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IoT Based Prison Break Monitoring and Alerting System Using RF

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Abstract

IoT-Based Prison Break Monitoring and Alerting System using RF (Radio Frequency) is a system that achieves a Microcontroller based circuit to fulfill the module using RF technology. Each inmate is equipped with a non-detachable wearable device consisting of RF transmitters to detect their presence in the premises. We install RF transceivers at strategic location within the prison and the gateway for relaying data to the central monitoring system which is responsible for analyzing data and triggering alerts in case of escape attempts. The central monitoring system is fed with data to scan through all the prisoners mounted with an RF transmitter who transmits their unique prisoner code wirelessly to keep the overall system in synchronization. If a prisoner moves out of range, the integrated system is unable to encrypt the data. As a result the receiver circuit sends the details of the prisoner to the officers alerting portal which in turn gives instant alerts and catches the prisoner before he runs a few meters away from the premises. The IoT Gecko is interfaced to build the alerting portal which receives data from monitoring devices and displays alerts or buzzers through the internet. Thus our system offers a comprehensive and customized approach to prison security which provides real-time monitoring and alert for any security breaches by enhancing public safety.

Keywords – Alerting system, Buzzer, IoT Gecko, Microcontroller, RF Transceivers.

1. Introduction

IoT Based Prison Break Monitoring and Alerting System using Radio Frequency is a system that aims to monitor and detect any attempt by prisoners to break out of their cells or escape from the prison premises. The system uses radio frequency signals and microcontrollers to detect movements and alert the authorities via IoT Gecko platform which was interfaced through the internet for monitoring purposes. The nature of the problem that our system aims to solve is the increasing incidents of prison breaks and escapes, which pose a significant threat to public safety. Prison breaks can result in the release of dangerous criminals, leading to potential harm to individuals and society. Previous work in this field has involved the use of various technologies, such as surveillance cameras, motion sensors, and alarms. However, these methods have not been effective in preventing prison breakouts or detecting them early enough to take action. Hence the purpose of our IoT-based system is to provide a more advanced and reliable solution for monitoring and

alerting prison break attempts by sending immediate alerts to the prison staff, enabling them to take quick action to prevent a prison break. Our system can be easily installed in existing prisons, and can be customized to meet the specific needs of each facility. Additionally, the system can be integrated with other security technologies, such as surveillance cameras and biometric scanners, to create a comprehensive security system for prisons. Overall contribution of our system is significant in terms of enhancing prison security and improving public safety. Our system provides a more advanced and reliable solution for detecting and preventing prison breaks, reducing the risk of dangerous criminals escaping and causing harm to society. By reducing the workload and stress of prison staff, who can rely on the system to detect and alert them to potential threats.

2. Problem Statement

There is a demand for a proper secure security system, that is under budget to use and can provide satisfactory surveillance security solutions to the Indian jails also to the society. Many systems are introduced earlier to fulfill this demand that generally use equipment such as Bluetooth, GSM, GPS but these systems are not steady and can be affected by cyber-attacks, which will be the issue of the safety. Also there are many problems associated with the modern security systems, Some of the detected issues with CCTVs are unclear images at night, unsaturated camera footage, disturbing videos, visible horizontal lines on videos, improper video signal is available sometime, starting some false alarms without a proper cause, bright spots on the monitor, etc.

3. Aim and Objective

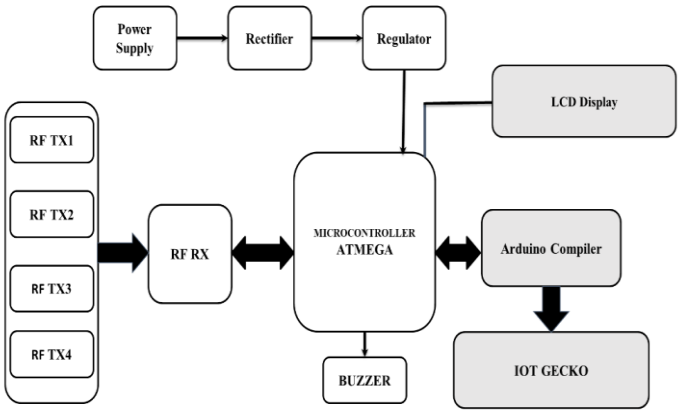
The purpose of this proposed project is to achieve a digital system for alerting and monitoring the prison breaks to the inmates using IOT.

