max30102), as well as an infrared temperature sensor (mlx90632), focused on low power and small form factor, a low power microcontroller (ESP32) for data acquisition, signal processing and wireless communication via Bluetooth Low Energy (BLE). The developed firmware shall guarantee, not only the reliability of the data acquired and transmission, but also offline data storage. This low-cost solution shall be the most autonomous possible, for a user-friendly approach, differentiating from current state-of-art devices [2].

The device will be validated against a certified portable multi-parameter monitor (PC-300). This proposal also intends to accelerate the time-to-market with a proof of concept by technically validating the solution and assess the acceptability and willingness of the user.

Keywords: Remote Patient Monitoring · Preventive Diagnosis · Wearable · BLE · Covid19.

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Importance of Quality, Environmental, Health and Safety management systems in monitoring the impacts of COVID-19 on organizations

Joana Costa, Martinha Pereira, and Estela Vilhena

2Ai – School of Technology, IPCA, Barcelos, Portugal
a19578@alunos.ipca.pt

Abstract

Since the end of 2019, COVID-19 pandemic has several daily implications on the organization's routines. Organizations are influenced and influence the changes that occur in their external context, at the political, economic, social, technological, environmental and/or legal level. The change in the external context is important in the dynamics established internally by the need for adaptation. It is in this scenario, that the management systems of quality, environment and safety, may act as value-added tools for certified organizations, acting as differentiating factors between an appropriate or inappropriate response to this pandemic crisis.

The objective of this work is to assess the importance of Quality, Environmental, Health and Safety Management Systems in controlling the impacts of the COVID-19 on organizations. It is expected to identify the different actions implemented by type of organization (services or industry), by certified and uncertified organizations, and in organizations with at least one management system implemented. Also, it will be assessed if the implemented actions differ according to whether the organization is certified, geographical location and number of management systems implemented.

It will be used a quantitative study, using the questionnaire survey as a technical procedure for data collection in order to meet the proposed objectives.

Taking into consideration the experience of certified organizations, in at least one management system, with risk-based thinking and the use of planning-based improvement methodologies as a basis for decisions/actions, it is expected that these organizations have felt less difficulty in implementing actions to mitigate the effects of COVID-19 in their organizations.

Keywords: Covid-19 · Organizations response · Quality, Environmental, Health and Safety Management Systems

Acknowledgments

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Permanent Magnet Synchronous Generator Design for Low-Speed Applications

Pedro Tavares de Azevedo[1,2], Thiago de Paula Machado Bazzo[2], and Ângela Paula Ferreira[1]

[1] Research Centre in Digitalization and Intelligent Robotics (CeDRI), Instituto Politécnico de Bragança, Bragança, Portugal
[2] Universidade Tecnológica Federal do Paraná, Brasil
{pedroazevedo,thiagobazzo}@alunos.utfpr.edu.br,apf@ipb.pt

Abstract

This paper presents a design overview of a permanent magnet synchronous machine (PMSG) of radial flux for low-speed applications. The utilization of permanent magnets allows the reduction of the pole pitch and consequently the design of low speed machines with reduced dimensions. The design is based on an analytical approach, according to the electromagnetic theory, followed by a numerical approach using the Finite Element Method (FEM) by using commercial software. The obtained results by the analytical and numerical approaches are similar.

Keywords: Permanent Magnet Synchronous Generator · Finite Element Method · Simulation

Collecting and monitoring energy data using an IoT system

André Luis Lermen de Souza[1], Paulo Leitão[1], and Luis Piardi[1]

Research Centre in Digitalization and Intelligent Robotics (CeDRI), Instituto Politécnico de Bragança, Bragança, Portugal
a42408@alunos.ipb.pt,{pleitao,lpiardi}@ipb.pt

Abstract

The importance of studying the technologies we are involved in, whether on a day-to-day basis or even in manufacturing environments, is not debatable. Analyzing all the behaviors, being them the simplest possible, makes all the difference if we seek to extract the maximum efficiency that the system can offer us.

This work addresses an example of a system based on the IoT model, where energy monitoring equipment was installed in the air conditioning system of the company Catraport, which develops parts for assembling automobile exhausts, located in the city of Bragança, Portugal.

The monitoring system is composed of equipment called IotaWatt, which collects energy information from the system and sends all collected data to a database in InfluxDB. These data are sent to Grafana, where it creates the interactive visualization of the data, through graphs and tables, which lead to decision-making and detailed analysis of the monitored system.

