Automatic Teller Machine (ATM) Theft Detection and Location Tracking using GSM & GPS Module

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ABSTRACT

The crime rate in Automatic Teller Machine (ATM) theft is rising highly. IoT-Internet of Things which is a technology paradigm helps to internetwork the physical devices to global internet world. IoT helps the objects (things) to collect / transmit / exchange data and actuate action according to the data threshold. The objective of designing ATM Theft detection / Location Identification is to detect the ATM from robbery and share the location of robbery to the nearby registered cop station. The Embedded development board Arduino helps us to monitor the status of the cash box. The cash box movement is detected using vibration sensor. If the vibration range is greater than the 15000 Hz, then a buzzer alert is created and the prototype actuates the DC motor, which then automatically closes the ATM door and communicates the location information -longitude and latitude to the nearby cop station using GSM & GPS module. The system performs four different security actions according to the threshold value of the vibration sensor, i.e., alert using buzzer, closing the ATM door, SMS alert to the registered mobile number and sharing the location of the robbery.

Key words: ATM –Automatic Teller Machine**,** Embedded Development Board, GPS Global Positioning System, GSM-Global System for Mobile, Vibration sensor.

1. INTRODUCTION

The public sector bank now-a-days dispenses the cash through a large network of ATM and cash depositor machine. The physical safety of the cash is very important to limit the fraud or theft in the ATM machine. The article [1] shows that the Indian Bank lost nearly Rs.109.75 crores in financial year 2018, which provides an eye watch for embedded system researchers to come with safety related theft detection and tracking which may reduce the percentage of the occurrence of such events in future.

A total of 972 such events were reported in 2017-18 according to the data collected by Reserve Bank of India. Since most of the ATMs are operated by private layers or organisations, it is very difficult for human vigilance 24*7.

Therefore a system is needed which detects the abnormal cash box movement and track the event of theft. The idea of the prototype - ATM Theft detection and Tracking is developed to address the societal related issues. The automatic ATM theft detection, alert and tracking is very important and implemented most technically and sounds autonomous ATM to watch out the occurrence of financial activities around the premises. To overcome the manual production to be perfect it is essential to use advanced embedded processor, sensor and communication Technology to automate the ATM surveillance system.

Developing an ATM protection using modern model microcontroller is simple because of the edge computer which is already presented in the ATM machine. So integration of microcontroller and building security monitoring will be easy since building a new security infrastructure upon existing internet and required power supply for internet connection is already available. The developer has to choose a better microcontroller, data collection sensor, alert system and communication technology which is very important. The existing advanced communication technology really helps the developer to create alert and tracking system. Collecting real time video surveillance data to theft detection is difficult because there is no proper intelligent algorithm existing. Therefore building a system using real time monitoring is very important and the accuracy of system is very essential in the time of abnormal activities.

2. RELATED WORK

In [2] the authors proposed a platform independent electronic device system and an application is developed to analyze the feedback of the users using SIM900A GSM module. The system consists of a Micro Controller to receive the message from the user. It decodes the message which is sent by the user for further comparsion and the message is finally displayed on the attached LCD screen. Finally the software application developed reads the serial port for the data given by micro controller and produces the corresponding bar & pie chart and shows the number of votes in each feedback.

Since remote control technology is developing rapidly, the authors [3] developed a prototype of electrical appliances

control through SMS using GSM Protocol as it is the simplest communication technology. The prototype developed is platform independent and work on any mobile device. The relay module is worked by the message given by SMS through SIM900A GSM module and the mobile device receives the feedback of the command. This prototype can also be applied to control the electrical equipment.

In [4] the system is developed on Embedded Technology and different inbuilt sensors - PIR sensor, ADXL335 accelerometer is used to monitor the surroundings for suspicious activities and ATMEGA-328 micro controller is used. FSR is to detect the motion, heat etc., The authors analyzed different forms of attacks on Automatic Teller Machines and different methods were discussed to detect the issues. The system employed proactive measures like siren notifications using GSM, visual effects etc., to counteract the burglary attempts. The developed system monitors the surroundings by temperature changes, orientation of ATM machines etc., and provides the facilities like continuous monitoring, siren, warnings , shutter locking etc.,

The authors in [5] concentrated on Machine-to-machine (M2M) communications technology. Without the involvement of human, this system provides real time monitoring & control. Authors developed Embedded Web Server (EWS) which is based on ARM11 processor & Linux OS using Raspberry Pi. The model developed is a low cost system which provides a robust networking solution with good range of applications. The overall setup is meant for ATM security. The modules involved are authentication of shutter lock, web enabled control, sensor & camera control. The work implemented is a secure way of accessing an ATM by authorized person alone in terms of monitoring the ATM using hardware accomplished by using RF modules, RFID Reader Tag, P89V51RD2. Vibration sensor is used to sense the vibration generated from ATM machine and this is processed by ARM controller based embedded system. DC motor is used to close the ATM door.