1) To design and fabricate a wearable RF transmitter device for the prisoner
2) To design the receiver module using microcontroller and hybrid RF transceivers
3) To synchronize the Tx and Rx part for monitoring through IoT Gecko Platform interfaced by Arduino Compiler
4) To trigger the buzzer in case of the transmitter module in out of range
5) To display the unique prisoner code as output on LCD screen

4. Proposed System

We propose a system comprising wearable devices equipped with RF transmitters worn by prisoners, RF transceivers installed at strategic locations within the prison and a gateway for relaying data to the central monitoring system which is responsible for analyzing data and triggering alerts in case of security breaches. The central monitoring system analyzes data in real-time and sends notifications to concerned authorities via a secure protocol like IoT Gecko triggering alerts through buzzer's .Our entire system is grounded with a Microcontroller Circuit and a Unique Prisoner Code with a Transmitter Module is given for each prisoner. The Hybrid Transceivers are used for end-to-end Synchronization between Tx and Rx side where the Receiver module is fixed in the Central Monitoring System. Where loss of RF signals from the Transmitter part initializes the Central Monitoring System to trigger the alert/buzzer through IoT Gecko that had been interfaced with our proposed system. Finally the attempted Prisoner Identity will be displayed on the LCD screen.

5. Block Diagram



Above mentioned block diagram represents how our modules are connected with its essential flow's. Initially ATmega microcontroller is integrated with the receiver module fixed as a central monitoring system along with the buzzer and remote transmitters, where the preprogrammed logic of the microcontroller makes the receiver to initialize the particular functionality like triggering the buzzer after the loss of RF signal/transmitter in out of range, then our whole hardware system is interface through the internet via IoT Gecko platform for monitoring purpose where the entire system is powered by the battery and adapter .

6. Existing Methodology

In the traditional system prison staff manually patrols the prison premises at regular intervals to detect any signs of an escape attempt by surveillance cameras and drones, and then they quickly report any suspicious activity by walkie-talkies, phones, or other means to coordinate their response. Emergency alarms installed at main gates, cell-blocks, and watch towers can be triggered in case of an escape attempt, alerting the staff and mobilizing them to respond. The security staff responds to the alerts and takes necessary measures such as deploying additional security personnel, activating security doors and gates to prevent the escape.

7. Design and Development

Our entire system is deployed with a Microcontroller Circuit and a Unique Prisoner Code with a Transmitter Module is given for each prisoner. We use Hybrid Transceivers for end-to-end Synchronization between Transmitter and Receiver side. And our Receiver module is fixed in the Central Monitoring System, In case of any Loss of Radio Frequency signals from the Transmitter part initializes the Central Monitoring System to trigger the alert. Our whole system is interfaced with the IoT Gecko platform through the internet for monitoring and alerting purpose, Finally the Escaped Prisoner Identity will be displayed on the Output LCD Screen

8. Hardware and Software Components

ATmega Microcontroller: The ATmega328P Microcontroller is the heart of the system, which controls all the operations and manages communication between the RF transmitters and the receivers based on the predefined programming logic. An AVR architecture of 32K 8-bit microcontroller is used. Most of the instructions are executed in a single clock cycle regulating a throughput of nearly 20 MIPS at 20MHz. The ATMEGA328-PU is a PDIP 28 pin package and is suitable for use in our 28 pin AVR Development Board.

RF Transmitters and Receivers: ST-TX01-ASK is an ASK Hybrid transmitter module designed by the Saw Resonator, with an effective low cost, small size, and simple-to-use which is responsible for transmitting signals from the prisoner to the monitoring center within the range. The ST-RX02-ASK is an ASK Hybrid receiver module, an effective low cost solution for use at 315/433.92 MHZ that receives signals from the RF transmitters worn by the prisoners to detect any break in RF attempts.

Buzzer: A buzzer is installed at the monitoring center to alert the security personnel in case of a prison break.

LCD : We use a 16x2 LCD display as output which has a resolution of 160x32 pixels, with each character taking up 5x8 pixels. The display can be controlled using a microcontroller that sends commands and data to the LCD module which allows text or other information to be displayed on the screen like alphanumeric characters, symbols, and basic graphics. It can also be programmed to display custom characters and graphics. The module typically includes a backlight, which can be controlled to adjust the brightness of the display.

Power Supply: Our system requires a power supply to run the various components. This may include batteries or a power supply unit.

Arduino Compiler: It is a critical component in the development of our system, as it allows us to write, compile, and upload code to the microcontroller, enabling the creation of customized monitoring and system.

IoT Gecko: This platform provides connectivity between RF transmitter and microcontroller, device management, data management, and cloud integration. The IoT Gecko interface can enable users to monitor the system in real-time and take proactive measures to prevent security breaches.
Additional Components: The extra components being used are Resistors, Capacitors, Push Button, Crystal Oscillator, Cables, Connectors, Diode, PCB, LED's, Transformer, and Adapter.