This monitoring, in turn, is done completely online and in real time, removing the need for an employee to be collecting machinery data during working hours, for example. In addition to the removal of human intervention, the digitization of collected data brings comfort for the user to get ready in the way they want, looking for specific or general information, in addition to making comparisons and discoveries.

After data collection and visualization, the system undergoes monitoring using Nelson Rules. These rules were created by Mr. Lloyd S. Nelson and their role is to analyze the stability of the systems graphically, which were inserted by a Pyhton code that conducts validation and assigns visual alarms in the Grafana software.

The accomplishment of this work has the objective of being able to predict behaviors of the electrical system of the company Catraport, in order to improve the functioning of the system and also a possible reduction in the energy costs of these equipments. This will be validated through the insertion of Nelson's rules in the database, in addition to the graphical analysis, which through its visualization allows the user to carry out a detailed study.

Keywords: Energy monitoring, energy efficiency, Grafana, InfluxDB, Internet of Things, IotaWatt, Nelson Rules.

Medication dispensing system architecture Abstract

Bruno A. Costa[1], Roshan Paudel[1], Richard Jonker[1], Inês Afonso[1], Rui P. Lopes[1], José Lima[1], Luís Mesquita[2], and Ana I. Pereira[1]

[1] Research Centre in Digitalization and Intelligent Robotics (CeDRI), Instituto Politécnico de Bragança, Bragança, Portugal
[2] Instituto Politécnico de Bragança, Bragança, Portugal
{bcosta,roshan,richard,lmesquita, rlopes,jllima,apereira}@ipb.pt,maggotnez10@gmail.com

Abstract

Non-adherence of prescribed medication is a global problem that affects many people. There are many factors related to this problem that contributes to further increase the problem and impact in a patient's life. It is proposed a system to assist in the management of medicine and the communication with carers. The system has many components that include mechanical components, electrical components and management system, and servers. It is intended to offer a system that can help reduce the non-adherence factors and the consequences in the life of the patients and their carers.

Keywords: pill management · non-adherence · system architecture

Autonomous navigation mobile robot in a simulation environment.

Gabriel da Silva Neto[1], Luis Piardi[1], and Paulo Leitão[1]

Research Centre in Digitalization and Intelligent Robotics (CeDRI), Instituto Politécnico de Bragança, Bragança, Portugal
a40519@alunos.ipb.pt,{piardi, pleitao}@ipb.pt

Abstract

Most commercial robots vacuum use random movement algorithms and require too much time to perform cleaning, even without ensuring that the entire environment is clean. As the size of the environment increases, the guarantee of cleaning quality decreases. When performing random paths, there is a waste of energy, considering that the robot can pass several times in the same place. Few robots can efficiently carry out cleaning route planning. Creating an environment and route planning is limited only to more expensive robot models. Based on this, the development of a coverage path planning algorithm was proposed, which calculates a path to be covered in an environment, avoiding static and dynamic obstacles, in order to efficiently clean the entire site. A study was carried out on the ROS system, in which it has the necessary tools for the creation of maps and navigation, enabling the development of an optimized algorithm. The work was performed in an environment created in the Virtual Robot Experimentation Platform (VREP) simulator that represents the L2I laboratory located at ESTIG. The results obtained proved to be promising in which the algorithm could still be improved in order to reduce the number of visited cells. The algorithm is fully operational and can be used in many dynamic environments.

Keywords: Mobile Robot · Coverage Path Planning · Optimization

Sustainability and Food Safety: Challenges and Impacts

Daniela Bastos, Martinha Pereira, and Estela Vilhena

2Ai – School of Technology, IPCA, Barcelos, Portugal
a18652@ipca.pt, mspereira@ipca.pt, evilhena@ipb.pt

Abstract

Sustainability sits on three pillars: environment, society, and economy. Nowadays the Food Value Chains are demanded to deliver food with security and quality considering social and environment dimensions. The sustainability of Food Safety depends on its ability to supply safe products without compromise the future generations regarding social, economic, and environmental grounds. So, how can food safety comply with sustainable measures? Can the analysis of food safety risks be more flexible? In a way to understand the challenges placed by the compliant of food regulations and assure sustainable development in food retail and hospitality restaurants, will be applied a survey to several representative companies. The survey aims to identify the problematics and its resolutions for issues regarding the consumption of food before expiring date, reutilization of food, temperature and portions controls, replacement and reutilization of food packaging, as well best practices implemented to reduce food waste and other generated waste, especially plastic waste. Also, the problematic of COVID 19 will be approached to understand the impacts on these sectors, regarding food waste and waste production. Approaching these subjects, aim to identify the main challenges of being sustainable and comply with food safety rules, describing ways to mark a sustainable path without compromise public health. Therefore, the collected data will be studied to set examples and find new approaches to relate and connect both areas in a way to facilitate procedures and processes.

