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IoT-Enabled Automated Teller Machine (ATM) Theft Detection andAutomatic Apprehension System

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ABSTRACT:

In this study, we present a cutting-edge IoT-based security system tailored for Automated Teller Machines (ATMs) with a primary focus on theft prevention. The core component of the system is an Arduino Uno microcontroller that orchestrates the seamless integration of various devices. A MEMS sensor strategically placed on the ATM door detects tilting, signaling potential unauthorized access. Upon detection, a servo motor is activated, releasing harmful gases as a deterrent to intruders. Simultaneously, a loud buzzer alerts nearby individuals, and an SMS notification is dispatched to predefined contacts to notify relevant authorities. To ensure the prompt containment of the situation.

To augment the system's surveillance capabilities, an IP camera is incorporated to provide real-time streaming of the ATM's surroundings. This live feed enhances monitoring and allows for remote assessment of potential security threats. The integration of an LCD display serves as an intuitive user interface, offering real-time status updates and feedback on the security system's functionality. By combining these components, our proposed IoT-based ATM security system aims to deliver a comprehensive solution that not only deters potential theft but also actively responds to security breaches, ensuring the safety and integrity of ATM operations.

Keywords: ATM, Theft Detection, Servo motor, DC Motor, Harmful gasses.

INTRODUCTION:

In an era dominated by technological advancements, the financial sector has witnessed a paradigm shift with the widespread adoption of Automated Teller Machines (ATMs). However, this surge in convenience has come hand-in-hand with an escalating concern for the security of these vital financial assets. As the reliance on technology grows, so does the need for innovative solutions to counter emerging threats. This research endeavors to address the pressing issue of ATM theft by proposing an Internet of Things (IoT)-based security system that not only detects potential breaches but also autonomously responds to safeguard these critical financial nodes.

The central premise of our study revolves around the integration of advanced components into the conventional ATM infrastructure. At the heart of the proposed system lies the Arduino Uno microcontroller, serving as the orchestrator for a cohesive network of devices. The inclusion of MEMS sensors strategically placed on the ATM doors allows for the detection of tilting, a key indicator of potential unauthorized access. Upon detection, the system deploys a series of responses, including the release of harmful gases through a servo motor, the activation of a loud buzzer to attract attention, and the dispatch of an SMS alert to predefined contacts. In tandem, a DC motor is engaged to automatically close the ATM door, minimizing the risk of further unauthorized access.

Beyond deterring theft, our system addresses the physical vulnerability of ATMs to

tampering and vandalism through the incorporation of a vibration sensor. This element serves as an additional layer of security, triggering an immediate response from the servo motor, buzzer, and DC motor if any illicit activities are detected. The inclusion of an IP camera enhances the system's surveillance capabilities, providing real-time visual monitoring of the ATM surroundings through live streaming. An intuitive LCD display serves as a user interface, delivering essential information on the system's status and functionality. Collectively, these features constitute a comprehensive IoT-based solution designed to fortify the security of ATMs and ensure the continued trust and reliability of these indispensable financial instruments.

I. RELATED WORKS:

The incidence of theft in Automated Teller Machines (ATMs) is on the rise, prompting a growing concern. When the vibration range exceeds 15000 Hz, an alert is triggered, activating the prototype's DC motor. This motor subsequently close the ATM door while utilizing the GSM & GPS module to relay the location information, including longitude and latitude, to the near by police station. The system executes a series of security measures based on the vibration sensor's threshold value, including alerting through a buzzer, closing the ATM door, sending an SMS alert to the registered mobile number, and sharing the incident's location.

Authors of this work include G Ahmed Zeeshan, R Sundaraguru, and Anjya Naik Vadithya. wrote that The introduction of an advanced system for preventing ATM theft has been developed in response to the global occurrence of ATM-related crimes. This research focuses on the proactive measures taken to prevent such criminal activities. The system incorporates a MEMS module to detect instances of theft at ATM machines. The proposed framework is implemented using an ARM controller-based embedded system designed for real-time data collection through a MEMS module. In the event of a theft, the system automatically activates alarms, such as a buzzer, controls the DC motor to lock the gate, sends an SMS to authorized personnel through GSM, and displays the status on an LCD for monitoring.

