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Design and Implementation of Motion Detector-Based Anti-Theft Bag System

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***Abstract*— Thievery and misplacement of luggage are two of the major exasperating and inconclusive troubles faced around the globe by the people who travel a lot. Many innovations were put in place to solve this problem, but they were unsuccessful and lacked in implementing progressive technologies. This work is an advanced approach to prevail over such concerns. Unlike the existing systems, this system equips an idiosyncratic and coherent property of the SMS (Short Message Service) controllable location tracer and motion detection of the luggage or the bag. Which can be turned on as per the need of the user. The system further integrates a GPS (Global Positioning System) which sends the coordinates as SMS. This proposed system is incorporated with existing technologies to get to the button of the above discussed obstacles faced by the user in the most efficient and peculiar way.**

***Keywords*—Arduino UNO, SMS, GSM module, GPS module, Orientation, anti-theft.**

I.INTRODUCTION

Data released by the Delhi Police show that over 70% of cases of baggage theft at Indira Gandhi International Airport involve items accidentally left behind in the trolleys or in the taxis by passengers involuntarily. According to a senior GRP Official, approximately 84% crimes on Mumbai railways reported in the year 2021 were of theft. Tourists have always been obvious targets for thieves. In 1950, at the commencement of the jet age, just 25 million people took foreign trips. By 2019, that number had reached 1.5 billion, and the travel and tourism sector had grown almost too big. These statistics give us a sign that frequently tourists are at risk of theft, exclusively bag theft, which is one of the foremost misdemeanours against tourists.

This work has been proposed after numerous analysis on the disputes encountered by the user with their luggage while traveling around like their bags has been missing or stolen because of the misplacement or because of some carelessness while transporting it, [1] and one of the major issues we received from the user is that they demand to depend on others to take care of their bags when they are not available at that particular places, so they are depended on some intruders to take care of their bag, which is a perilous process. People who lead their life in metropolitan cities are frequently prone to thievery and misplacement of their bags because of their frenetic schedule. The presently usable smart bag system particularly allows the user to access its location whenever it is missing through a real time location detector, but does not contribute any kind of comprehensible anti-theft features [2,3,4]. The put forward system serves a solution for concluding the cited issues adequately.

The proposed work yields an effective solution for luggage security. The system is more favourable to people in metropolitan cities who carry expensive things. Gadgets for their day-to-day activities and some for special things such as an application of the internet of things. The user entirely controls this system with the help of SMS [16,17]. In this system, a signal is sent through an SMS since the primary target of the system is to make it convenient for the users to ensure maximum safety, such that no extra applications are required to control the system which may lead to unwanted malware entering the phone. This system is also incorporated with the motion detection which provides extra protection [13,14]. The user will be able to control all the above things with a very basic phone. This ensures that the user does not need to buy any special device.

II.LITERATURE SURVEY

Nagar M et al. have done research on implementation of GSM and GPS modulebased tracking systems with an emphasis on easiness in installation in [2]. The authors claim it to be a "plug-and-play device" owing to the simplicity it provides for the user. MNH Raimi et al.have implemented a smart bag which has a solar panel with it for both powering the system and charging devices in [3]. Object tracking feature, implemented using GPS, is present in this project. The author abbreviates it as 'SVB'. E Terence et al.have made a project which solves the strain of carrying heavy bags in [4]. This system also incorporates a GPS tracking system with GSM acknowledgement to the user. A. Ifeoluwa and I Francis have implemented a GPS tracking technology with the main intention of providing security to Nigerian school students in [5].It is told that this project could be considered as a business-to-government (B2G) model. NavyaAnanthula et al. have proposed a system base of which is a GPS based women's safety system that consists of dual-alerts that is voice module and message which is sent through GSM to the predefined mobile number in [6]. The entire system is

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activated with the help of a dedicated button. SuvarnaLakshmi et al. have made a research on a device mainly intended in providing safety to women in [7]. This is implemented using a GPS-GSM tracking system with audio and image capturing of the culprit. M. V. Singh et al. have implemented a GPS tracking device with target users as students in [8]. This device has an alerting system which reminds the users about the books to be arranged into their bags. Sunil K Punjabi et al. in [9] have proposed a system for women and children which allows immediate responses to any harassment in public places, societies, etc. It has a pressure switch which sends an SMS when pressure is applied at critical instances.