Keywords: Sustainable development, Food Safety, Food Waste, Waste Management, Best Practices.

The A3 Problem Solving Methodology In Complaints Management

Olga Cerqueira, António Moreia, and Gabriela Viana

2Ai – School of Technology, IPCA, Barcelos, Portugal
a17968@ipca.pt, amoreira@ipca.pt, gviana@ipb.pt

Abstract

The ability to solve problems in a structured way and as a team is a key competitive advantage of any organization. Whether in dealing with non-conformities, in solving quality problems, in accident investigation and analysis, or even in continuous improvement projects. A3 methodology provides a practical, visual, and objective framework to characterize the problem, determine its root cause(s), and develop the most appropriate solutions based on reasoned decision making, supported by evidence, and solved as a team. The goal of this project is to apply the Lean A3 Problem Solving methodology to analyze and improve the complaints management process. This methodology allows monitoring KPI's (Key Performance Indicator), defining improvement actions, achieving goals and validating results, providing greater efficiency of the process and satisfaction of stakeholders. To solve the problems identified, improvement actions will be implemented based on the NP ISO 9001:2015 and NP ISO 10002:2020 standards and Lean methodologies and tools. Thus, transforming the problems into positive opportunities for the organization through an effective management of complaints. Improving continuously, the products/services, the processes, the reputation of the organization and consequently the organizational performance in the short and long term. It is expected to obtain an overall improvement of 15% in the KPI's under study,by implementing the improvement actions resulting from the application of the A3 methodology. The A3 Problem Solving methodology can be standardized and applied to a wide variety of improvement and problem solving projects.

Keywords: Lean, A3 Problem Solving, Continuous Improvement, Complaint Management, Customer Satisfaction.

Implementation of a navigation system for a mobile robot in a dynamic environment using AR tags to increase localization accuracy

Alexandre de Oliveira Júnior[1], Luis Piardi[1], and Paulo Leitão[1]

Research Centre in Digitalization and Intelligent Robotics (CeDRI), Instituto Politécnico de Bragança, Bragança, Portugal
{alexandrejunior,piardi,pleitao}@ipb.pt

Abstract

Mobile robotics is one of today's fastest expanding scientific fields, having applications in numerous areas. One of the main areas of study within mobile robotics is in the localization and navigation of robots within an environment. Simultaneous Localization and Mapping (SLAM) strategies are widely used in solving problems involving navigation, however, SLAM algorithms do not have excellent position estimation in dynamic environments where obstacles are present that constantly change position. Aiming to obtain better results in the localization of mobile robots using SLAM algorithms, this paper presents an approach that aims, through the detection of augmented reality tags positioned in a simulation environment, to increase the accuracy of the determination of a mobile robot on wheels. To this end, the ar_track_alvar package with ROS integration is used, which makes it possible to accurately determine the relative distance between a tag and a camera. This way, when a camera is positioned on a robot it is possible to determine its distance and orientation in relation to tags positioned at fixed points in the environment, in order to use this information to decrease the localization error of the SLAM algorithm. A comparison of the results obtained when navigating the robot between different points using SLAM, before and after the tags was applied, was then performed.

Keywords: Robotics · Simultaneous localization and mapping · ROS.

Optimal Energy Management of a Microgrid System

Yahia Amoura[1,4], Ana I. Pereira[1,2], José Lima[1,3], Ângela Ferreira[1], and Fouad Boukli-Hacene[4].

