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“Optimizing Innovation in Knowledge, Education and Design”

EXTENDED ABSTRACT



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3.	MOBILIAID: Robotic Independence of Disabilities <i>Nur Husna Serip Mohamad & Nur Hana Serip Mohamad</i>	243-245
4.	Investigating the Acceptance of Course File Electronic Knowledge Acquisition PPPG (CEKAP)System Via UTAUT Model <i>Mastura Mohamad, Rozita Mengen, Nor Farhana Mohd Azmi, Noorsuraya Mohd Mokhtar & Nurul Zahidah binti Md Juperi</i>	246-250
5.	XL2S Pan Borneo Vs Rajang River Boardgame 2.0 (Empowering Fitness and Fun: A Board Game for Inclusive Physical Activity Among People with Disabilities) <i>Suhardi bin Kram, Abbylolita Sullah, Siti Nurr Atika binti Mohd Sanif, Luke anak Nikol, Asmalini binti Che Abu Shafie, Gordon Nicolaus Jemat Anchang, Ashley Irenaeus bin Jeck</i>	251-254
6.	MoTSEL: Model of Technology-Supported Learning for Special Educational Needs Learners in Institutions for Higher Learning <i>Roslinda Alias, Nor Aziah Alias & Azwadi Mokhtar</i>	255-261
7.	E-Care Sentinel: ECG- Based Emergency Alerts <i>Rosziana Hashim, Suziana Ahmad, Gloria Raymond Tanny, Dayanasari Abdul Hadi, Ahmad Alif Ahmad Aina, Ahmad Firdaus Mohd Rasdi & Muhammad Harries Ezary Ahmad Khairi</i>	262-269
8.	Enhancing Dyscalculia Identification Through an Innovative 3D Game Framework <i>Sazilah Salam, Bambang Pudjoatmodjo, Ahmad Naim Che Pee & Rikman Aherliwan Rudavan</i>	270-274

CATEGORY: AST ACADEMIC INVENTOR

1.	Program Outcomes Monitoring System for Civil Engineering Students (POSCES) <i>Md Rasul Mohamad Nor, Hazrina Ahmad, Nurjuhanah Juhari, Norlizan Wahid, Noor Syafeekha Mohamad Sakdun, Shafienaz Ismail & Ruqayyah Ismail</i>	275-279
2.	Web-Based System for Dyslexic: A Screening and Learning Style Recommendation <i>Nur Melissa binti Mohammad Faisal Wee, Mohd Zaki bin Sadik, Mohamad Hafiz bin Mohd Yusof, Nurul Hidayah binti Mohd Yusof & Ummi Qaisara Faqihah binti Reman</i>	280-282
3.	2DAMP: The Novel of (2D)-Aminoethyl MethacrylatePerovskite for Ammonia Gas Sensor <i>Hasyiya Karimah Adli, Muhamad Yuzaini Azrai Mat Yunin, Norfatihah Mohd Adenam & Hadhrami Ab Ghani</i>	283-288
4.	An Attractive Approaches in Studying Basic OC (Organic Chemistry) <i>Ropisah Binti Me, Nur Syakilla Asyiqin Binti Hasan & Nur Syaida Maisarah Binti Hasan</i>	289-292

Assalamualaikum warahmatullahi wabarakatuh,



First and foremost, I would like to express my gratitude to the organizing committee of i-Spike 2023 for their tremendous efforts in bringing this online competition a reality. I must extend my congratulations to the committee for successfully delivering on their promise to make i-Spike 2023 a meaningful event for academics worldwide.

The theme for this event, 'Optimizing Innovation in Knowledge, Education, and Design,' is both timely and highly relevant in today's world, especially at the tertiary level. Innovation plays a central role in our daily lives, offering new solutions for products, processes, and services. By adopting a strategic approach to 'Optimizing Innovation in Knowledge, Education, and Design,' we have the potential to enhance support for learners and educators, while also expanding opportunities for learner engagement, interactivity, and access to education.

