Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 6, No.3, June : 2024

INTEGRATION OF SENSORS AND THE INTERNET OF THINGS (IOT) TO DEVELOP A SECURE PERSONAL BANKING LOCKER THAT PROVIDES INSTANT STATUS UPDATES.

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ABSTRACT
The issue we encountered cantered around out-dated security measures in traditional bank lockers. These lockers were insufficiently safeguarded against unauthorized access, compromising the security of valuable items stored within them. Concerns about theft and tampering arose due to their limited security features [2]. Therefore, there was an urgent need for a more advanced solution capable of providing real-time notifications to owners in the event of unauthorized access. To address these vulnerabilities, we developed an IoT-based Smart and Secure Banking Locker System [1]. This smart locker offers enhanced security features and mobile connectivity. The locker door is managed via the Blynk application, allowing users to customize their access passwords. A servo motor, connected to the locker gate, is controlled through the mobile app to open the locker. Furthermore, the system includes IR sensors that detect unauthorized access attempts and immediately send SMS alerts to the owner's mobile. These real-time notifications ensure owners receive instant updates whenever their locker is accessed unlawfully. In essence, we utilize an IFTTT server connected to the Node MCU for automatic SMS generation. This setup allows users to operate the locker while ensuring their security and privacy. The IFTTT server also assists with password resets when needed.

Keywords:
Bank locker. Servo Motor, IR sensors, ESP 8266, Blynk App, IFTTT server

Introduction
A bank is an institution known for providing high-level security for storing personal belongings. Many types of bank lockers system available now a days, but key-based individual bank lockers can often be problematic. Our project aims to enhance the security of individual bank lockers, which are meant to provide a high level of protection for personal belongings [9]. Although automatic security systems use passwords, fingerprints, and cards, these can still be stolen. Keys for traditional individual bank lockers can be inconvenient for both bank employees and users, and they can also be lost or duplicated. To address these issues, we have developed an IoT-based Smart and Secure Banking Locker System. The development and implementation of the IoT-based automated bank locker system marks a revolutionary shift in the traditional banking landscape. This section highlights the unique

contributions and advancements that make this work a significant breakthrough in banking security, operational efficiency, and user experience. A key innovation of this project is the seamless integration of Internet of Things (IoT) technologies into bank locker systems. While traditional lockers offer secure storage, incorporating IoT capabilities adds a dynamic layer of connectivity and intelligence. The system includes an Android app (Blynk), IR sensors, and microcontrollers (Node MCU) to create a networked environment that enhances security, privacy, monitoring, and management. The IoT-enabled automated bank locker system introduces advanced monitoring and remote access control [4]. If bank administrators or unauthorized individuals attempt to track the status of a locker, users receive instant alerts about suspicious activity and can precisely control access permissions. This detailed level of management not only strengthens security measures but also streamlines administrative processes, reducing the need for physical interventions. The system's ability to send automated alerts to users when their locker is accessed adds transparency and improves communication. Users receive immediate notifications about any activity related to their lockers, fostering a sense of awareness and control. This feature not only enhances the user experience but also contributes to the overall security framework by keeping users informed and engaged in the protection of their valuables. By incorporating IoT technologies; the system not only boosts security and efficiency but also modernizes the overall user experience in banking. The dedicated mobile application (Blynk) empowers users to remotely check their lockers, initiate access requests, and manage their valuables with unprecedented convenience. This user-centric approach positions the system at the forefront of technological innovation within the banking sector. As financial institutions aim to boost security and enhance customer experience, there is an increasing demand for innovative solutions that utilize IoT technology. One such solution is the IoT-based Smart and Secure Banking Locker System [10], which aims to transform traditional banking locker services through the integration of IoT devices and real-time monitoring features. This paper delves into the development and implementation of an IoT-based Smart and Secure Banking Locker System specifically designed for banking, with a focus on providing users with instant access notifications. The system seeks to tackle major challenges faced by banking institutions and customers, including security issues, operational efficiency, and user experience. While traditional banking locker systems effectively secure valuables, they often lack real-time monitoring and convenient access features. Figure 1 represents our prototype of individual bank locker system.