[1] Research Centre in Digitalization and Intelligent Robotics (CeDRI), Instituto Politécnico de Bragança, Bragança, Portugal
[2] Algoritmi Center, University of Minho, Braga, Portugal
[3] INESC-TEC - INESC Technology and Science, Porto, Portugal
[4] Higher School in Applied Sciences of Tlemcen, Algeria
{yahia.amoura,bhfouad}@yahoo.com,{apereira,jllima,apf}@ipb.pt

Abstract

A smart management strategy for the energy flows circulating in microgrids is necessary to economically manage local production and consumption while maintaining the balance between supply and demand. Finding the optimum set-points of the various generators and the best scheduling of the microgrid generators can lead to moderate and judicious use of the powers available in the microgrid. This work aims to apply an energy management system based on optimization algorithms to ensure the optimal control of microgrids by taking as main purpose the minimization of the energy costs and reduction of the gas emissions rate responsible for greenhouse gases. The approach is based on a multi-objective optimization approach based on the Pareto-search algorithm that deals with the optimization of the two functions: cost and gas emission simultaneously providing a set of non-dominated points that represent different scheduling scenarios of the microgrid system. Numerical results are presented and discussed.

Keywords: Renewable Energies · Microgrid · Hybrid Energy System · Energy Management System · Optimization Algorithms.

Monitoring and Optimising of Public Transportation

Diogo Martins[1], Márcio Neves[1], Roger Reis[1], Sara Paiva[2], Sérgio Lopes[2], José Lima[1], and Ana I. Pereira[1]

Research Centre in Digitalization and Intelligent Robotics (CeDRI), Instituto Politécnico de Bragança, Bragança, Portugal
Instituto Politécnico de Viana do Castelo, Portugal
{a32665,a33134,a29589}@alunos.ipb.pt,{jllima,apereira}@ipb.pt,{sara.paiva,sil}@estg.ipvc.pt

Abstract

The smart city topic became a very prominent concept in recent years, especially in the area of public transportation. This work aims to develop a modular GPS sensor based system which can be installed in any transportation vehicle. The module collects GPS location data of the vehicle, user flow and time and sends it through mobile data network to a database in a server. The sent data can be analysed through data mining strategies to decision support in terms of existing routes or add new routes through population flow analysis. The module will be powered by the vehicle via the car auxiliary power outlet. Some data will be available to the users through website and mobile App. In the website the public transportation institution can access to privileged information about it's bus fleet. In the website, the public transportation institution, can access to privileged information about it's bus fleet. In the mobile app, the user, can access the bus arrival time information, if the bus is on time or if it's late.

Keywords: GPS Monitoring · Data Analysis · Optimisation · Modular System.

Response Surface Method combined with Data Analysis to Optimize Extraction Process Problem

L. A. Lima[1,2], A. I. Pereira[1], C. B. Vaz[1], O. Ferreira[2], and M. Carocho[2]

[1] Research Center in Digitalization and Intelligent Robotics (CeDRI), Instituto Politécnico de Bragança, Bragança, Portugal

[2] Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal

limalaires1@gmail.com,{apereira,clvaz,oferreira,mcarocho}@ipb.pt

Abstract

Find and develop an appropriate optimization approach is directly associated with the reduction of the time and labor employed in a given chemical process and could be decisive for quality management. In this context, this work presents an approach to implement the Response Surface Method. This technique combines Response Surface Method with Genetic Algorithm and data mining. The main objective is to develop in MATLAB® a method able to optimize the surface function based on three variables using Hybrid Genetic Algorithms combining with Cluster Analysis to reduce the number of experiments and to find the closest value to the optimum within the established restrictions. The results are in accordance with those reported in a previous study. The proposed method has proven to be a promising alternative strategy since the optimal value was achieved without going through derivability unlike conventional methods, and fewer experiments were required to find the optimal solution in comparison to the previous work using the traditional Response Surface Method.

Keywords: Optimization · Genetic algorithm · Cluster analysis.

Novel SOC Monitoring Approach for Lithium Batteries

Arezki A. Chellal[1,2], José Lima[2,3], José Gonçalves[2,3], and Hicham Megnafi[1,4]

[1] Higher School of Applied Sciences, BP165 13000 Tlemcen, Algeria
[2] Research Centre of Digitalization and Intelligent Robotics CeDRI, Instituto Politécnico de Bragança, Bragança, Portugal
[3] Robotics and Intelligent Systems Research Group, INESC TEC, 4200-465 Porto, Portugal
[4] Telecommunication Laboratory of Tlemcen LTT, University of Abou Bakr Belkaid, BP119 13000 Tlemcen, Algeria
{arezki,jllima,goncalves}@ipb.pt,h.megnafi@essa-tlemcen.dz