I am awed by the magnitude and multitude of participants in this competition. I am also confident that all the innovations presented have provided valuable insights into the significance of innovative and advanced teaching materials in promoting sustainable development for the betterment of teaching and learning. Hopefully, this will mark the beginning of a long series of i-Spike events in the future.

It is also my hope that you find i-Spike 2023 to be an excellent platform for learning, sharing, and collaboration. Once again, I want to thank all the committee members of i-Spike 2023 for their hard work in making this event a reality. I would also like to extend my congratulations to all the winners, and I hope that each of you will successfully achieve your intended goals through your participation in this competition.

Professor Dr. Roshima Haji Said
RECTOR
UiTM KEDAH BRANCH



WELCOME MESSAGE (i-SPIKE 2023 CHAIR)



We are looking forward to welcoming you to the 3rd International Exhibition & Symposium on Productivity, Innovation, Knowledge, and Education 2023 (i-SPIKE 2023). Your presence here is a clear, crystal-clear testimony to the importance you place on the research and innovation arena. The theme of this year's Innovation is "*Optimizing Innovation in Knowledge, Education, & Design*". We believe that the presentations by the distinguished innovators will contribute immensely to a deeper understanding of the current issues in relation to the theme.

i-SPIKE 2023 offers a platform for nurturing the next generation of innovators and fostering cutting-edge innovations at the crossroads of collaboration, creativity, and enthusiasm. We enthusiastically welcome junior and young inventors from schools and universities, as well as local and foreign academicians and industry professionals, to showcase their innovative products and engage in knowledge sharing. All submissions have been rigorously evaluated by expert juries comprising professionals from both industry and academia.

On behalf of the conference organisers, I would like to extend our sincere thanks for your participation, and we hope you enjoy the event. A special note of appreciation goes out to all the committee members of i-SPIKE 2023; your dedication and hard work are greatly appreciated.

Dr. Junaida Ismail

Chair

3rd International Exhibition & Symposium Productivity, Innovation, Knowledge, and Education 2023 (i-SPIKE 2023)

E-CARE SENTINEL : ECG- BASED EMERGENCY ALERTS

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ABSTRACT

The electrocardiogram (ECG) is a vital biosignal extensively used in healthcare for pulse monitoring and health evaluation. This project takes ECG signals for heart rate by exploring inventive methods involving ESP8266 and Internet of Things (IoT) technology to create emergency alert systems. The primary goal of this project is to design an IoT-based Personal Emergency Response System utilizing ECG signals. The study involves the analysis of data from the ECG simulator MS400 to categorize heart rate conditions, including bradycardia, normal, and tachycardia. Three ECG signals for heart rate, measuring 40 BPM, 80 BPM, and 120 BPM, are selected as sample signals for analysis. The simulator data serves as the reference input. The ESP8266 microcontroller is employed to gather inputs and classify the ECG signals based on heart rate conditions. The outcomes are presented through the Blynk

Application on smartphones and an integrated LCD display. The project undergoes functional testing to validate its effectiveness. Utilizing the ECG reference input, the project effectively functions as an alert system. It successfully indicates three heart conditions: bradycardia, normal, and tachycardia, presenting this information through both mobile apps and hardware displays such as LCD and LEDs.

Keywords: Electrocardiogram signals; IoT; Alert System

INTRODUCTION

An electrocardiogram (ECG) is a fundamental and rapid method to assess the heart's electrical activity that reveals heart rhythms and abnormalities such as arrhythmias. With the advent of new technologies, ECG are not only used in clinical settings but the application have grown to from personal health monitoring system to driver drowsiness detection (Chowdhury et al., 2018), stress condition (Cassani et al., 2021; Trobec, 2018), disease detection (Shaown et al., 2019) and others. ECG has been shown to be useful monitoring system for driver conditions.

