International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Developing A Microcontroller Driven RSSI Controlled Prisoner Escape Management System

Mahalakshmi S
Assistant Professor Department of Electronics and communication Engineering, Peri Institute of Technology, India

Nidheesh Raj S
Department of Electronics andcommunication Engineering, Peri Institute of Technology, India

Diviesh N
Department of Electronics and communication Engineering, Peri Institute of Technology, India

Harish Balaji Kanna S
Department of Electronics and communication Engineering, Peri Institute of Technology, India

Abstract **- This project aims to develop a system using Arduino Uno microcontroller to monitor the vital signs and location of prisoners. The system includes a heart rate sensor and a DS18B20 body temperature sensor to continuously monitor the heart rate and body temperature of the prisoner. The acquired data is then stored and updated in a PLX-DAQ database. In addition to monitoring the vital signs, the system utilizes Receive Signal Strength Identification (RSSI) technology to track the signal strength of the prisoner. If the prisoner attempts to escape, the signal strength will decrease due to the increased distance from the monitoring system. This change in signal strength serves as an indicator of a potential escape attempt. By continuously monitoring the vital signs and signal strength, the system provides real-time data to identify any abnormal or suspicious activities. In the event of a significant drop in signal strength indicating an escape attempt, appropriate actions can be taken to prevent the prisoner from escaping. This project enhances prison security and enables prompt response to escape attempts by leveraging technology and monitoring systems. It ensures the safety of prisoners and assists in maintaining a secure prison environment. The collected data can also be used for further analysis and evaluation of prisoner health and behaviour patterns, contributing to improved prison management and security protocols.**

Keywords- **RSSI Technology, IoT, Temperature Sensor, Heartrate Sensor.**

I. INTRODUCTION

This project introduces an advanced prisoner management system designed to enhance security and prioritize the well-being of incarcerated individuals within correctional facilities. Utilizing a microcontroller-driven approach, the system integrates RSSI (Receive Signal Strength Indicator) control to monitor signal strength, enabling efficient detection of potential escape attempts. Alongside these security measures, the project incorporates health monitoring functionalities by leveraging sensors like a heart rate monitor and body temperature sensor. By seamlessly integrating escape prevention measures with real-time health monitoring, this innovative system provides a comprehensive solution to the complex challenges faced by correctional institutions. The continuous monitoring of vital signs ensures prompt intervention in medical emergencies, contributing to inmate welfare and risk mitigation. Through its dual focus on security and humanitarian concerns, the system represents a significant advancement in correctional technology, offering a proactive approach to managing both security risks and inmate well-being. By harnessing the capabilities of microcontroller-driven systems and cutting-edge technology, this project aims to improve safety and security within correctional facilities, ultimately fostering a more secure and humane environment for both inmates and staff.

II. SYSTEM OVERVIEW

This project presents an innovative integration of an Arduino Uno microcontroller within a comprehensive prisoner monitoring system, aimed at enhancing both the security and well-being of incarcerated individuals. Central to this system is the utilization of a heart rate sensor, which continuously monitors the prisoner's heart rate, providing invaluable insights into their health status. Complementing this, a body temperature sensor is employed to consistently measure the prisoner's body temperature, ensuring their physical well-being is monitored in real-time. Through the utilization of the PLX-DAQ database, this system facilitates the recording and updating of vital health parameters such as heart rate and body temperature, enabling correctional staff to have access to timely and accurate health data. Additionally, the system incorporates Receive Signal Strength Identification (RSSI) technology to gauge the signal strength emitted by the prisoner. This

International Conference on Electrical Electronics & Communication Technology (ICEECT'24) ISBN: 978-93-340-6066-9, PERI INSTITUTE OF TECHNOLOGY, Chennai. Volume: 06 Issue: 05 | May -2024

technology serves as a proactive security measure, as any attempt by the prisoner to escape results in a detectable drop in signal strength. This drop triggers an immediate alert, enabling swift identification and apprehension of the individual attempting to escape. By amalgamating these advanced technologies, the system ensures efficient and proactive prisoner monitoring, significantly enhancing security measures within correctional facilities. Moreover, the real-time monitoring of vital signs and signal strength not only contributes to the prevention of escape attempts but also supports the prompt intervention in medical emergencies, thereby safeguarding the overall well-being of inmates. This comprehensive approach to prisoner monitoring exemplifies a significant advancement in correctional technology, promising to improve safety and security within correctional facilities while simultaneously prioritizing the health and welfare of incarcerated individuals.