9. Prototype Model

We have developed the whole prison break monitoring and alerting system mentioned in the Fig.1 which represents the entire deployment of our system integrated along with a microcontroller as the base circuit which was connected to the RF Transmitters of the prisoner and Receivers module as central monitoring system, the status of the system is being displayed in the output LCD display of two cases. In Case 1: The transmitter and receiver is within the range of synchronization where the connection has been established which shows the system is in the monitoring state by displaying the message as "MAN PRESENT". In Case 2 : If the prisoner is absent the RF transmitter connection has not been established with the receiver

due to the modules in out of range, thus the monitoring system initializes the microcontroller to trigger the buzzer and display the output message as “MAN NOT PRESENT”. Hardware prototype is done and we are developing this system to interface with the IoT Gecko Platform for a software level monitoring purpose through the monitor to accomplish our overall IoT based system.

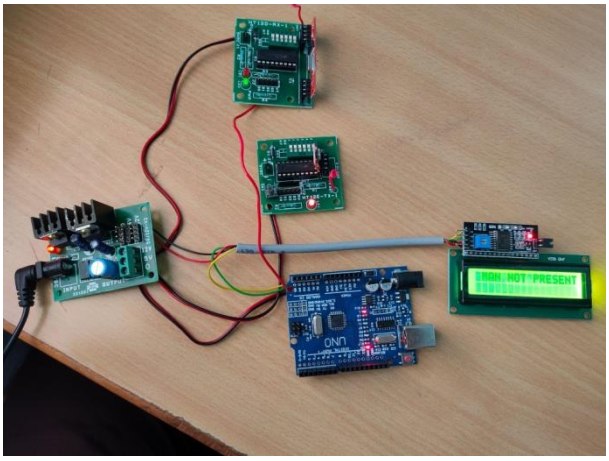
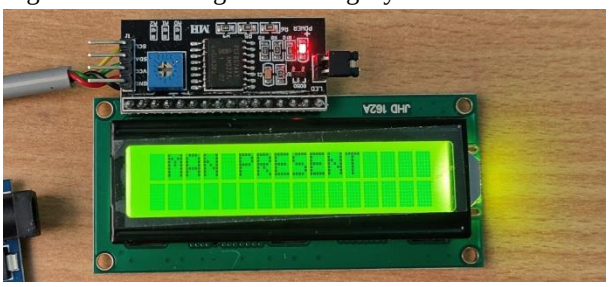


figure.1: monitoring and alerting system



case 1: system in monitoring state

case 2 : alerting state (prisoner absent)

10. Future Scope

In forthcoming years, we can expect to see further development and refinement of IoT-based prison monitoring systems. This may involve integrating new types of sensors, making compact transmitter devices by nanotechnology and machine learning algorithms, to improve the accuracy and effectiveness of the system. There may also be opportunities to use block chain technology to create a more secure and tamper-proof system. Additionally we can integrate motion sensors and heart beat sensors with this system to provide added benefit for the overall system. Overall, the future scope of IoT-based prison break monitoring and alerting systems using radio frequency is quite promising, and it has the potential to revolutionize prison security and prevent escape attempts.

11. Challenges and Constraints

Our system is mainly dependent on time constraints as it is one of the real time solutions which cause problems during execution. The module requires a strong internet connection for execution, if the internet connection is lost the system needs to reset. The front end interface has to run continuously without closing. The system loses connection when the window is closed.The main challenge of this system is of making the transmitter module as non-detachable wearable device that is to be worn by the prisoner where if the one attempts to remove the module we make the power supply to cut off and automatically the RF signal loss initiates the alert to the concerned authorities regarding the unusual activity of the prisoner.

12. Conclusion

An IoT-based prison break monitoring and alerting system using RF technology is a promising approach to enhance the security of prisons and ensure that inmates are unable to escape and that prison staff can respond quickly in the event of an attempted break. Our prison gives improved security rules for our country and minimizes the number of jailbreaks happening per year. It is a cost-effective solution that can be scaled to cover large areas of the prison, and it operates silently, minimizing the chances of false alarms or inmate evasion with a critical security measure that helps to keep both inmates and prison staff safe, secure, and protected from harm. The possible applications of this system include not only prison security but also other areas such as hospital security, industrial security, and public safety. The system can be extended by incorporating machine learning and artificial intelligence techniques of existing security access control systems and can be customized to meet the specific security requirements of different prisons to improve its accuracy and reduce false alarms. The importance of this work lies in its potential to improve the security of prisons, which is a critical aspect of public safety. Our system can also reduce the workload of prison staff by automating certain tasks and providing them with accurate and timely information. Moreover, it can help prevent costly escapes, which can be dangerous and result in significant economic losses. Overall, the IoT-based prison break monitoring and alerting system using RF technology is a valuable tool in enhancing prison security and preventing inmate

escapes. Its advantages and limitations must be carefully considered before implementing it in any prison, but the potential benefits make it a worthwhile investment.

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