Electrocardiogram (ECG) monitoring has witnessed a transformative shift with the integration of Internet of Things (IoT) technology (Huang & Song, 2022; Kamble & Birajdar, 2019; Nita et al., 2019). Using small wearable sensors (Celik et al., 2017; S. Rahman et al., 2022), it has enabled for real-time ECG tracking for remote patient monitoring (Aldammas et al., 2019; A. Rahman et al., 2019). The data is transmitted to cloud platforms, granting healthcare professional remote access for analysis. The structure of IoT assisted ECG monitoring framework (Xu, 2020) as in Figure 1.

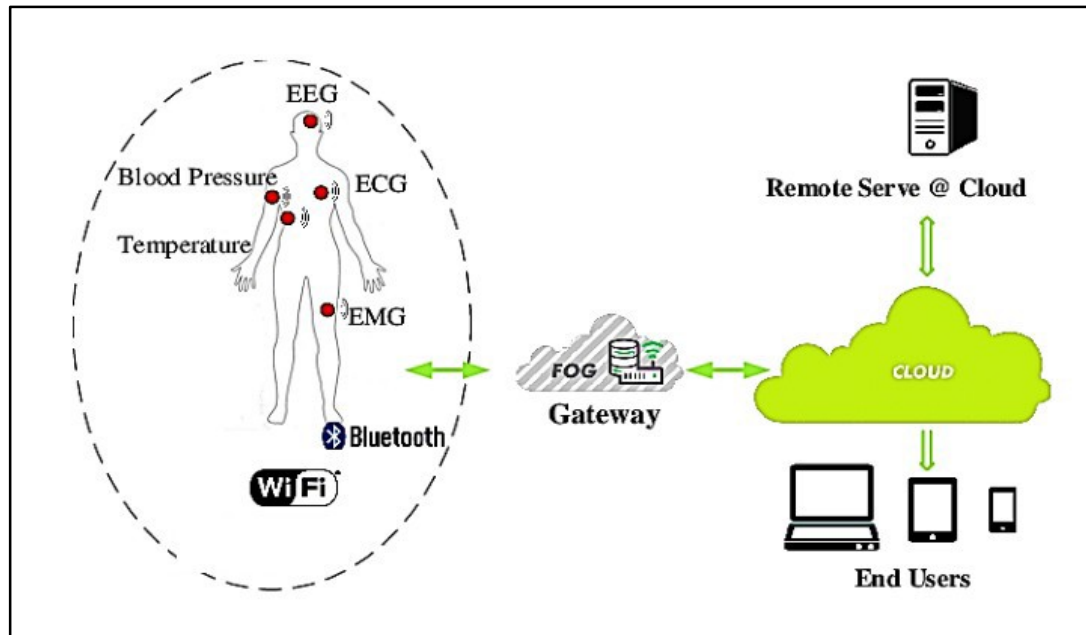


Figure 1. Structure of IoT assisted ECG monitoring framework (Xu, 2020).

The smooth connection boosts patient care, allowing uninterrupted daily activities, and aids swift irregularity response. ECG-IoT convergence promises healthcare transformation, precise diagnoses, and better patient results. The most important wave of an ECG signal is the QRS complex, which allows us to compute the R-R interval (Preethi et al., 2022; Shrestha & Yu, 2022). The most straightforward function of the R-R interval is to determine the heart rate. Heart rate is calculated by taking the reciprocal of the R-R interval duration. A shorter R-R interval

corresponds to a higher heart rate, while a longer interval indicates a slower heart rate

This E-Care Sentinel : ECG- Based Emergency Alerts introduces an emergency alert system that utilizes the ECG signal as its primary input. The research commences by gathering data through an ECG signal simulator. The acquired data serves as the reference input for a microcontroller; ESP8266. Subsequently, an IoT system is created to display three distinct conditions derived from the ECG signal: bradycardia, normal, and tachycardia. These conditions are visually displayed using both an LCD screen and LED indicators.

PROBLEM’S & ISSUE SCENARIO

One of the key issues faced by individuals with disabilities is the lack of timely assistance during medical emergencies. People with disabilities require assistance during emergencies to reach their caregiver if the caregiver is not present. In other hand, sseizures and cardiac events can be unpredictable among the disabilities people. Therefore, The Internet of Things (IoT) and ECG-based Alert Systems can be integrated to both help and assist people with disabilitiesin seeking the help during emergency.