Satvik Gogineni, K Marimuthu, and Syed Amma Sheik are associated with the School of Computer Science and Engineering at Vellore Institute of Technology (VIT), Vellore-632014, India. Additionally, Syed Amma Sheik is affiliated with the Department of Electrical and Electronics at Ibra College of Technology, Oman. For correspondence, please contact K Marimuthu as the corresponding author wrote that In contemporary times, ensuring security has emerged as a critical imperative for safeguarding valuable resources. The escalating risks of intrusion and theft underscore the significance of robust security measures. Moreover, safeguarding institutions like banks from potential fire outbreaks and other irregular activities further emphasizes the imperative nature of security protocols. While conventional security systems predominantly center around alarm functionalities using microcontrollers, our research takes a distinctive approach by integrating Microcontrollers with diverse sensors such as PIR, Smoke or Fire, IR, and Gas. This integration transforms the system into an observatory capable of detecting and identifying intruders or anomalous activities within the premises of banks and ATMs.

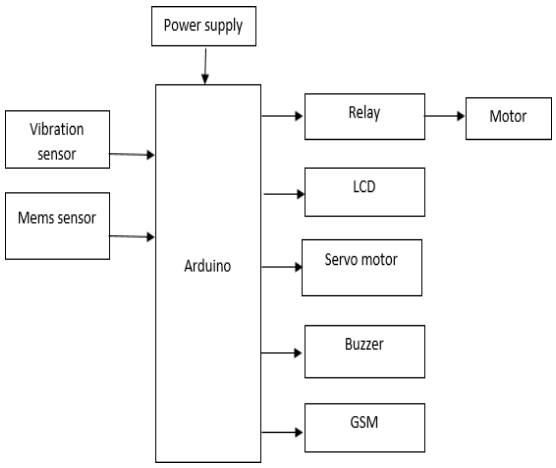
The primary objective of our research is to formulate a comprehensive system designed to promptly alert against theft and autonomously apprehend the perpetrator within the bank or ATM itself, facilitated through a centralized monitoring unit. The essence of the system lies in creating a sophisticated and centralized

monitoring and control infrastructure, leveraging IoT technologies. This strategic integration aims to elevate the system into a smart, proactive mechanism that enhances the overall security paradigm in financial institutions.

II. PROPOSED METHOD/ METHODOLOGY

The proposed method encompasses a multifaceted approach to enhance ATM security, leveraging state-of-the-art IoT technologies. The central processing unit of the system is an Arduino Uno microcontroller, orchestrating the harmonious integration of diverse components. A MEMS sensor strategically positioned on the ATM door serves as a pivotal element, capable of detecting tilting indicative of potential unauthorized access. Upon identification of such events, a servo motor is triggered to release harmful gases, acting as a potent deterrent against intruders. Simultaneously, a loud buzzer is activated to alert nearby individuals, while an SMS notification is promptly dispatched to predefined contacts, notifying relevant authorities in real-time.

An automatic closing of the ATM door is achieved by a DC motor, preventing any further unauthorized access to the ATM. An immediate response from buzzer, DC motor and servo motor is triggered by a vibration sensor that senses physical attacks in complement to these strategies. The system's surveillance capabilities are bolstered through the incorporation of an IP camera, enabling real-time streaming of the ATM's surroundings. This live feed facilitates continuous monitoring and enables remote assessment of potential security threats. Furthermore, an LCD display is integrated as an intuitive user interface, providing real-time status updates and feedback on the functionality of the security system. The synthesis of these components forms a holistic and proactive IoT-based ATM security system, designed to not only deter potential theft but also actively respond to security breaches, thereby ensuring the safety and integrity of ATM operations.