Abstract

The key element in storage based systems remains the ability to monitor, control and optimise the performance of one or more modules of these batteries, the type of device performing this task is often referred to as a Battery Management System (BMS). A BMS is a basical units of electrical energy storage systems, a variety of already developed algorithms can be applied to define the main states of the battery, among others: state of charge (SOC), state of health (SOH) and state of functions (SOF) that allow real-time management of the batteries. All research in the field of Extended Kalman Filter (EKF) based BMS is based on bench-scale experiments using powerful softwares, such as MATLAB, for data processing and controllers such as dSPACE. So far, the constraint of computational power limitation is not really addressed in the majority of scientific papers dealing with this subject. This paper proposes an approach to implement an extended Kalman filter linked to a Coulomb counting method, this method called DCC-EKF will allow a better quality monitoring of the battery.

Keywords: Embedded System · Battery Management System · Extended Kalman Filter · Coulomb Counting.

Strategic budgeting in a Portuguese job-shop company

Lucas Henrique Matte[1] and Clara Bento Vaz[1,2]

[1] Research Centre in Digitalization and Intelligent Robotics (CeDRI), Instituto Politécnico de Bragança, Bragança, Portugal
[2] Centre for Management and Industrial Engineering (CEGI/INESC TEC)
a49139alunos.ipb.pt,clvaz@ipb.pt

Abstract

Rapid challenges and changes are common in the business environment but they require from the enterprises to plan carefully their business, in order to respond in short time to the market. This planning is critical in industries that do not work with standardization in their products, processing them according to the design ordered by each customer. The budget is the first step that a customer wants before approving a specific product order as the sale price is normally unchangeable after this stage. Thus, it is essential that the realized budget approaches to the product real value plus the company margin, maximizing the profit and avoiding possible losses [1]. A good budgeting process should accurately reflect the costs of raw materials, cost of direct labor and factory overhead costs. This requires that a company should estimate the production costs before the activities start indeed that depends on the effective planning of the operations required to achieve the desired product design. After defining all these variables, the budget converges to a beneficial value for the company. The objective of this paper is to present a literature review about the budgeting strategies and processes taking in consideration the product characteristics and the difficulties in the current budgeting method in order to bring an ideal solution to this specific case.

Keywords: Budget · Production cost · Planning.

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Functional Electrical Stimulation System for a Wearable-based Biostimulation

João Lucas Gonçalves[1], José Lima[1], and Paulo Leitao[1]

Research Centre in Digitalization and Intelligent Robotics (CeDRI), Instituto Politécnico de Bragança, Bragança, Portugal
a37887@alunos.ipb.pt,{jllima,pleitao}@ipb.pt

Abstract

The objective of this paper is to describe the methodology and preliminary results of the development of an electrical stimulation system, for a wearable device aiming the biostimulation. The paper describes the project environment of this work, the function and importance of the functional electrical stimulation, the current development of the system and presents the preliminary results with further expectations.

Keywords: Functional Electrical Stimulation · Wearable · Stimulation circuit.

DNS firewall based on Machine Learning: Proposal, Methodology and Preliminary Results

Cláudio Marques[1], Silvestre Malta[2], and João Paulo Magalhães[3]

[1] Instituto Politécnico de Viana do Castelo, IPVC, Portugal
[2] ADiT-Lab, Instituto Politécnico de Viana do Castelo, IPVC, Portugal
[3] CIICESI, Instituto Politécnico do Porto, IPP, Portugal
claudioms@ipvc.pt,smalta@estg.ipvc.pt,jpm@estg.ipp.pt

Abstract

In this paper we present a data analytic process that involves the creation of a Domain Name System (DNS) dataset to be trained by machine learning algorithms in order to detect malicious DNS domains on the fly. The dataset is based on real DNS logs and it was enriched using Open-Source Intelligence (OSINT) sources. The exploratory analysis and data preparations steps were carried and the final dataset will be submitted to different Machine Learning (ML) algorithms. Some preliminary results reveals the accuracy and time required to classify if a domain request is malicious or not.

Keywords: Cybersecurity · DNS · Firewall · Machine Learning.