III. Functioning of Proposed Work

The whole system is controlled using the SMS system through the GSM module. As a result, the system must only execute commands issued by the owner of the bag. To do this, each unit of the system is given a unique password during the initial step of system setup. An Arduino UNO, being one of the most conveniently programmable and effective development board, is programmed with Embedded C to control all the modules connected to it. A GSM module is connected to the Arduino UNO, and it receives commands from the user through SMS and transfers them to the Arduino UNO's digital pins. To increase the system's applicability, it also sends an SMS to the user with information on possible threats as well as real-time geographic coordinates. There are several ways to implement position tracking using a GPS module, and it has numerous uses [5-8]. A GPS module is connected to the Arduino in order to collect real-time position coordinates. The precision and reliability of GPS systems are enhanced in numerous ways [9,10]. Gyroscopes are employed in a variety of applications [11,12,13]. They are getting better as technology develops [14]. This module is additionally linked to the system and provides real-time changes in the orientation or location of the bag when it is secured by the user, detecting changes in all six axes in three dimensions. A burglar alarm is linked to the system, and if there is any change in position, the alarm is activated, alerting the surroundings and sending an alert to the user through SMS. The preceding is depicted as a block diagram (Figure.1)

Whenever anyone tries to move the bag when it is locked by the user, the user receives an SMS warning. The burglar alarm in the system is also activated, and the people in the vicinity get notified of the theft. The system was designed such that motion detection begins only when the user sends a command to the system of their choosing. This is done to ensure that the user does not receive a warning for moving their luggage by themselves. A buzzer is rung for 2 seconds to notify the user that the system has been enabled. There are many additional equivalent features that may be enabled from anywhere in the globe using the network through SMS [15,16]. Users can replace the initially provided passwords with relevant terms which are easy for their remembrance. When the activation instruction is received from the user, the gyroscope is activated to alert the user of the bag's orientational changes. The GPS coordinates are delivered through SMS when the instruction to get location is sent. This is useful for guaranteeing the bag's security even when the user is not there. Additionally, specific commands are given for this system to assist the user with the system. The alarm will be activated when the command to instantly find the bag is sent, making it easier for the user to locate the bag in the nearby local places. It also keeps the user informed of any changes in the bag's orientation. Similarly, all of the system's digital outputs will be conveyed to the user via SMS in linguistic structure. The messages contain the necessary data, so that the user is kept up to date on all relevant information. This assures the bag's safety. When the user needs to grab the bag, the lock may be temporarily deactivated by disabling the gyroscope using a simple command, allowing the user to access the bag. When the system is deactivated and free to move, the user will be notified with a beep sound via the system's alarm, ensuring that the user does not get into any trouble.

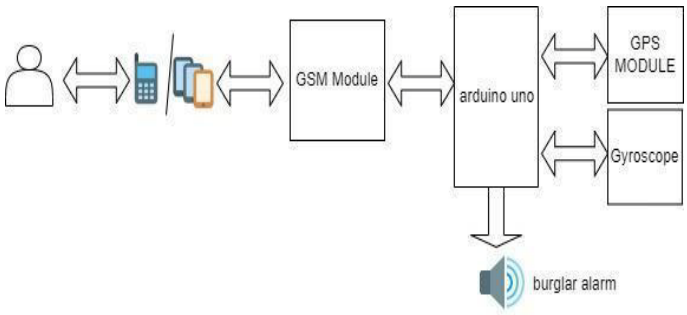

Fig. 1. The figure portraying the process flow of the system

IV. Flow Chart

The flowchart broadly comprises two parts, namely the initialisation part and the loop part. In each process described below, these two parts are described.