Proposed/Methodology

Hardware Used:

Arduino UNO:

In this specific context, we have chosen the Arduino UNO as our preferred microcontroller. The Arduino Uno is recognized for its exceptional features, characterized by adaptability and user-friendly attributes. Originating from Italy, it has become a cornerstone tool for individuals with a passion for electronics, as well as for enthusiasts and professionals worldwide. Powering the Arduino Uno is the ATmega328P microcontroller, operating at a clock speed of 16 MHz. With 14 digital input/output pins, 6 analog inputs, and a USB connection, this microcontroller provides a robust foundation suitable for a diverse range of projects. The Arduino Uno is distinguished by its unwavering commitment to open-source principles, affirming that both its design and software are open for scrutiny, modification, and distribution to the public. This open environment has cultivated a vibrant community of developers and programmers who contribute libraries, guides, and projects, enabling the exploration of inventive ideas.

Whether you're a beginner working on a simple LED project or an experienced engineer immersed in a complex robotics undertaking, the Arduino Uno's openness and the wealth of accessible resources make it an exceptionally advantageous choice.

The affordability of the Arduino Uno significantly broadens its accessibility, making it a cost-effective option for a diverse user base. Unlike alternative microcontroller platforms, it serves as a budget-friendly choice for individuals interested in delving into the realms of electronics and programming. Furthermore, its user-friendly integrated development environment (IDE) simplifies the coding process, allowing users to easily generate and upload their code. In essence, the Arduino Uno's accessibility, versatility, and the strong support from its open-source community position it as an essential tool driving innovation in the domain of embedded systems and electronics.

Beyond its technical capabilities, the Arduino Uno has played a pivotal role in fostering a spirit of collaboration and creativity among the community of makers and innovators. Its user-friendly interface, extensive documentation, and vibrant online communities position it as an ideal choice for those entering the realms of electronics and programming. Offering a seamless experience for individuals new to these fields, the Arduino Uno empowers users to bring their ideas to life through a spectrum of projects, ranging from home automation systems to engaging interactive art installations. It serves as a compelling example of the transformative potential of accessible technology when wielded by imaginative minds.

Mems(ADXL345) Sensor:

Micro-Electro-Mechanical Systems (MEMS) sensors represent a revolutionary advancement in sensor technology, incorporating miniaturized mechanical and electronic components on a single chip. These sensors are characterized by their microscopic size and multifunctionality, enabling them to detect various physical parameters with high precision. MEMS sensors are widely employed in diverse applications, including automotive systems, consumer electronics, healthcare devices, and industrial machinery. The MEMS sensor's compact size, low power consumption, and cost-effectiveness have contributed to their ubiquitous integration in electronic devices, enhancing functionalities such as motion sensing, environmental monitoring, and inertial measurement.

One notable aspect of MEMS sensors is their versatility in detecting and measuring changes in the surrounding environment. Utilizing principles such as capacitive, piezoelectric, or thermal sensing, MEMS sensors can capture intricate data related to acceleration, pressure, temperature, and more. Their miniaturized form factor enables seamless integration into various devices, offering enhanced precision and responsiveness. As MEMS sensor technology continues to evolve, it plays a pivotal role in shaping the landscape of modern sensor applications, providing innovative solutions for an array of industries and contributing to the development of smart and interconnected systems.

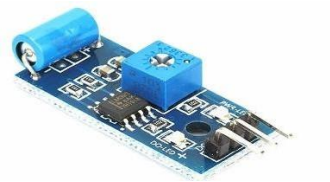
The ADXL345 is a highly advanced MEMS (Micro-Electro-Mechanical Systems) sensor

renowned for its exceptional precision in measuring acceleration across three axes. Manufactured by Analog Devices, this compact and versatile sensor employs a combination of microfabrication techniques and innovative engineering, enabling it to detect both static and dynamic accelerations with remarkable accuracy. With a wide dynamic range and low power consumption, the ADXL345 finds widespread applications in diverse fields such as consumer electronics, robotics. The ADXL345 stands out for its ability to provide reliable and real-time acceleration data, contributing significantly to the advancement of motion-sensing technologies and the development of sophisticated applications across different industries.