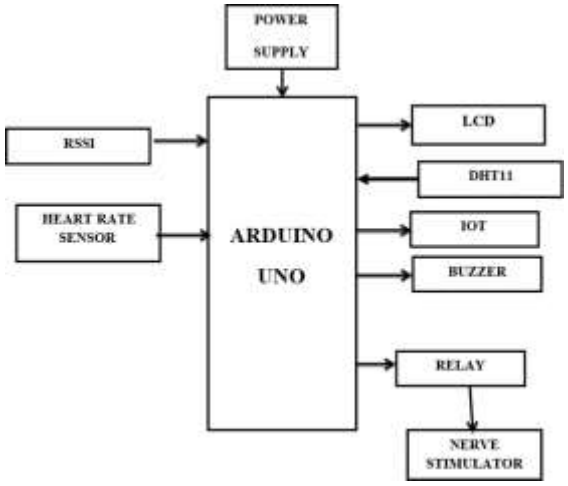

Figure 1. System architecture of the system

The system comprises three main modules: "Prisoner Range Identification," "Health Monitoring System," and "Alert System." The "Prisoner Range Identification" module utilizes advanced Receive Signal Strength Identification (RSSI) technology to accurately determine the range of the prisoner within the facility. This module enables real-time tracking of the prisoner's location and provides timely alerts in case of any attempt to breach the designated range. The "Health Monitoring System" module continuously monitors the prisoner's vital signs, including heart rate and body temperature, using dedicated sensors. This ensures the immediate detection of any health anomalies or emergencies, facilitating prompt medical assistance when needed. The "Alert System" module integrates with both the prisoner range identification and health monitoring systems to trigger alerts in response to detected deviations or breaches. These alerts enable correctional staff to swiftly respond to security threats or medical emergencies, enhancing overall safety and security within the correctional facility. Together, these modules form a comprehensive and proactive system for prisoner management, ensuring both security measures and the well-being of incarcerated individuals are effectively addressed.

A. Prisoner Range Identification

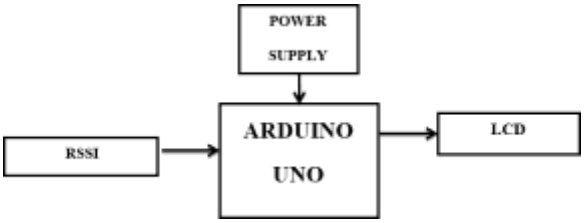

Figure 2. System architecture of the range identification system

In this system, ARDUINO UNO microcontroller controls all over system. ESP8266 microcontroller is used as RSSI module (Receive Signal Strength Identification). This module placed on the prisoner hand that continuously finds the signal strength of the prisoner. LCD is used to display the signal strength parameter of prisoner.

B. Health Monitoring System

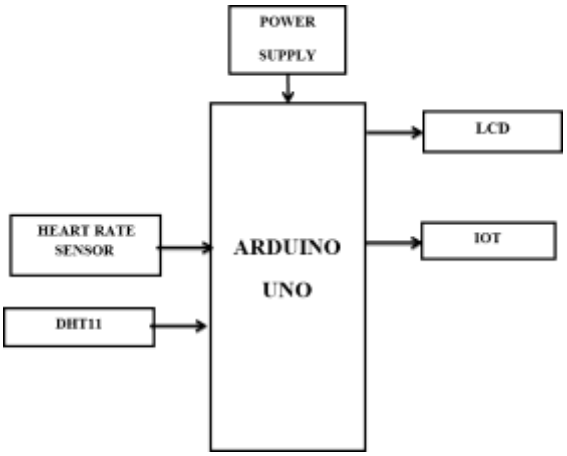

Figure 3. System architecture of the health monitoring system

Within this section, the ARDUINO UNO microcontroller serves as the central control unit for the entire system. Utilizing a DHT11 sensor, the system continuously monitors the body temperature of the prisoner, while a heart rate sensor tracks their heartbeat. These vital sign data are seamlessly transmitted and updated on an IoT webpage, ensuring remote access for monitoring purposes. Moreover, to provide immediate on-site feedback, an LCD screen displays real-time updates of the prisoner's vital signs within the facility. Through this integrated approach, the system facilitates comprehensive monitoring of the prisoner's health status, enabling timely interventions in case of any abnormalities.