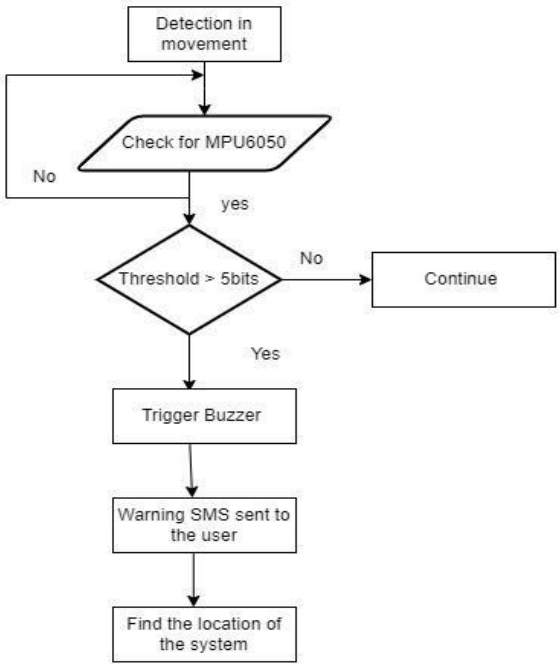

Fig. 2. Complete flowchart of the anti-theft bag system

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In Figure. 2, the GSM module is initialised by connecting its transmitter and receiver pins to the microcontroller's digital input pins. During initialization, the module attempts to connect to the GSM frequency band. The system is set up to run in SMS mode. The methodology for dealing with received messages has been established.

These parameters in the startup section are accomplished through the utilization of AT commands. A variable is declared in the loop and is used to record the received messages. All the characters within the string of received messages are capitalised. The pre-defined instructions are compared to the recorded messages. When the SMS received contains the word "LOC," the geographical coordinates are sent to the user via SMS. When the received SMS contains the word "FIND," the buzzer is activated for a limited period of time. The motion detection begins, Whenever the SMS received by the system is "ON ". The system then enters a loop in which variations in orientation are continually monitored.

The messages received are also updated on a regular basis in this loop. When an SMS is received by the system is "OFF" the system disables the motion sensing by interrupting the loop. This module serves as a conduit between the user and the protection system.

In Figure 3, the gyroscope is initialised by connecting its serial clock and serial data pins to the microcontroller's analogue inputs. The serial connection between the microcontroller and MPU6050 is established during the initialization process. The MPU6050 has a 0 to 63 Hz high-pass filter and a motion detection duration of 20ms. When the system is turned on through the command received from the user, motion detection begins inside the loop. When the change in orientation detected exceeds a threshold of 5 bits, it is considered as a change in motion of the bag, the user will be notified about movement in the bag through SMS. Following the previous step, this will activate the buzzer by digitally programming the buzzer's pin as high, enabling the user to catch the burglar red-handed. The flowchart in Figure 4 shows how the location retrieved from the GPS module and the data is transmitted to the user. When the user sends an SMS with the keyword "LOC," the position of the bag is communicated to the user in the form of coordinates for latitude and longitude. When the GPS does not acquire a proper signal, it takes some time to locate the correct coordinates which must be communicated to the user, and data from the GPS is also necessary when there is movement detection in the system to alert the user about the theft and the location of the crime. The system has some pre-defined text that must be delivered to the user through SMS based on the function invoked by the user. The above-mentioned combination of GPS and GSM has yielded numerous favourable performance [17,18]

