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SMART HANDBAG SYSTEM WITH LOCATION TRACKING

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ABSTRACT

As a snatch theft has become a serious problem to the society, it is required an immediate action to put an end to this problem. One of the solutions is to develop Smart Hand Bag system using Radio Frequency (RF) signal and location tracker as the main component. This project is implemented using an Arduino microcontroller, RF transmitter and receiver module, SIM900 Global System for Mobile Communications (GSM) and Global Positioning System (GPS) module, and 9dB buzzer. This smart handbag produces a loud sound to attract people surrounding whenever a snatch crime happens. The system is also able to track the location of the handbag by using GPS. The location tracked by the GPS module will be sent to the victim by using Short Messaging Service (SMS). Hence, this successfully developed Smart Hand Bag project is expected to help women to prevent this crime from spreading.

Keywords: radio frequency, global positioning system, smart hand bag, short messaging service.

INTRODUCTION

Snatch theft is a criminal act of forcefully stealing from a pedestrian's person while employing rob-and-run tactics. Statistics show that most of the victims are women. A growing problem in Malaysia, some instances of snatch theft have caused fatalities, when the person holding onto the handbag has been dragged by the motorbike or through subsequent acts of violence. The crimes have caused severe injury to head and let them to death. This, combined with the apparent lack of police control over crime, has prompted outrage among its citizens enough to take justice into their own hands in apprehending thieves.

To solve this problem, there are initiatives that have been done by the engineers. This includes on developing a special alarm to avoid from snatch theft to happen. There are three different types of these alarms; hardwired alarm, self-contained alarm and wireless alarm (E. Efiong, 2013). A basic alarm system is divided into three different parts, which is the main control system, the buzzer, and the sensor. The main control system which is the brain of the device will receive signals from the sensor for analyzing before determine the action that to be taken, whether to turn on the alarm or otherwise. In wireless system alarm, receiver and transmitter units will act as the sensor which is the input, and buzzer as the output of the device.

This project will develop based on wireless system alarm, which turn on when detecting the distance between the receiver and transmitter more than 50 meters. It integrates with a GPS location tracker to determine the location of the handbag, and the unit will automatically send the longitude and longitude of the position to the user by SMS.

LITERATURE REVIEW

The snatch theft alarm system has been developed using the RF signal (Wan Omar, 2007) as the main component of the alarm. To build this project, there are two circuits that need to be designed, first, the circuit that contain the siren and the receiver unit, and second, is the circuit with the transmitter unit. The transmitter unit will control the siren from a distance using RF signal.

The user will bring along the transmitter unit as a keychain or to be put in the user's pocket. Another circuit that contains the receiver unit will be placed inside the user's handbag. This project disadvantage is the device is limited to a certain range and not using rechargeable battery as the power source.

The ultrasonic sensor is used to detect distance between two points. The alarm system was developed using the HC-SR04 ultrasonic sensor in order to determine the distance between the device and the ground (Ahmad Yasser, 2014). The sensor will be clipped on the handbag handles. When the snatch theft happens, this handle will be snapped and separated from the bag, and hence fall into the ground. When the sensor detects the ground, the alarm will be activated. However the project undergoes many problems due to impractallity and non user friendly design. The main drawback is the alarm is turned on by mistake when it is close to the ground.

The other snatch theft alarm project is based on hardwired system, by using 555 timer, and audio mono jack plug as a switch (Muhsin, 2010). The idea is, the user must wear a necklace that contain an audio mono jack, that have been plugged into a socket into a circuit inside the handbag. Whenever the bag is snatched, the jack will be plugged out, and hence, activated the alarm. The main disadvantage is the needs to always wear the necklace that contains the mono jack anywhere.

Table-1 shows the difference between all the handbag alarm system above in terms of components, power sources, and their range of operation.

Table-1. Difference between previous projects.