B. Alert System

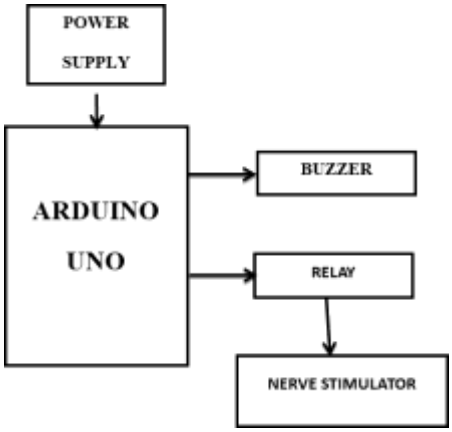

Figure 4. System architecture of the alert system

This section details the utilization of the ARDUINO UNO microcontroller as the central control unit for the entire system. In the event of a prisoner escape attempt, the system employs an RSSI module to detect a decrease in signal strength, signalling a potential breach. Upon detection, a buzzer attached to the prisoner's hand is activated, emitting a loud alarm to alert correctional staff. Additionally, a relay is triggered, activating a nerve stimulator device that administers an electric shock to the prisoner, effectively impeding their escape. This multi-layered response mechanism ensures swift and decisive action in response to security breaches, enhancing the facility's ability to prevent escapes and maintain order.

III. System Evaluation

The presented prisoner monitoring system demonstrates a commendable integration of advanced technologies, primarily cantered around the Arduino Uno microcontroller. The system's ability to monitor vital signs, track prisoner location, and trigger alerts in response to security breaches is a significant advancement in correctional technology.

The Health Monitoring System effectively utilizes sensors like the DHT11 and heart rate sensor to continuously monitor the prisoner's vital signs, ensuring timely interventions in case of any abnormalities. The integration with an IoT webpage for remote access enhances the system's usability and accessibility for correctional staff.

The Prisoner Range Identification module, utilizing ESP8266 microcontroller as an RSSI module, showcases the system's capability to accurately determine prisoner location and promptly detect escape attempts. The real-time display of signal strength parameters on an LCD provides immediate feedback to correctional staff.

The Alert System, triggered upon detecting a decrease in signal strength, demonstrates a proactive approach to security breaches. The integration of a buzzer and nerve stimulator device effectively deters escape attempts, enhancing the facility's ability to maintain order and security.

Overall, the system presents a comprehensive and proactive approach to prisoner monitoring, enhancing both security measures and the well-being of incarcerated individuals. However, further testing and evaluation in real-world correctional environments are essential to assess the system's effectiveness and reliability in practical applications.

IV. Future Enhancements

Future enhancements for the project could include integrating biometric identification technologies, such as fingerprint or facial recognition systems, to provide an additional layer of security for prisoner identification and verification. Enhancing the prisoner range identification module with GPS technology could enable more precise real-time tracking of prisoner movements both within the facility and in outdoor areas. Implementing machine learning algorithms could allow the system to analyse historical data for patterns or anomalies in prisoner behaviour, facilitating predictive insights and proactive security measures. Integrating wearable devices, like smart wristbands or tags, could enhance prisoner monitoring by providing continuous tracking of vital signs and location data without manual input. Developing mobile applications or web portals for correctional staff to remotely monitor and control the system could improve operational efficiency and responsiveness to security incidents. Furthermore, integrating the system with centralized management systems used in correctional facilities could streamline data collection, analysis, and reporting processes, enabling better decision-making and resource allocation. Implementing advanced data analytics techniques, such as predictive analytics or anomaly detection, could further enhance the system's ability to detect security threats and anticipate potential issues before they escalate. Finally, designing the system with scalability and interoperability in mind would ensure seamless integration with existing infrastructure and future technologies, ensuring long-term viability and adaptability to evolving security needs.