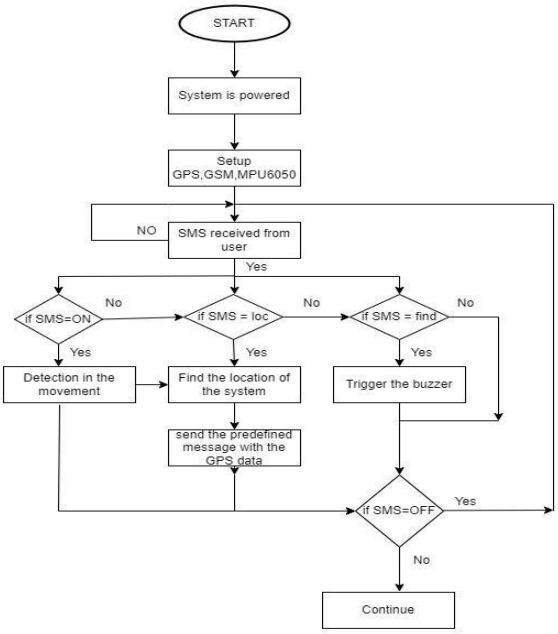

Fig. 3. Movement detection flow chart

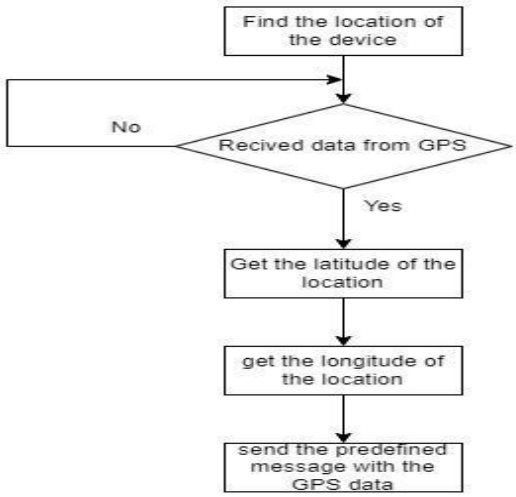

Figure. 4 Finding the location of the system flow chart

IV. RESULT

The presented results were taken out from the real time hardware testing in the period of the testing the final proto type of the proposed system and the the output results were further mainly classified into the different working states of the system which gives out the correct signals on the period of the large movement applied to the system while placed inside a bag and the classification of results are.

A. Initialization of hardware

In Figure5, all modules have been initialized. First, GPS is configured. The GSM is then connected to the global system network, as shown by the phrases "Connecting" and "Connected." The four "OK" phrases indicate that GSM is connected to the network, the module is set to SMS mode, received SMS is defined, and all unread received messages are recovered in that order. The phrase "MPU6050 detected"

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indicates that communication between the controller and the gyroscope has commenced.

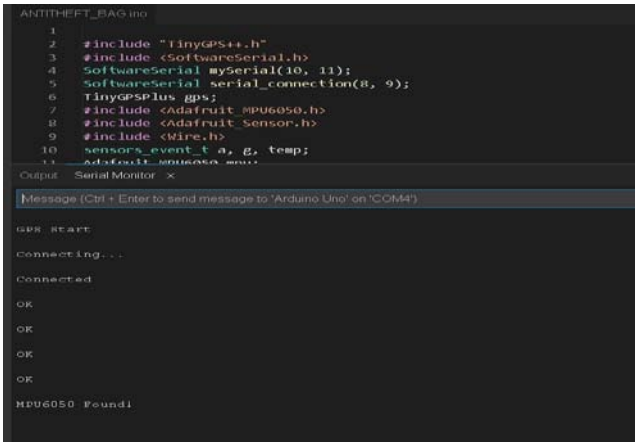

Figure.5 The initialization of the system

B. The ON function (activating the motion detection)

Figure 6(a) Figure 6 (b)

Fig. 6 User pressing the trigger button on phone

Figure.6labelled with (a) and (b) where (a) represents SMS app indicating theON function and (b) representing Serial monitor indicating the ON function .In Figure.6(b), the keyword beginning with "+CMT" specifies the phone number (which has been anonymized), as well as the date and time the message was received. Similarly, incoming messages are received. All phrases with "Ok" indicate that the message has been sent to the user. This is supported by the words in Figure.6(a). Similarly, remaining messages that are transmitted are marked. The line "Motion detected" indicates that somebody attempted to move the bag.