Type	Main Component	Range	Power Source
(Wan Omar, 2007)	Wireless receiver and transmitter	Up to 50 meter.	9V
(Ahmad Yasser, 2014)	Ultrasonic sensor HC-SR04	5 cm-10 meter	Lithium Battery
(Muhsin, 2010)	555 Timer	None	9V

METHODOLOGY

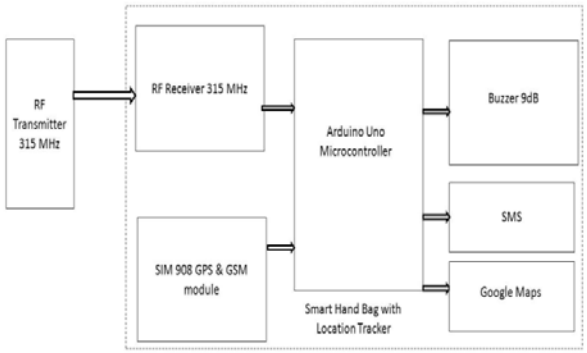

Figure-1. Block diagram of smart handbag system with location tracking.

Figure-1 illustrated the block diagram of the proposed smart handbag system with location tracking. The component parts are: RF transmitter and receiver, Arduino, GPS and GSM module, buzzer, SMS and Google Maps. RF receiver circuit connected and programmed with Arduino microcontroller that produce an output when the distance within the transmitter and receiver is 50 meters. The output is sent to buzzer to produce a loud sound as the alarm.

SIM908 GPS and GSM module are assembled with the Arduino to implement the location tracker. Arduino is used to locate the position of the handbag via satellites and hence sent out the location of the victim by SMS.

The device is tested under real event when snatch theft happens. The device produces a loud sound after the bag are snatched to alert people surrounding. The victim able to locate the bag via Google Maps after the criminals are running away with the bag to another secluded place.

RADIO FREQUENCY (RF) ALARM SYSTEM

The alarm buzzer will be activated when the distance between transmitter and receiver is more than 50 meters. The transmitter will transmit the RF signal to the receiver. Whenever someone snatch the bag contain the receiver unit, and run 50 meters away from the victim, the alarm will be activated. This will aware the people surrounding of the snatch theft, and help the victim to catch the criminal.

Development of RF system

In this project, the RF receiver unit used is LXDR06A model. The receiver unit will be connected to the Arduino as the microprocessor and to the buzzer as the output. The function of the circuit is to receive signals from the transmitter, and if the circuit fails to receive any signal, then the alarm buzzer will be triggered, by the command of the Arduino control unit.

The transmitter unit on the other hand, is independent of the main circuit. It has own power source and will be placed in the user's pocket. This unit will transmit 315MHz RF signal continuously to the receiver until it is turned off when the user has arrived a safe destination.

GLOBAL SYSTEM FOR MOBILE COMMUNCIATION (GSM)

GSM is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe protocols cellular networks used by mobile phones, and has become the default global standard for mobile communications. The GSM standard originally described a digital, circuit-switched network optimized for full duplex voice telephony. This expanded over time to include data communications, first by circuit-switched transport, then by packet data transport via GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution or EGPRS). Subsequently, the 3GPP developed third-generation (3G) UMTS standards followed by fourth-generation (4G) LTE Advanced standards, which do not form part of the ETSI GSM standard.

In this project, GSM is needed to send the location of the snatcher that has been tracked by Global Positioning System (GPS) to the user or policemen by Short Service Messaging (SMS).

Development of GSM system

The GSM module needs to be connected to Arduino in order to read location by GPS. There are many GSM module that can be integrated with Arduino in the market, but there are 4 types of module that suitable with this project, which are:

1- GSM Module A000043.
2- GSM Module with Antenna A000044.
3- SIM900 GSM Module.
4- SIM908 GSM and GPS Module.

After further research on the above models, SIM908 is chosen to be installed in this project due to its special features to integrate with GPS module.

GLOBAL POSITIONING SYSTEM (GPS)

The key of the project is in developing an alarm system that will integrate with Global Positioning System (GPS) module that will determine a location of the handbag, as well as the criminal. GPS is a system of satellites, computers, and receivers that is able to determine the latitude and longitude of a receiver on Earth

by calculating the time difference for signals from different satellites to reach the receiver. The receiver in the term is the handbag, where the location can be found easily when the latitude and longitude has been determined.

GPS system is essential in this project because most of the criminals will escape even after the people surrounding tried to stop the criminal due to their escape with the handbag using the vehicle. Hence, with the GPS system, hopefully the location of the handbag can be tracked, and the criminal will be prosecuted.