Vibration Sensor:

The vibration sensor constitutes a pivotal element within the proposed IoT-based ATM security system, contributing to the comprehensive protection against physical attacks. This sensor is strategically integrated to detect any unauthorized attempts at tampering or break-ins. When triggered by unusual vibrations, the sensor initiates an immediate response, activating the servo motor, buzzer, and DC motor simultaneously. This coordinated reaction is designed to swiftly address and thwart potential security breaches, enhancing the system's overall robustness.

The significance of the vibration sensor lies in its ability to provide an additional layer of security, complementing other detection mechanisms in the system. Its responsiveness to physical disturbances ensures that the security system remains vigilant against various modes of attack. By integrating the vibration sensor, the IoT-based ATM security system not only fortifies its capabilities against conventional theft attempts but also demonstrates a proactive approach in safeguarding the integrity of the ATM infrastructure, contributing to a more resilient and adaptive security framework.



Servo Motor:

The servo motor is a versatile and essential component in the realm of automation and robotics. Renowned for its precision and ability to control angular position with remarkable accuracy, the servo motor finds widespread applications across various industries. The core functionality of a servo motor lies in its capacity to receive control signals and translate them into precise movements. This is achieved through a closed-loop system, where feedback mechanisms, often in the form of sensors, continuously monitor the motor's actual position and relay it back to the controller. The controller then adjusts the motor's output to ensure it aligns precisely with the desired position, resulting in smooth and controlled motion.

One of the distinctive features of servo motors is their suitability for applications demanding high levels of accuracy and repeatability. Whether utilized in industrial automation, robotics, or hobbyist projects, servo motors play a crucial role in achieving controlled movement, making them indispensable for tasks that require a specific angle or position to be maintained. Their versatility, reliability, and ability to provide precise motion control make servo motors a cornerstone in the development of intricate and sophisticated electromechanical systems.

In addition to their precision and reliability, servo motors are prized for their compact size and energy efficiency. These qualities make them particularly advantageous in applications where space constraints are a concern, and energy conservation is paramount. The design of servo motors allows for rapid response times, contributing to their effectiveness in scenarios that demand quick and accurate adjustments. This responsiveness is crucial in diverse fields such as manufacturing, aerospace, and robotics, where precise and prompt control over machinery or robotic components is essential. The servo motor's ability to function as a dynamic and adaptable actuator positions it as a key enabler in the ever-evolving landscape of automation, continuously playing a pivotal role in enhancing the efficiency and performance of a wide array of electromechanical systems.

DC Motor:

A DC motor is an electromechanical device which converts electrical energy into mechanical energy through the interaction of magnetic fields. Its fundamental operation involves the utilization of direct current to generate a magnetic field within the motor, which interacts with the magnetic field produced by a set of fixed magnets or coils. This interaction results in a force that causes the motor to rotate, converting electrical power into mechanical work. The simplicity of its design, ease of control, and efficiency make DC motors versatile components widely employed in various applications, ranging from small electronic devices to industrial machinery.

One notable feature of DC motors is their ability to change speed and direction with relative ease. This flexibility is achieved through the adjustment of voltage levels applied to the motor, enabling precise control over its rotational speed and torque. This characteristic makes DC motors particularly suitable for applications where varying speeds or bidirectional motion is essential. Additionally, the straightforward implementation of speed control mechanisms contributes to their popularity in systems where precision and adaptability are paramount.In practical terms, DC motors find extensive use in diverse industries, including robotics, automotive systems, and manufacturing processes. Their reliability, efficiency, and adaptability to different operational requirements make them a preferred choice for tasks demanding accurate control over motion. Whether powering the wheels of an electric vehicle, regulating the movement of a robotic arm, or driving conveyor belts in industrial settings, DC motors continue to play a crucial role in translating energy.