Due to the wide coverage and low power consumption, stealth sensors are very much used in today's applications. In this article [6] the authors developed an ecological intelligence system which is a wireless surveillance sensor network system with acoustic and seismic vibration sensors (geophone) to detect objects or events for area security in real time. The acoustic data given by the sensors is classified using Support Vector Machines classification method and once an intruder like human, vehicle or animal sounds is identified, the system triggers the camera.

In [7] the authors developed an Arduino controller device security system for ATM theft which explores various physical attacks. Face recognizing camera is used here to capture the face of the person. To identify the irregular activities, Tilt & vibration sensors are used. If any intrusion occurred, an alert message is sent through social media using

GSM network. Liquidator chloroform is used to spread the chloroform to make the intruder unconscious.

In this article [8] the authors developed an arduino platform based system to lock/ unlock an electronic door. These security systems enable to lock/unlock the door using three different modules Bluetooth, Keypad, and Global System for Mobile (GSM) modules. All these modules operate on a 4-digit password. We can open or close the door by using keypad, Bluetooth application from smart phone and also by using 4 digit message from GSM phone. If an intruder does the three repeated unsuccessful attempts to enter the password in any one of the system, then arduino controller will send a warning message to the registered GSM mobile number and also initiate the buzzer alarm as a warning of unauthorized intrusion.

3. PROPOSED WORK

"ATM Theft Detection and location tracking using GSM and GPS Module" is developpled by Adrduino Uno modern microcontroller development board.
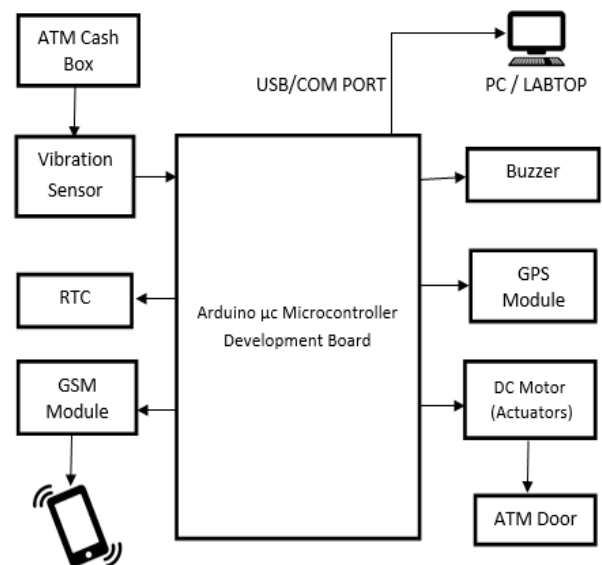
Figure 1: Architecture of Theft Detection Prototype

Here the controller is integrated with a sensor, actuators and other modules.

- Arduino Uno – Modern Microcontroller development board
- Vibration Sensor – To detect ATM Cash box vibration
- DC Motor – To Shut the ATM Door
- GSM - Global System for Mobile communication for sending SMS to the Registered Mobile number.
- GPS –Global Positioning System – To identify the Location ATM Theft Latitude and Longitude) and attached along SMS
- RTC – Real-time Clock
- Buzzer

Figure 2 gives the complete details about Arduino interconnections & demonstrates the prototype working.

The proposed prototype performs four layered security alert operations. Whenever the cash box gets tampered, the vibration sensor senses the vibration and if the vibration is greater than 15000Hz, the arduino actuates the buzzer and immediately the DC motor shuts the door of the Automatic Teller Machine and the alert information is communicated through GSM module by sending an alert message to the registered mobile number with the GPS coordinates using Google map.

The prototype uses Arduino development board; built with atmega microcontroller (8bit MC). The implementation of the system is done with the help of Arduino IDE (Development Environment).The board is directly connected to PC/Laptop through USB COM port and the program can be easily dumped into the board memory. The block diagram in Figure 1 shows the semantic interconnection of the peripherals attached to GPIO (general purpose Input Output) lines of the arduino board. The peripherals connected to GPIO can be programmed in input or output mode. Since arduino has both analog/digital GPIO lines, it is easy to interface with both analog/ digital peripherals. Figure 1 shows different types of devices interconnected. The sketch (program) is developed to measure and control peripherals in Arduino IDE, with Arduino C platform.

The vibration sensor connected to the board measures the vibration frequency. If the frequency is greater than the fixed frequency i.e, 15000 hz, then the controller activates an actuator DC motor which is attached to the door. It sheds the door and also buzzers the sound alert. The time occurrence of the event is notified by the ITC timer. An SMS is composed based on the GPS module location (LL), and is transmitted to the registered mobile phone user through GSM module using cellular communication medium.