Development of GPS system

To develop the GPS system, GPS module needs to be connected with the Arduino processor. There are many models of GPS module system; however SIM908 GPS/GSM module is chosen due to its integration with GSM.

RESULTS AND DISCUSSIONS

There are three tests that have been conducted to verify the functionality and reliability of this project. which involved the volume of the alarm buzzer, reception speed of GPS and GSM signal and SMS for location.

Volume of alarm buzzer

The alarm buzzer is a very important component in the project. The resulting sound should attract the attention of the public from a distance. Therefore, experiments were conducted to test the volume of alarm in two different locations which are the roadside and in the parks. The test was also carried out during the day and night. In addition, the alarm buzzer is being tested when the weather was in the rain.

The distance in the graphs in Figure-2, Figure-3 and Figure-4 refers to the distance between the activated alarm buzzer and the people surrounding. The distances are vary, starting from 5 meters. A person who acts as the listener to the alarm sound will stand 5 meters from the activated alarm, and recognize whether the volume is 'slow', 'medium', 'loud' or 'very loud' using ear. This process is repeated up to a distance where the sound of the alarm is no longer can be heard, this concludes the result as 'mute'. Since this experiment will be affected by human error, the test is repeated with a different tester or listener, and the result shown on the graphs below are the average volume in respect of distances between the activated alarm and the listener.

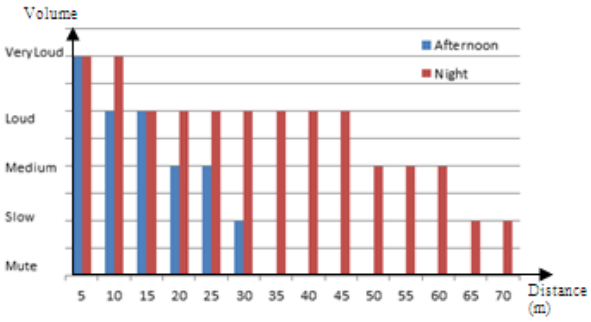

Figure-2. Volume of alarm at the roadside.

Figure-2 shows the volume of the alarm buzzer at a specified distance. The first test was conducted on the streets during the day, around 5 pm. The site chosen was at the bus stop in UTHM Campus. This location is always noisy due to the sound of cars and buses. Therefore, the situation at this location is consistent with the situation at the location where the crime occurred thefts. This data prove that the buzzer sound can be heard in the evening up to 30 meters. The hearing range is sufficient to steal the attention of the public to this alarm.

The next test was conducted about 9 pm at the same location. The current situation is much quieter than during the day. Figure-2 shows the alarm still can be heard up to 70 meters. Therefore, the alarm will definitely grab people's attention at night.

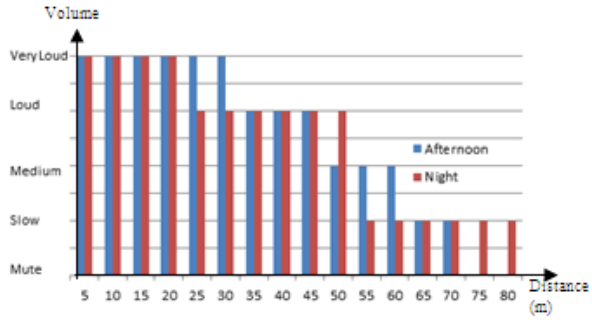

Figure-3. Volume of alarm in the park.

The test was conducted in the park on afternoon at around 6 pm and also 9 pm at night. The place chosen is at the park lake beside G3 Block, Universiti Tun Hussein Onn Malaysia (UTHM). Figure-3 shows that the audio of the buzzer can be heard up to 70 meters on the afternoon. In the night, the maximum distance for the sound of the buzzer can be heard is up to 80 meters. This is because of the atmosphere in the park is much quieter than on the roadside. Therefore, the sound of the alarm can be heard at longer range.

However, in reality, the snatch thefts that occur when the environment is quiet and dark is more difficult to prevent. This is due to less people who are around in the park at night. The lack of people surrounding means there is less chance for the criminal to be arrested, even if the sound of the alarm is high. Therefore, the system requires

modification in terms of GPS module to track the location of the handbag.