GSM Module:

The GSM (Global System for Mobile Communications) module has emerged as a pivotal component in the real wireless communication, playing a crucial role in enabling devices to connect seamlessly with mobile networks. This module facilitates the transmission of data via mobile networks, allowing for effective communication between devices and remote systems. Its widespread adoption is attributable to its versatility, supporting various communication functionalities such as sending and receiving SMS (Short Message Service) messages, voice calls, and data transfer. The GSM module serves as a linchpin in numerous applications, ranging from IoT (Internet of Things) devices and home automation systems to security systems and remote monitoring solutions.One notable feature of GSM modules is their

compatibility with SIM (Subscriber Identity Module) cards, which authenticate and authorize the device on the mobile network. This authentication mechanism ensures secure and reliable communication, making the GSM module an ideal choice for applications where data integrity and confidentiality are paramount.

In addition to their communication capabilities, GSM modules are often integrated into various embedded systems, offering a cost-effective and efficient solution for remote communication. Whether used in tracking devices, weather stations, or industrial automation, the GSM module continues to be a cornerstone technology in modern wireless communication, fostering connectivity and enhancing the functionality of a myriad of electronic devices.

Relay:

Relays hold a pivotal role in electrical systems, serving as integral devices for the control and switching of electrical circuits. Their significance spans a broad spectrum of applications, ranging from everyday household appliances to intricate industrial systems. The diversity of relays is evident in their various types and configurations, tailored to meet specific application needs. Parameters such as the number of poles and throws, coil voltage, contact ratings, and switching speed contribute to the classification of relays. These classifications include widely used types like single-pole, single-throw (SPST), single-pole, double-throw (SPDT), and double-pole, double-throw (DPDT) relays, among others.

Each variant is designed to address distinct scenarios, providing engineers and designers with the flexibility to choose the most suitable relay for their intended applications.

In brief, relays demonstrate versatility as electrical devices that provide electrical isolation, enabling the safe switching of high-power loads with low-power control signals. Their role as electromechanical switches renders them indispensable components across diverse applications, spanning automotive systems, industrial machinery, home automation, and electronic circuits.

Buzzer:

The buzzer, as a crucial component in various electronic systems, serves the fundamental purpose of generating audible alerts or warnings. Its versatility makes it a valuable addition to systems ranging from security devices to home automation setups. Typically, buzzers operate by converting electrical signals into sound waves, producing distinct tones or patterns depending on the intended application. This auditory feedback is instrumental in conveying information, especially in scenarios where visual indicators may not be sufficient or practical.In security systems, buzzers play a pivotal role in alerting individuals to potential threats or breaches. When integrated with sensors, such as in the context of our proposed IoT-based ATM security system, the buzzer becomes an immediate auditory response mechanism to unauthorized access or tampering. The loud and attention-grabbing nature of the buzzer serves as a deterrent, aiming to discourage intruders and draw the attention of nearby individuals or authorities to the security breach. Furthermore, the buzzer's role extends beyond security applications to include interactive and user notification

systems. In home automation, for instance, a buzzer can be employed to audibly signal the successful completion of a task, alert users to specific events, or even serve as an integral part of creative projects, contributing to the overall user experience. The flexibility and simplicity of buzzers make them indispensable in a wide array of electronic applications, emphasizing their significance in conveying information and enhancing the functionality of diverse systems.

Power supply:

Our project harnesses electricity through power supplies to activate its various components. Within the realm of electronic devices, power supplies play a pivotal role in ensuring the essential electrical power required for seamless functioning. The primary function involves transforming input voltage, typically derived from an alternating current (AC) wall outlet or direct current (DC) battery, into a reliable and controlled output voltage tailored to meet the specific demands of the device. Power supplies come in diverse configurations, including both linear and switch-mode varieties, with the latter being more prevalent due to its superior efficiency and compact dimensions.

These devices assume a critical function in guaranteeing the reliable and secure operation of electronic equipment, spanning from compact gadgets to intricate industrial setups. They provide a consistent and pure power supply while concurrently shielding against voltage variations, surges, and other electrical abnormalities. This comprehensive role ensures the prevention of potential disruptions, thereby underscoring the significance of power supplies in maintaining the stability and longevity of electronic systems.

LCD:

The landscape of our interaction with electronic devices has been revolutionized by Liquid Crystal Display (LCD) technology. Essentially, an LCD is a flat-panel display technology that utilizes the unique properties of liquid crystals to control the passage of light. Placed between two layers of glass or plastic, the optical characteristics of these liquid crystals can be altered by applying an electric current.