Identification and Characterization of Improvement Opportunities in Industrial Processes

Ana Oliveira[1], Paulo Matos[2] and Paulo Leitão[3]

Research Centre in Digitalization and Intelligent Robotics (CeDRI), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal
a41301@ipb.pt pmatos@ipb.pt pleitao@ipb.pt

Abstract

Flexibility in responding to demand has become a major challenge for industries today. To achieve customer expectations, organizations must be flexible enough to offer a wide range of products and services that are available at any time and with the quality expected by customers. Digitization and Industry 4.0 have a strong impact on today's production environment. Established lean production methods are part of this flexibilization process and can be improved through new technologies. Any digitization must deal with waste and reduce it more effectively than a classic lean approach could. When compared to conventional automation, lean automation spaces are smaller, system prices are cheaper, inventory and energy use are lower. The system designer and operator, however, must have higher skills and knowledge. The integration of innovative automation technology along with lean production is an up-to-date and promising topic as industry 4.0 will not solve the problems of poorly organized and managed manufacturing systems. Furthermore, its tools must be applied to lean activities that are already successful even before automation.

Keywords: Industry 4.0. · Lean Manufacturing · Continuous Improvement · Industrial Processes.

Exploring Security Vulnerabilities in LPWANs: The IPVC BIRA Bicycle Case

Nuno Torres[1], Pedro Pinto[1], and Sérgio Ivan Lopes[1]

ADiT - Instituto Politécnico de Viana do Castelo, 4900-348 Viana do Castelo, Portugal
nunotorres@ipvc.pt,pedropinto@estg.ipvc.pt

Abstract

Due to its pervasive nature, the Internet of Things (IoT) is demanding for Low Power Wide Area Network (LPWAN) since wirelessly connected devices need battery-efficient and long-range communications. By using LPWAN technologies, the IoT devices are less dependent on common and existing infrastructure, can operate using small, inexpensive, and long-lasting batteries (up to 10 years), and can be easily deployed within wide areas, typically over 2 km in urban zones. The BIRA bicycle is an initiative of Instituto Politécnico de Viana do Castelo (IPVC) that aims to promote bicycle usage on campus, by encouraging the adoption of more sustainable mobility habits within the institution.

In this work we provide a systematic review on the security vulnerabilities that exist in LPWANs, followed by a literature review with the main goals of substantiating an attack vector analysis specifically designed for the IoT ecosystem. Results have shown that LPWANs contain security vulnerabilities that can lead to irreversible harm. Also, the conception and implementation of up-to-date defenses are relevant to protect systems, networks, and data. More details can be found in [1].

With the knowledge from the systematic review, a secure LoRa-based tracking system for the BIRA bicycle was proposed. The system consists of BIRA bicycles equipped with low-cost GPS trackers. The collected data is then transmitted using a LoRaWAN infrastructure to an application server, which is responsible for storing and serving the client application with several contextual information. The proposed system is a viable low-cost solution for tracking bicycles and users' habits at a campus or city level.

For future work, an experimental setup will be defined with focus on hacking the RF physical layer with Software Defined Radio (SDR) techniques, performing GPS Jamming and Spoofing, Replay Attacks, and Selective Jamming, in an environment that relies on LoRaWAN networks.

Keywords: LPWAN · IoT · Cybersecurity · Smart Mobility

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A Smart Contract Architecture to Enhance the Industrial Symbiosis Process between the Pulp and Paper Companies - a case study

Ricardo Gonçalves[1] Pedro Pinto[12] and António Pinto[3]

[1] Instituto Politécnico de Viana do Castelo, 4900-347 Viana do Castelo, Portugal
[2] ISMAI and INESC TEC, Porto, Portugal
[3] CIICESI, ESTG, Politécnico do Porto, Portugal CRACS & INESC TEC, Porto, Portugal
rmiguelgoncalves@ipvc.pt,pedropinto@estg.ipvc.pt,apinto@inesctec.pt

Abstract

Pulp and Paper Companies collaborate to monitor and monetize waste and create value from their by-products. This process of Industrial Symbiosis requires the creation and maintenance of trusted and transparent relationships between all entities participating in these networks, which is a constant challenge. In this context, a blockchain-based system can help in establishing and maintaining these networks, serving as a ground truth between companies operating at a national or a global scale. This paper proposes a scalable and modular blockchain architecture design using smart contracts to enhance the industrial symbiosis process of the Pulp, Paper, and Cardboard Production Sector companies in Portugal. This design comprehends all entities participating in the network, namely the Pulp and Paper companies, the Sand Producers, the Mortar Producers, the organizations that use the resulting material mixture, and the Environmental Portuguese Agency (EPA) [1]. The implementation of this design assumes the use of a permissioned ledger built using Hyperledger Fabric to provide the required trust and transparency between all entities.

