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"An Intelligent IoT-Driven ATM Security Framework with YOLOv5-Based Object Recognition"

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Abstract

In the era of digitalization, advanced technology is employed to enhance the safety and security of ATM users, ensuring the integrity of banking operations. The Real-time Automatic ATM Booth Security System aims to provide an innovative and effective solution by integrating sophisticated monitoring, detection, and reaction capabilities. To mitigate different types of robberies, we propose a security system for ATMs that detects specific threat objects based on real-time image analysis using the YOLOv5 Object Detection Algorithm. This system leverages an Arduino-based embedded platform to process real-time data collected through sensors. The module is designed to recognize and classify potential weapons, including screwdrivers, scissors, hammers, and rods. Upon detecting an individual carrying a weapon, the system generates an instantaneous alarm signal and autonomously triggers the closure of the ATM booth door, preventing the suspect from escaping. Another key feature of the proposed system is the real-time notification to the control center of the nearest police station and the respective bank. This approach ensures enhanced monitoring and control, ultimately improving ATM security.

Keywords—IoT, Arduino, ATM Security, Object Detection, YOLOv5.

I. INTRODUCTION

Automated Teller Machines are essential in modern banking, providing users with the ability to conduct financial transactions efficiently. Nevertheless, ATM security is still a major issue due to increasing cases of physical attacks and fraudulent transactions. A robust ATM security system must provide multiple levels of protection against both physical and electronic threats [1].

At present, there are nearly Three million Automated Teller Machines (ATMs) installed and operating across the globe, providing convenient access to banking services for people in both urban and rural areas. [2]. In Turkey, ATM users conduct various transactions beyond cash withdrawal and deposit, such as

transferring money, paying bills, and purchasing mobile minutes [3]. Traditional ATMs rely on magnetic stripe cards or smart cards with embedded chips for user authentication, containing unique identification numbers and security details like expiration dates and CVV codes [4].

One of the most common methods of ATM theft involves staff exploiting cash refill schedules. To mitigate this risk, ATM refilling times should be confidential and vary regularly. Modern ATMs incorporate security cassettes that release dye onto banknotes if the cassette is tampered with, rendering stolen cash unusable [5].

Our system seeks to improve ATM security through monitoring sensors, GSM modules, and real-time social media updates, which will help prevent ATM robberies effectively.

II. PRESENT WORK

ATMs have become an essential component of daily financial activities, offering 24/7 access to banking services. However, security remains a pressing issue. Despite the deployment of security personnel at ATM booths, many incidents occur where thieves overpower guards and steal cash. A single security guard is often insufficient against organized crime groups, necessitating automated security systems [6].

According to the proposed system outlined in [7], ATM security can be significantly improved by leveraging IoT and GSM networks to send real-time alerts via platforms such as Facebook, Twitter, and Gmail. Furthermore, the system is designed to release liquid chloroform upon detecting unauthorized activities, thereby incapacitating potential intruders.

In conventional ATM security systems, vibration sensors detect tampering attempts and immediately alert the nearest police station via GSM modems [8]. Research indicates that secure electronic transactions are among the most effective measures to prevent ATM fraud [9].

III. SYSTEM ARCHITECTURE

The proposed system enhances ATM security by implementing an automated and proactive response mechanism. The core components include:

- **Image Processing Algorithms:** Detects individuals entering the ATM booth and identifies threat objects such as screwdrivers, scissors, hammers, and rods.
- **YOLOv5 Object Detection Algorithm:** A real-time object detection algorithm known for its high speed and accuracy, making it suitable for security applications.
- **IoT-based Security Mechanism:** Enhances ATM safety by detecting unauthorized individuals and their potential threats.
- **Central Monitoring System:** Enables real-time surveillance and control of ATM booths.
- **Automated Door Mechanism:** Locks the ATM booth upon detecting a security threat,

preventing unauthorized individuals from escaping.