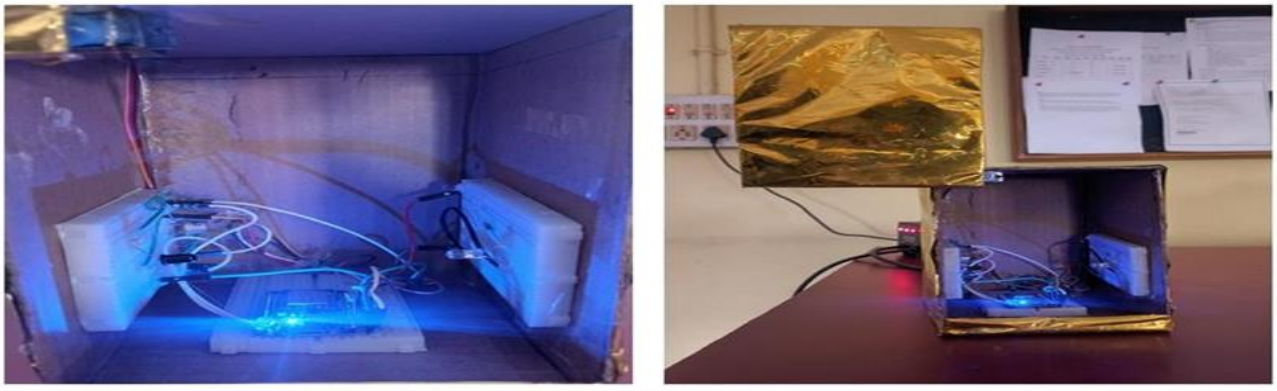

Figure 1: Prototype of IoT based smart individual bank locker

Technology and Methodology

Creating an IoT-based Smart and Secure Banking Locker System necessitates thorough deliberation of various factors to guarantee both functionality and security [3]. Presented below is a methodology delineating the stages involved such as (i) Requirement Assessment: Identify the precise needs of the banking locker system, encompassing security functionalities, user access tiers, notification methods, and integration with pre-existing banking infrastructures. (ii) System Structure Planning: Develop a

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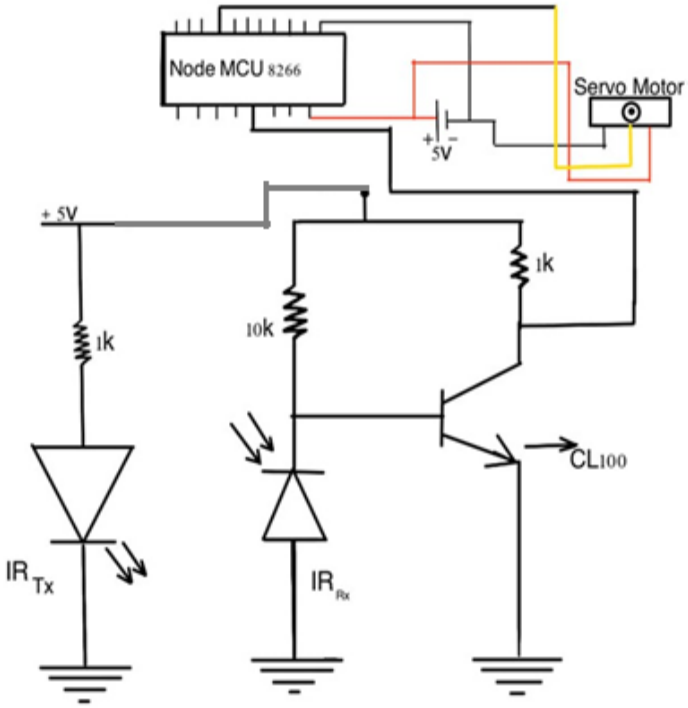