V. Discussion

The development of a comprehensive prisoner monitoring system is motivated by the imperative to bolster security measures and prioritize the well-being of incarcerated individuals within correctional facilities. Challenges such as escape attempts and medical emergencies necessitate innovative technological solutions, integrating Arduino Uno microcontrollers, vital sign sensors, and RSSI

modules. This project aims to create a system that not only ensures facility security but also monitors prisoners' health status in real-time, enabling swift interventions when necessary. By continuously tracking vital signs and employing RSSI technology for real-time location monitoring, the system enhances security measures while promoting the health and welfare of inmates. Additionally,features like remote data access and integration with management systems enhance operational efficiency and facilitate timely responses to security incidents. Overall, the project's goal is to modernize correctional facility operations, contributing to safer, more secure, and more humane environments for both staff and inmates.

VI. Conclusion

In conclusion, the development of the prisoner monitoring system represents a significant advancement in correctional technology, addressing critical challenges faced by correctional facilities worldwide. By integrating advanced technologies such as Arduino Uno microcontrollers, vital sign sensors, and RSSI modules, the system offers a comprehensive solution to enhance security measures and prioritize the well-being of incarcerated individuals. Continuous monitoring of vital signs enables prompt interventions in case of medical emergencies, contributing to better inmate health outcomes. Moreover, the utilization of RSSI technology enables real-time tracking of prisoner movements, facilitating swift detection of escape attempts and enhancing overall facility security. The integration of features such as remote data access and interoperability with management systems further enhances operational efficiency and enables timely responses to security incidents. Through these innovative approaches, the project not only addresses current challenges but also sets the stage for future advancements in correctional technology. As correctional facilities continue to evolve, embracing technological solutions like the prisoner monitoring system will be essential in creating safer, more secure, and more humane environments for both staff and inmates. Ultimately, the success of this project underscores the importance of leveraging technology to improve the effectiveness and efficiency of correctional facility operations, ultimately leading to better outcomes for all stakeholders involved.

References

[1] Y. Wu, J. Lim, and M.-H. Yang, *"Object tracking benchmark," IEEE Trans. Pattern Anal. Mach. Intell.*, vol. 37, no. 9, pp. 1834–1848, Sep. 2015.

[2] M. Mu€ller, A. Bibi, S. Giancola, S. Alsubaihi, and B. Ghanem, *"TrackingNet: A large-scale dataset and benchmark for object tracking in the wild," in Proc. Eur. Conf. Comput. Vis.*, 2018, pp. 310–327.

[3] H. Fan et al., *"LASOT: A high-quality large-scale single object tracking benchmark," Int. J. Comput. Vis., vol.* 129,no. 2, pp. 439–461, 2021.

[4] M. Kristan et al., *"The visual object tracking vot2017 challenge results," in Proc. IEEE Int. Conf. Comput. Vis. Workshops*, 2017, pp. 1949–1972.

[5] L. Huang, X. Zhao, and K. Huang, *"GOT-10K: A large high-diversity benchmark for generic object tracking in the wild," IEEE Trans. Pattern Anal. Mach. Intell., vol.* 43, no. 5, pp. 1562–1577, May 2021.

[6] L. Hyv€arinen, R. Walthes, N. Jacob, K. N. Chaplin, and M. Leonhardt, *"Current understanding of what infants see," Curr. Ophthalmol. Rep., vol. 2, no. 4, pp. 142–149, 2014.[Online].Available:https://europepmc.org/articles/PMC4243010*

[7] P. Lennie and V. H. Sb, in *Visual Impairments: Determining Eligibility for Social Security Benefits. Washington, DC, USA: Nat. Acad. Press, 2002*.

[8] S. M. Marvastizadeh, L. Cheng, H. Ghaneiyakhdan, and S. Kasaei, *"Deep learning for visual tracking: A comprehensive survey," IEEE Trans. Intell. Transp. Syst., 2019.*

[9] G. Ciaparrone, F. L. Sanchez, S. Tabik, L. Troiano, R. Tagliaferri, and F. Herrera, *"Deep learning in video multi-object tracking: A survey," Neurocomputing, vol. 381, pp. 61–88, 2019.*

[10] A. Esteva et al., *"Deep learning-enabled medical computer vision," NPJ Digit. Med., vol. 4, no. 1, 2021, Art. no. 5.*