C. Detecting the location of the bag

Figure 7(a) Figure 7 (b)

Fig. 7 User knowing the location using simple command

Figure 7.labelled with (a) and (b) where (a) indicating SMS app indicating the LOC function and (b) indicating Serial monitor indicating the location of the system.

The keyword "LOC" in Figure 7(a) indicates that the user has sent the command to determine the position of the bag. The following phrase demonstrates how the bag's latitude and longitude are determined. The determined value is delivered to the user, as seen in Figure 7(b). There are several applications for tracking systems in this manner [19,20].

VI.HARDWARE IMPLEMENTATION

To implement the proposed idea, an Arduino UNO microcontroller, GSM module, GPS module, Gyroscope, phone, burglar alarm, and a 12 V, 1.3 Ah battery are used. These modules are controlled by Arduino UNO (microcontroller), and it is programmed using Embedded C in the Arduino IDE platform. The connections of the hardware modules are previewed in EasyEDA. The Gyroscope module makes use of the former, while the GPS and GSM modules make use of the latter. Figure 8 depicts the suggested system's architecture. The system is constructed in such a manner that all of the modules are powered by the Arduino UNO, which is supplied by an external power supply. The motion detecting capacity of the gyroscope is used here, as in prior publications [21,22]. The threshold is set low to avoid the detection of very small changes in orientation by accident or by Naturally induced acceleration.The GSM module's Rx and TX pins are linked to the Arduino board's digital pins, accordingly, so that signals are delivered and received through the allocated lines. And it is employed in SMS mode. Similar applications exist for GSM modules in SMS mode [22, 23].

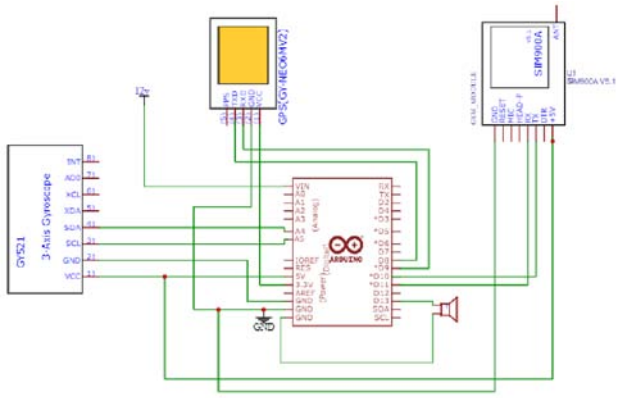

Figure 8 circuit diagram replicating the hardware which is used for simulation purpose

VII.CONCLUSION AND FUTURE WORKS

Anti-theft bags are currently available in the market, but they do not address some major and crucial issues. To address these shortcomings, a security system against bag theft using SMS controllability and a GPS location is designed. With this proposed paper, the rate of luggage theft or misplacement can be reduced in contrast to the existing scenario and systems. This also aids in finding people in critical instances such as getting lost. A basic cell phone that is a part of everyone's life today is all that is required to manage the system and obtain

information on lost or misplaced luggage. It additionally operates in locations with low network coverage. In addition to this, it benefits those who travel alone. This makes them more independent. Unlike other smart and handy bags, this method ensures additional security along with smart features. Instead of providing an image of the suspect, the proposed system provides the exact coordinates of the bag, which is more simplified but much more effective. This system may be incorporated with containers while shipping expensive items. To a much wider reaching extent, this offers security for all types and sizes of commodities. Unlike the existing security system, which catches the suspect when the bag is opened and sends a mail to the owner, instead of providing an image of the suspect, the proposed paper provides the position of the bag, which is simpler but much more effective. In industries, we may integrate this system with containers while shipping expensive goods. To a great extent, this system provides security for the commodities.

In the future, in addition to all of these functions, item detection within the bags may be added; they can also identify such that individual protection is provided to each thing present in the bag through SMS. In addition, instead of utilising the GPS module, alternative technologies can be used in the system to determine the position of the bag, as the GPS may lose signal and be unable to relay the location of the bag to the user in certain conditions.

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