Figure 1: Circuit Diagram of smart Bank Locker

detailed blueprint illustrating the system's elements, comprising IoT gadgets, sensors, actuators, communication protocols, and backend infrastructure.(iii) Hardware Procurement: Select suitable hardware elements, such as IoT devices (e.g., microcontrollers, sensors), electronic locks, biometric scanners, and communication modules, in accordance with the system specifications. (iv)Security Measures: Incorporate strong security measures to safeguard data confidentiality, integrity, and availability. Employ encryption methods for both data transmission and storage [5]. (v) Locker Access Management: Create systems for controlling access that regulate user permissions and levels of access. (vi) IoT Device Incorporation: Incorporate IoT devices like electronic locks, sensors, and actuators into the system framework. Guarantee smooth communication between these devices and the backend infrastructure. (vii) Alert Mechanism: Establish a rapid notification system to inform users promptly about locker operations. (viii) User Interface Development: Create intuitive interfaces tailored for administrators and end-users. Develop mobile apps or web platforms enabling users to oversee their locker accounts, access logs, and receive notifications. (ix)Testing and Quality Control: Conduct comprehensive testing across the system to pinpoint and resolve any weaknesses or glitches. Conduct penetration testing to evaluate the system's resistance against potential security risks. (x) Implementation and Upkeep: Roll out the system in banking premises, ensuring accurate installation and setup of hardware elements. Offer continuous maintenance and assistance to resolve any concerns and maintain seamless system functionality. Through adhering to this approach, we have developed and put into operation an IoT-based Smart and Secure Banking Locker System, delivering user-friendly access while upholding top-tier security and dependability. We utilize a servo motor to control the opening and closing of individual bank locker door. The servo motor's input data is linked to a NodeMCU ESP8266. We establish a security password via the Blynk Android application and apply it for operation. The Blynk IoT App is a flexible and user-centric tool crafted to enable both individuals and enterprises to effortlessly develop IoT projects. Its user-friendly drag-and-drop interface empowers users to connect diverse hardware devices and sensors to the internet without requiring advanced programming skills. Moreover, Blynk seamlessly integrates with popular IoT platforms and services like IFTTT, Google Sheets, and Zapier, facilitating task automation and data analysis effortlessly. Within the locker, we have installed a pair or infrared Transmitter and Receiver. Figure 2 shows a simple circuit diagram of IoT based smart bank locker system, An infrared transmitter and receiver are positioned on opposite sides of the locker wall, facing each other. The IR transmitter sends a signal to the receiver. As long as the receiver is receiving this signal, it generates a high output. The IR receiver is connected to the base of a common emitter BJT, with a 5-volt VCC applied to the collector terminal (CL 100). Consequently, as long as the IR receiver produces an output, the base-emitter junction of the BJT remains closed, grounding the collector current. If a hand or any object enters the locker, the IR receiver stops receiving signals from the transmitter and produces a low output. This causes the base-emitter junction to open, resulting in a high collector output. The collector

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of the BJT is connected to a specified pin on the NodeMCU ESP8266. The ESP8266 interfaces with the IFTTT server to automate data collection and counting tasks through seamless IoT technology integration. The NodeMCU ESP8266, a versatile microcontroller, serves as the core of this system, enabling wireless communication and data processing [12]. By utilizing the IFTTT (If This Then That) web server, a powerful automation platform, data reception becomes effortless. The NodeMCU ESP8266 connects with various sensors or input devices to collect relevant data, such as product quantities or environmental parameters. Upon receiving the data, the IFTTT web server triggers predefined actions based on specified conditions, which may include data logging, sending notifications, or initiating counting processes. This setup leverages the capabilities of the NodeMCU ESP8266 and IFTTT to eliminate the need for manual data collection and counting, thereby enhancing efficiency and accuracy. Additionally, the real-time nature of this system ensures timely responses to changing conditions or inputs. Overall, this system exemplifies the seamless integration of IoT devices, web-based automation, and data processing to streamline operations and boost productivity in various applications, from inventory management to environmental monitoring. In our proposed system, when the IR sensor detects an object inside the locker and produces a low output, a specific pin on the NodeMCU is programmed to generate a high output through microcontroller coding. This high output condition is defined in the IFTTT server coding. When this condition is met, the IFTTT server triggers a predefined alert message to be sent to the contact number specified in the microcontroller code. The entire system is illustrated in a flow chart shown in Figure 3.

The process of data reception and automatic counting in an IoT-based smart and secure banking locker system involves several key steps and components such as: (i)Data Reception: The banking locker system integrates various sensors [6]. These sensors continuously gather data related to locker access, such as user identification, timestamps, and changes in the locker's contents. The sensor data is securely transmitted to a central IoT communication protocols like Wi-Fi, Bluetooth, or Zigbee.