1. Block Diagram of Object Detection Process

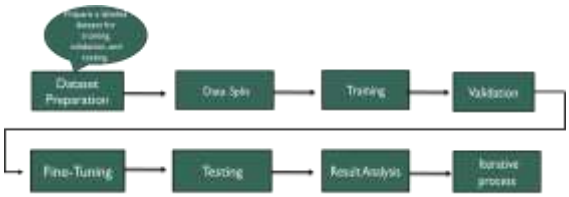

Figure 1: Methodology of System

The system improves security by detecting harmful objects such as knives, hammers, and sticks. The detection process relies on a pre-trained dataset and real-time object recognition. It Improves the overall security of the system by detect harmful object which is knife, hammer, stick etc. For training data set and object detection above working proceeds are maintained. Data flow diagram Is shown in the following dataflow diagram:

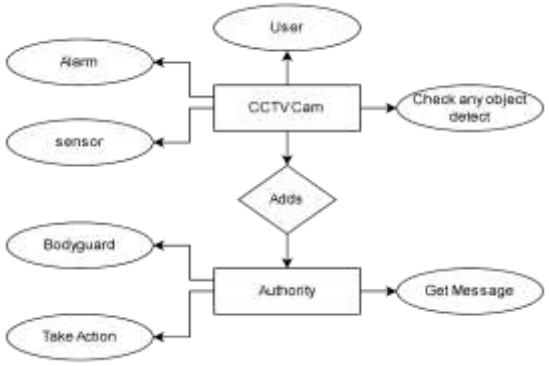

Figure 2: Data flow diagram

The IoT-based ATM Security System aims to improve the safety and security of ATM booths by identifying unauthorized people who may be carrying threats like screwdrivers, scissors, hammers, and rods.

System's main components include a webcam for person and object detection, a central control room for monitoring, and an automated door mechanism for securing the ATM booth. Image processing algorithms will be used to recognize individuals entering ATM booths and identify specific threat objects. This system uses a camera to capture real-time images, processing them with the YOLOv5 algorithm to identify these specific objects and trigger a series of predefined security protocols.

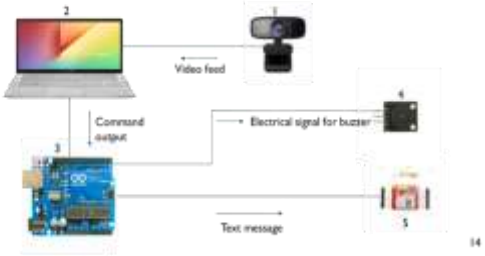

Fig 3: System Architecture

The following requirements outline the functionality of the system:

IV. RESULTS AND ANALYSIS

This section presents the simulation results and hardware implementation of the ATM security system. The system ensures user safety by:

1. Person and Object Detection

The system employs a webcam with image recognition capabilities to detect individuals entering the ATM booth.

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It classifies objects such as screwdrivers, scissors, hammers, and rods as potential threats.

2. Real-Time Alarm Generation

Upon detecting a potential threat, the system triggers an instant alarm.

The alarm provides real-time information about the type of object detected.

V. CENTRAL CONTROL ROOM INTEGRATION

Establishes a secure connection with a control room, allowing continuous monitoring of multiple ATMs.

The control room receives and manages alerts from various locations.

VI. AUTOMATED DOOR CLOSURE

Upon detecting a security threat, the system locks the ATM booth door, preventing the suspect from escaping. This feature enhances protection for ATM users and secures cash vaults.

1. Real-Time Messaging System

The system employs a GSM module to send real-time notifications. Alerts include timestamped messages sent to the nearest police station and bank authorities.

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VII. CONCLUSION

The proposed Real-Time Automatic ATM Booth Security System significantly enhances ATM security by utilizing image processing, IoT, and real-time monitoring. The integration of YOLOv5 object detection ensures rapid identification of threats, while the automated door mechanism and GSM-based alert system prevent unauthorized access and facilitate prompt law enforcement response. Future enhancements may include AI-powered behavioral analysis and cloud-based security monitoring to further optimize ATM security solutions.

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