Keywords: blockchain, smart contracts, industrial symbiosis, hyperledger fabric

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Content-based Email Phishing Detection

Marco Saraiva[1], Silvestre Malta[2], and João Paulo Magalhães[3]

[1] Instituto Politécnico de Viana do Castelo, IPVC, Portugal
[2] ADiT-Lab, Instituto Politécnico de Viana do Castelo, IPVC, Portugal
[3] CIICESI, Instituto Politécnico do Porto, IPP, Portugal
marcosaraiva@ipvc.pt,smalta@estg.ipvc.pt,jpm@estg.ipp.pt

Abstract

Among the various cyberattack vectors, phishing continues to lead. Phishing is a social engineering technique used to trick users and obtain sensitive information. It can be divided into two main types. As mentioned in [3] Regular phishing uses a broad-strokes approach that involves sending bulk emails or SMS to massive lists of contacts and spear phishing which is targeted and personalized to a specific individual, group, or organization. A report published by Keepnet Labs in [2] refers that 96% of phishing attacks are made via email and around and that 97% of users cannot identify a sophisticated phishing email. According to the Verizon DataBreach Investigations Reports Phishing statistics [4], 30% of phishing messages are opened by targets and 12% of those users open the attachments and/or malicious links coming from that email. According to the FBI [1], by comparing the numbers between the year 2019 and 2020, the problem has doubled and when compared to 2016 it has increased 11 times. Address the problem is not easy, since it requires a holistic vision involving technologies, processes and people.

Our contribution aims to reduce the problem of email phishing. More specifically, within the scope of the project, a dataset is being created with a focus on the content of the emails. The dataset is composed of phishing emails and regular emails and a vast set of parameters obtained from the content of the emails. In order to classify emails as phishing or not, a set of machine learning models will be modelled. The initial set of emails is composed of 3527 benign emails and about 1296 phishing emails. For each email 72 features were derived from the email content. The number of errors, email size, the sentimental analysis and the Named Entity Recognition, i.e., the grammatical composition of the emails. Currently dataset cleaning is being preformed (remove null values, normalization, etc.) and it will be submitted to different machine learning algorithms to learn how to classify emails. Create an automatic detection mechanism for phishing emails is a significant contribution to a complex problem that affects organizations in terms of finance and reputation.

Keywords: Email Phishing · Social Engineering · Machine Learning.

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Implementation and Comparison of Low Power Wireless Protocols in a Mesh Topology

Amani Nafkha[1] and Paulo Matos[1]

Research Centre of Digitalization and Intelligent Robotics CeDRI, Instituto Politécnico de Bragança, Bragança, Portugal
{amani.na.nafkha@alunos.ipb.pt,pmatos@ipb.pt}

Abstract

The Internet of Things is one of the upcoming networking that helps bridge the gap between the real world and the virtual world by enabling monitoring and control of certain elements.

The critical point for the future is the design with low power wireless technologies based on mesh topologies because it is very attractive due to their reliability and scalability of failures. In this report, we provide an overview of the most popular short-range wireless communication standards, such as BLE, Zigbee, and Thread technologies, comparing their key features and behaviors in terms of various metrics, network topology, security, quality of service, and power consumption.

This study presented in this work will be useful to the application in selecting the best technology for a concrete use of the low power wireless protocol.

Keywords: IoT · BLE · Zigbee · Thread.

An IoT-based approach for monitoring the hydraulic stability of breakwater infrastructures

Jorge Neiva[1], Sara Paiva[1], and Sérgio I. Lopes[1]

ADiT-Lab, Instituto Politécnico de Viana do Castelo, Portugal
jneiva@ipvc.pt

Abstract

A breakwater is a structure that aims to protect the coast or a port area from the action of sea waves and is commonly used to stop the force of the waves and limit the speed of the sea currents. These critical infrastructures are often built with massive concrete units, such as the Antifer block [1].

This work presents the design of the Smart-Antifer, a small-scale IoT-enabled Antifer block, capable of measuring, recording, processing, and communicating data that reports displacements of Antifer block, in a laboratory context.