Disability-related mobility limitations put many people at increased danger, and their need on others makes the situation much more urgent. In cases where individuals with disabilities are dependent on caregivers or family members, the burden of constant monitoring can lead to caregiver burnout. ECG-based Alert Systems, when combined with IoT connectivity, offer a transformative solution by enabling the emergency alert system. Through real-time data transmission, the caregivers can receive immediate alerts, ensuring responses even in the absence of the disabled person's ability to communicate distress. This convergence of technology not only promises to enhance their safety but also restores a sense of independence, granting them the freedom to live with reduced constraints.

OBJECTIVES OF PRODUCT

Objectives of the project ;

1. To develop an emergency alert system that utilizes ECG signal with IoT for disable people
2. To alert caregivers in the event of an emergency occurrence, facilitating the provision of timely assistance

PROJECT DETAILS

The proposed project has several features and its technical specification as presented in table.1 and Table 2. respectively.

Table 1. E-Care Sentinel’s Features

1.	Heart rate abnormal detection
2.	IoT connectivity
3.	Mobile app- user friendly
4.	Real-time alert notification

Table 2. Technical Specification

1.	ECG input reference signal
2.	Microcontroller –ESP8266
3.	WiFi connectivity
4.	LEDs
5.	LCD display
6.	Blynk Application

The project is implemented according to the diagram in Figure 2. The system consists of three main components; data collection, IoT, and output, with the main unit is the ESP8266 microcontroller.

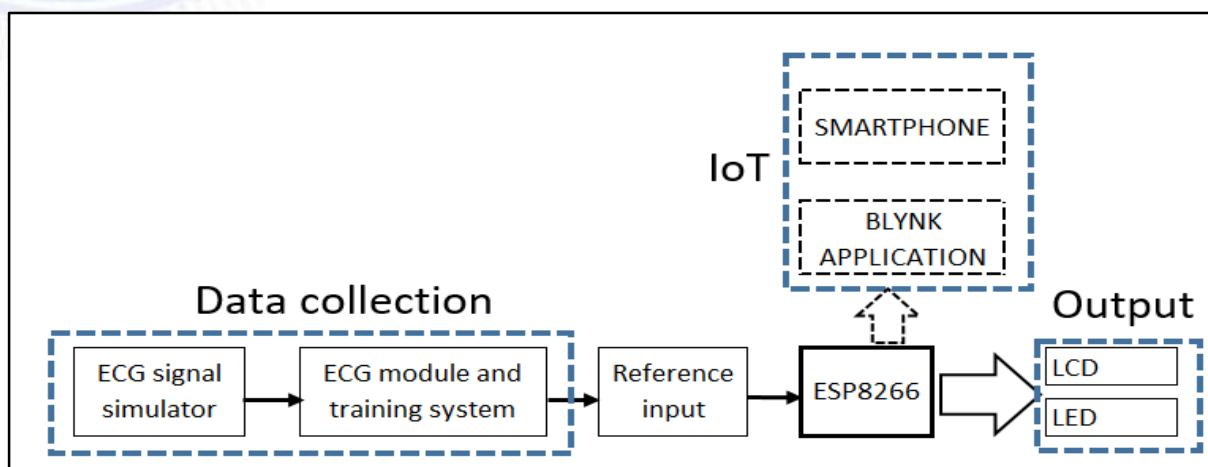
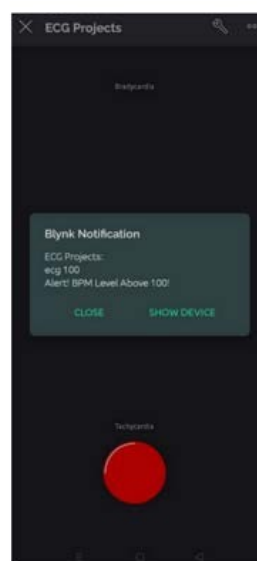