The prototype development is shown in the following pseudocode.

a. *Initialize the Standardval=15000hz;*
b. *Begin serial data transmission with the computer at 9600 baud rate. Serial.begin(9600);*
c. *Read the output of Vibration sensor on GPIO pin 9. Inputval=PulseIn(EP,High);*
d. *İf (Inputval >= Standardval) then*
    d.1. Actuate the DC motor connected in GPIO pins 2, 3, 4;
    d.2. Activate the Buzzer sound using Tone function;
    d.3. Read the Date and Time through rtc.now function;
    d.4. Send the SMS through GSM module using SMS AT
        comments;

    AT+CMGF = 1; define text mode
    AT+CMGF = 'Number'; register mobile number to which
    SMS delivered
  else
  repeat steps a to d.

The activity modeling of the proposed system is shown below in Figure 2
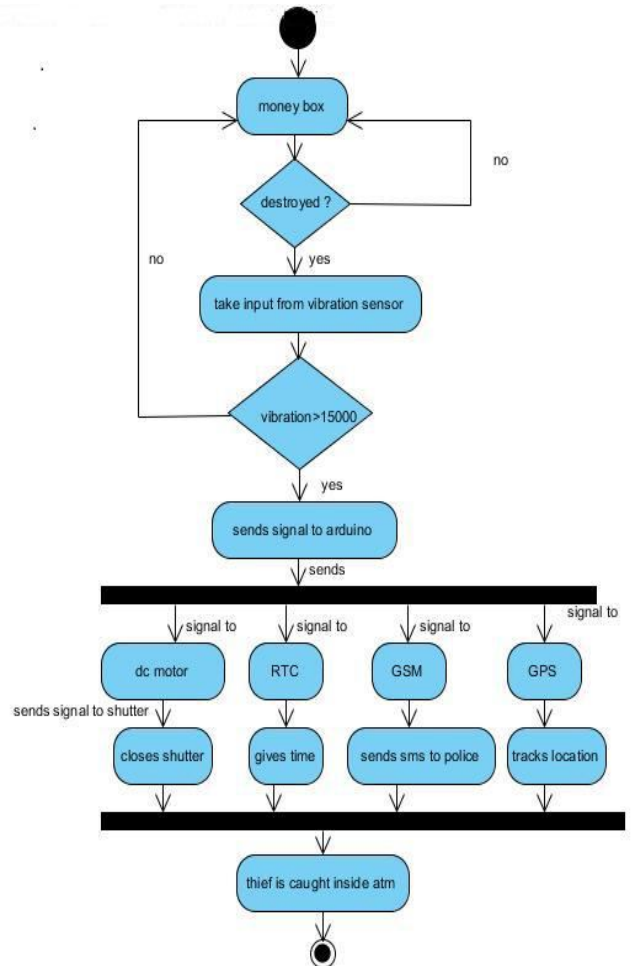

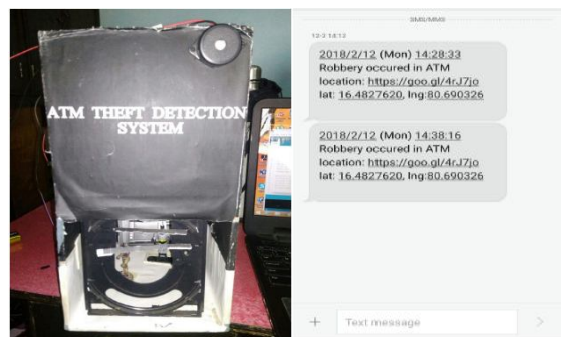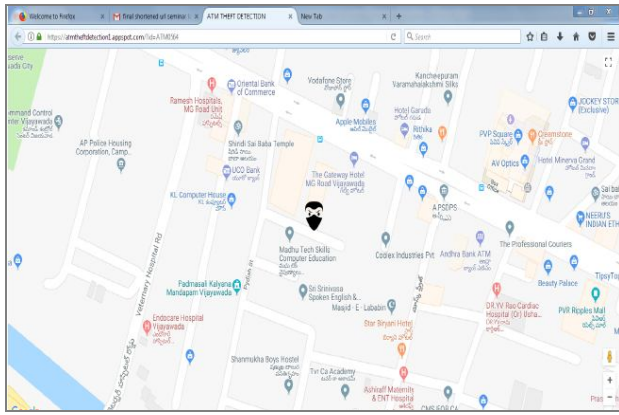**Figure 2:** Workflow of the system using Activity diagram

Figure 3: Prototype view and sample SMS delivered

Figure 4: Location of the ATM Theft in Google Map

5. CONCLUSION

This article demonstrated a prototype of how to automate ATM theft detection & location tracking using GSM & GPS module. The prototype exhibits the process of identifying the movements of cash box access using vibration sensor input, alerts the buzzer in abnormal condition and the embedded control unit shuts the main door using actuator DC motor & the SMS alert containing a link of the geographical location of the robbery is transmitted to the registered cop station. Further this prototype model can be incorporated into the design of new ATM.

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