Typically, Hydraulics Laboratory procedure for carrying out a simulation test consists of constructing a small-scale structure with several concrete Antifer blocks [3], and then evaluate its displacement between experiments. After performing a laboratory test, the wave pool is emptied (can take up to 2 days) to proceed with the acquisition of the photographic evidence and obtain the displacement of the Antifer blocks. Then, after completing the displacement data collection, the pool is refilled again. After the pool is filled, all steps are performed again.

In the work *Smart Rocking Armor Unit* [2], *Bas Hofland* describes an embedded system installed in a Tetrapod block. The system was developed in Arduino and is based on a low-cost IMU. The size of the embedded system is 20 x 20 x 20 mm and includes a battery, a USB connector, a microcontroller, a 9-axis IMU, and a memory card. The maximum sampling frequency that was obtained is 30 Hz.

The overall system architecture describes its functional blocks, which can be divided into three main blocks.

The proposed device aims to streamline the collection of data between experiments. It takes advantage of Bluetooth technology for data collection to a mobile application running on a smartphone, which then transmits the data to the cloud.

The SmartAntifer block was designed to comply with the following application requirements:

- 3D displacement measurement with 25 mm resolution;
- Wireless connectivity;
- Minimum sampling frequency of 4 Hz;
- Possibility to export data in CSV format;
- Be prepared to be installed in a watertight system;
- Charging without physical connectors;
- Autonomy between 6 and 8 hours.

The mobile application also allows changing the configuration parameters of each Smart-Antifer block and also manages the stored data. Another functionality of the mobile application is to send the collected data to the application server through Wi-Fi/4G which are natively available in the mobile device.

Meanwhile, on the server side, the data received from the mobile application is stored in a database and processed for visualization. Furthermore, a block of analytics is used to identify movements and evaluate the 3D displacement of each specific Smart-Antifer block that has been used in a specific experiment.

Preliminary results have shown that the Smart-Antifer prototype fulfills the core application requirements. A PCB was developed and a prototype unit was fully assembled. All the building blocks were tested and validated. Regarding future work, three main tasks have been identified: i) create a 3D enclosure for the device; ii) implementation of the mobile application to configure and manage the data obtained; and iii) implementation of server-side and data analysis to show the offset performed.

Keywords: IoT · Smart Monitoring · Antifer · Hydraulic Stability.

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Security in Vehicle-to-Everything (V2X) and communications for Future Intelligent Transportation Systems (ITS)

João Silva[1], Luís Barreto[1], and Sérgio I. Lopes[1]

Instituto Politécnico de Viana do Castelo, IPVC, Portugal
jemanuelsilva@ipvc.pt

Abstract

Autonomous driving has become a reality, with different manufacturers already implementing this concept in their vehicles, although at an early stage. To achieve this goal, vehicles have to be in constant communication with the surrounding environment to exchange the necessary information that will allow them to make correct and timely decisions. These communications co-exist with different stakeholders in the road environment (traffic lights, roads, bicycles, people, other cars, infrastructure, etc), and are thus considered as V2X, Vehicle-to-Everything communications.

This work aims to study the main security vulnerabilities of V2X communication standards in two specific application contexts concerning the future of Intelligent Transportation Systems (ITS). This study will focus on two specific application cases, namely Truck Platooning and Cooperative Collision Avoidance. To avoid the need for physical access to different equipment and facilitate the simulation of the two application scenarios, we have chosen to develop this study using digital simulators/emulators. Firstly, we evaluated and compared several simulators/emulators that have been recently used by the research community in the ITS context. Then, after evaluation, we selected the Eclipse Mosaic simulator to perform all the tests and present all the results and impacts on Vehicle-to-Everything communications when the main security vulnerability of V2X standard communication is exposed and used. With the previous research it was possible to verify that the main advantage of this emulator is the possibility of integration between different simulators and a wide possibility of choice with regard to communication simulators, which is the most relevant simulator for this paper. Thus, SUMO will be used to create the ITS scenarios mentioned above and NS-3 to simulate the communication between all participants.

Future work involves assessing vulnerabilities in the previously mentioned contexts, using the Eclipse Mosaic that proved to be the most suitable simulator.

Keywords: ITS · V2X Communication · Truck Platoon · Intersection Collision Avoidance · Simulation · Emulation.