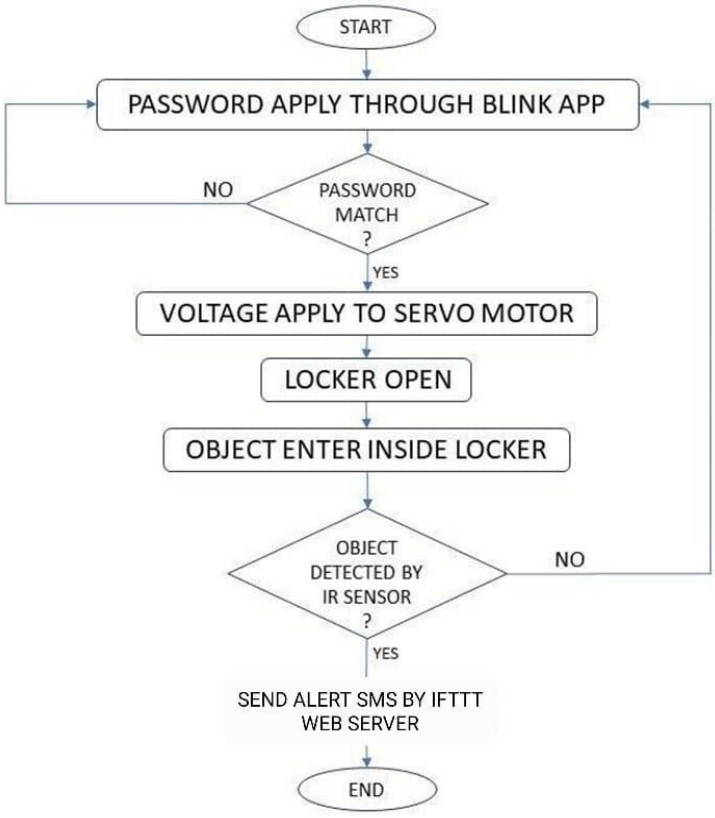

Figure 2: Flow chart of Automatic Smart Bank Locker

(ii) Banking Application: The system employs strong security protocols to safeguard sensitive banking assets stored in the lockers [7]. This includes data encryption during transmission and storage, access control mechanisms, and real-time monitoring. The system adheres to banking regulations and standards concerning data security, privacy, and audit trails. (iii) Integration with Banking Systems: The system integrates with the bank's core banking system for seamless transaction processing, account reconciliation, and reporting [8]. (iv) Instant Access Notification: Any locker activity, such as access or changes in contents, triggers instant notifications sent to the authorized user's registered mobile device or email address [11]. These notifications provide details including the type of activity (access or deposit/withdrawal), timestamp, and locker identification. Users can receive notifications and respond with authorization or alerts in case of suspicious activity. By following these principles, an IoT-based smart and secure banking

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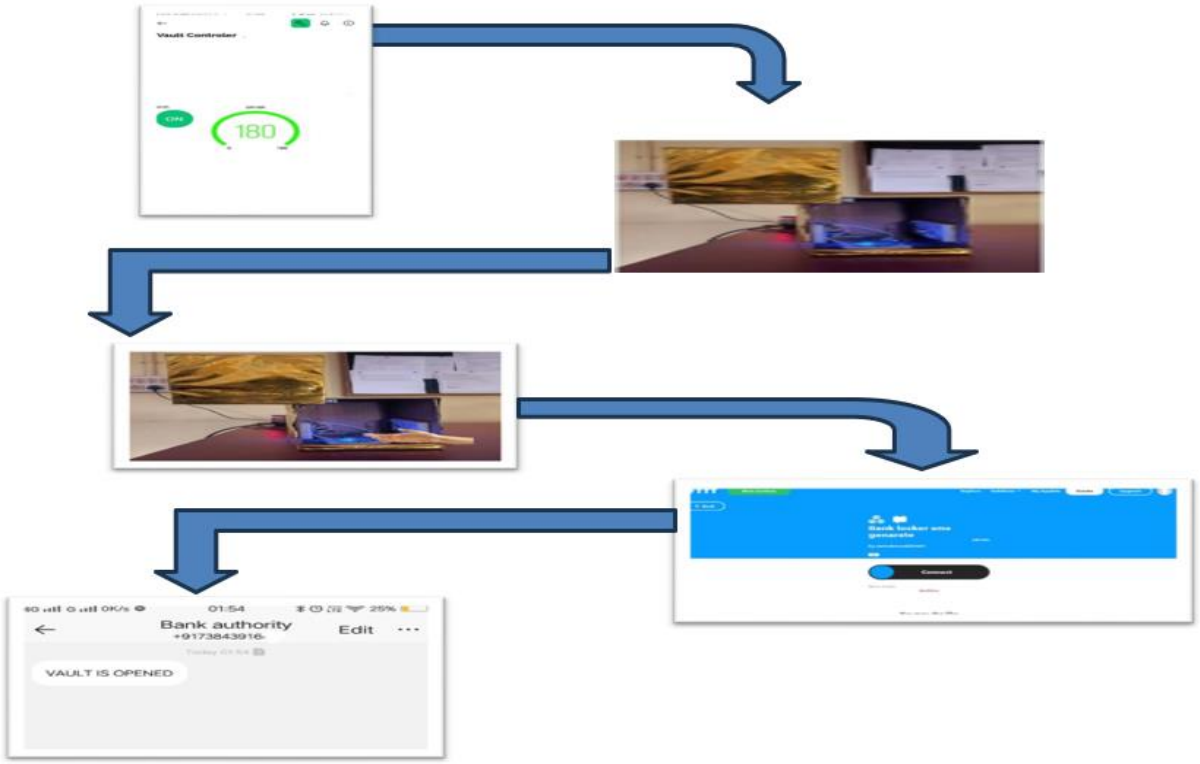
locker system ensures efficient data reception, accurate auto-counting, enhanced security, and real-time notifications for users, thereby improving overall banking operations and customer experience.