LCDs offer significant advantages due to their flexibility. They are widely utilized in a range of devices, including televisions, computer screens, smartphones, and digital watches. The adaptability of LCDs is attributed to their ability to produce clear and vibrant visuals while consuming minimal power. Furthermore, LCDs deliver impressive viewing angles and accurate color reproduction, making them suitable for various personal and professional applications. Another noteworthy characteristic of LCD technology is its continuous evolution and improvement.

Advantages and Applications

ADVANTAGES

- Security for ATM’s
- Avoidance
- Safety
- Alerts
- Connectivity

APPLICATIONS

- Manufacturing procedures
- Precautionary measures
- Supervision of environmental aspects
- Surveillance and command

- Alert systems
- Identification mechanisms
- Crisis management
- Protocols for communication

III. KIT FINAL RESULTS

Fig1
Title of the Project

Fig2
X value From MEMS (ADXL345)

Fig3
As if Mems or vibration sensor detects then LCD Displays as ATM door is open

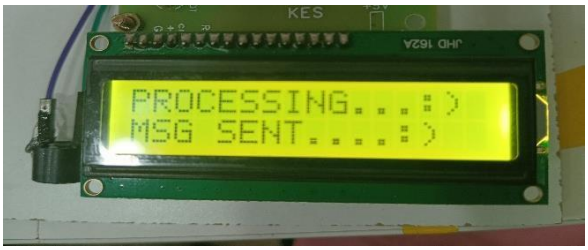


Fig4
Sending Message through GSM

Fig 5
IP Cam for survillance

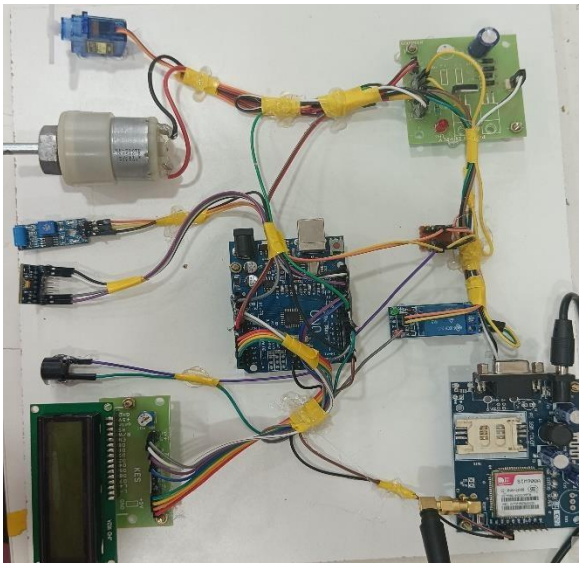


Fig6
Total KIT

IV. CONCLUSION

In conclusion, our study introduces an innovative IoT-based security system specifically designed for Automated Teller Machines (ATMs) with a primary objective of preventing theft. The system, centered around an Arduino Uno microcontroller, seamlessly integrates various devices to create a robust security framework. Key features include a strategically placed MEMS sensor on the ATM door to detect tilting, triggering the release of deterrent gases via a servo motor upon potential unauthorized access. Simultaneously, a loud buzzer alerts nearby individuals, and SMS notifications are sent to predefined contacts to notify relevant authorities. To contain situations promptly, a DC motor automatically closes the ATM door, preventing further unauthorized access. The system also incorporates a vibration sensor to address physical attacks, prompting immediate responses from the servo motor, buzzer, and DC motor. The addition of an IP camera enhances surveillance capabilities by providing real-time streaming of the ATM's surroundings, allowing for remote assessment of potential threats. The inclusion of an LCD display serves as an intuitive user interface, providing real-time updates on the security system's functionality. Through the integration of these components, our proposed IoT-based ATM security system aims to offer a comprehensive solution that not only deters theft but also actively responds to security breaches, ensuring the safety and integrity of ATM operations.

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