Figure 2. E-Care Sentinel's Block Diagram

The KL-75001 Electrocardiogram ECG Module, Multiparameter Simulator MS400, KL-76001 Biomedical Measurement Training System, and KL-730 Biomedical Measurement Training System were utilized to collect data. The information gathered is used to divide heart rate disorders into three categories: bradycardia (less than 60 bpm), tachycardia (more than 120 bpm), and normal heart rate (between 60 and 100 bpm). Data from the ESP8266 is obtained by the IoT section, which then displays it on the user's smartphone using the Blynk Application. The nodeMCU ESP8266 is used to send this input data. The Blynk Application interface displays indications and the application both send out notifications. LEDs and an I2C LCD panel with the output data are present. The product has been developed as presented in Figure. 3.



(a) Prototype



(b) User's interface

Figure 3.E-Care Sentinel : ECG- Based Emergency Alerts

PROJECT IMPACT AND VALUE

A. BENEFITS TO DISABLE PEOPLE

E-Care Sentinel: ECG-based Alert Systems with IoT offer a few benefits for disabled individuals. The foremost advantage is the prompt emergency assistance through real-time ECG monitoring. In case of irregular cardiac patterns or abnormal heart rate conditions, the E-Care Sentinel product able to trigger immediate alerts to caregivers and medical professionals in which enabling swift action even in the absence of the user's communication.

Remote notifications keep caregivers updated regardless of the location in which promoting a sense of security and reducing anxiety for disable person, care takers and families.

Most importantly, the product alerts enable caregivers or emergency services to intervene quickly expedite medical intervention, potentially averting life-threatening situations.

By bridging the gap between the onset of cardiac issues and response, ECG-based Alert Systems with IoT significantly enhance the overall quality of care and well-being for disabled individuals, emphasizing safety, peace of mind, and faster access to crucial medical attention.

B. NOVELTY & INVENTIVENESS

The innovative uniqueness of E-Care Sentinel: The advantage of ECG-based Alert Systems for disabled people is their capacity to warn both caregivers and families in real time during emergency breaks. The features included in the product as following;

- Real time notification
- Integrated Internet of Things (IoT) technology
- Mobile integration

- d. Emergency response
- e. User friendly
- f. Peace of mind
- g. Public health impact

C. COMMERCIALIZATION POTENTIAL

Commercialized as wearable device with mobile apps offering real-time activity monitoring not only addresses the unique needs of disabled individual but also aligns with current market trends in healthcare technology. Provides a user-centric, accessible, and scalable solution that has the potential to improve the quality of life and safety of individuals with disabilities while offering commercial opportunities for developers and healthcare providers.

PRODUCT'S RESEARCH EVIDENCE

E-CARE SENTINEL : ECG- BASED EMERGENCY ALERTS has been undergo the functionality testing. The development of the product till the experiment are presented in the acceptance paper in Scopus journal, Kongzhi yu Juece/Control and Decision as below.



Figure 3. Accepted article in Scopus journal.

CONCLUSION

In conclusion, the E-Care Sentinel project introduces an innovative ECG-based emergency alert system that leverages IoT technology to provide timely assistance for individuals with disabilities. By utilizing ECG signals, this system effectively detects and alerts caregivers about abnormal heart rate conditions such as bradycardia, tachycardia, and normal heart rates. The integration of IoT ensures real-time data transmission, enabling immediate responses even when the disabled person cannot communicate in distress. This project's impact is significant, offering enhanced safety, peace of mind, and faster medical intervention. Its novelty lies in its real-time notifications, IoT integration, and user-friendly design. With its commercialization potential as a wearable device and mobile app, it addresses the evolving healthcare technology landscape. Functionality testing validates its effectiveness, and its development journey is documented in a Scopus journal. ECare Sentinel exemplifies a transformative solution at the intersection of healthcare and technology, improving the lives of disabled individuals while catering to market demands.

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