Result and Discussions:

Passcodes are entered through the Blynk app. The servo motor successfully opened the locker door. Another code is used to close the door, and the task was completed successfully. After opening the door, a hand was inserted into the locker. Instantly, a predefined SMS alert, "Vault is opened" was delivered to the mobile device. Figures 4 and 5 display the locker door opening action using the Blynk app and a screenshot of the received alert message, respectively.



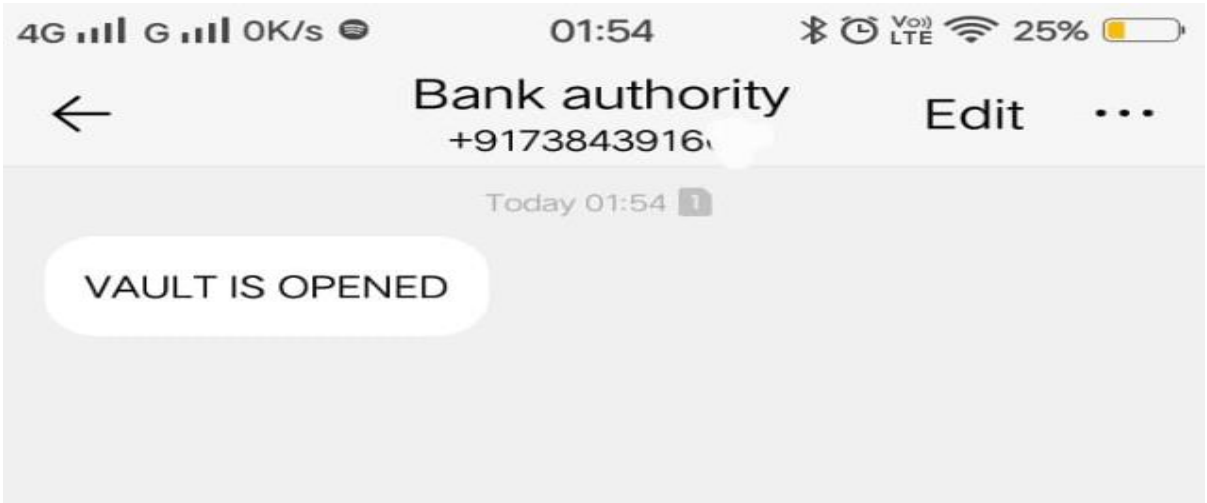


Figure 3: SMS alert received in phone

Conclusion

In summary, the IoT-based Smart and Secure Banking Locker System presents a significant advancement in banking infrastructure, offering a holistic solution to meet the evolving needs of customers and the industry's security standards. Through the integration of IoT technology, biometric authentication, and real-time notifications, the system ensures unmatched security and convenience for users accessing their bank lockers. By enabling real-time monitoring of locker access and delivering instant notifications to both users and bank authorities, the system enhances security by promptly detecting and addressing any unauthorized attempts. This proactive approach effectively reduces the risk of theft or tampering, fostering customer confidence in the safety of their stored valuables.

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