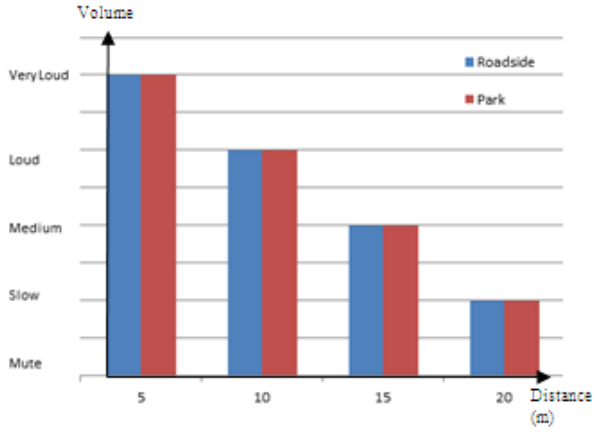

Figure-4. Volume of alarm when raining.

Data obtained during rainy seasons is disappointing. The maximum distance for the buzzer to be heard is only up to 20 meters as shown in Figure-4. The noise of rain has drowned the sound of the alarm system. No matter where the locations of this test, the results remain the same because the noise of the rain water is on the same level. However, on a rainy day the probability of criminal thefts occurs very little due to inactive criminal as rain.

Reception speed of GPS and GSM signal

Table-2. GPS and GSM signal speed access.

Time	Weather	Reception Speed (s)
Morning	Bright	10
Morning	Cloudy	50
Afternoon	Bright	10
Afternoon	Cloudy	50
Afternoon	Rain	No reception
Night	Bright	10
Night	Rain	No reception

The access rate for SIM908 Global Positioning System (GPS) and Global System for Communications (GSM) module can be determined by the period for the user to receive Short Message Service (SMS) to their smartphones. The user can request the location via SMS by making a phone call to GSM module.

Table-2 shows the speed of the GPS and GSM module to determine the location of current position at different time and weather. When the weather is sunny, regardless the time of the day, the GPS module provides a maximum reception speed which as fast as 10 seconds. On the other hand, when the weather is cloudy, the speed of access GPS rather slow which is around 50 seconds.

However, this depends on access GPS location to be determined. This is because, when the experiment is conducted, the location chosen was inside the UTHM mosque that have a 3G+ access signal. 3G+ or known as High-Speed Downlink Packet Access (HSDPA) is an enhanced 3G (third-generation) mobile-telephony communications protocol, which allows networks based on Universal Mobile Telecommunications System (UMTS) to have higher data speeds and capacity. All Malaysian HSDPA networks operate at 2100 MHz. Currently, all major towns and many high-traffic sites in Malaysia already HSDPA-enabled, which allows data, transfer at high speed. However, some rural and countryside areas in Malaysia are only limited up to EDGE (Enhanced Data rates for GSM Evolution) speed which is only around 400 kbps instead of HSDPA speed which is up to 7.2 Mbps. Hence, if the experiment is done outside of HSDPA area, such as in villages and rural areas, most likely the GPS and GSM access speed are much slower. From the research, it is proven that the GPS signal is non accessible when the weather is raining.

Short messaging service (SMS)

Short Messaging Service is used as a medium for the user to be informed about the location of the handbag. It contains longitude, longitude, as well as a hyperlink to the Google Maps application to show the location directly from the phone.

The location tracker is operated according to the following steps:

1- A phone call from the victim to the number phone fixed in GPS/GSM module need to be done as Figure-5.
2- The call will be automatically hang up.
3- After around 30 seconds, an SMS will be received by the victim as shown in Figure-6.
4- Click the hyperlink to show the instant location of the handbag in Google Maps as in Figure-7.

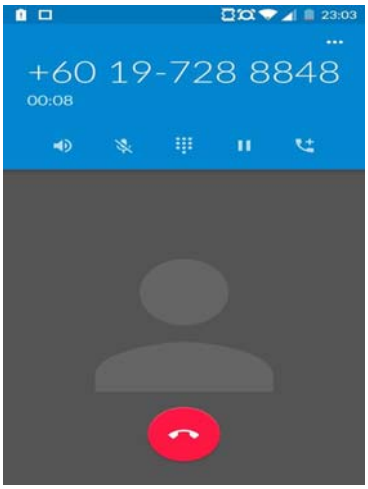

Figure-5. Phone call to GSM module.

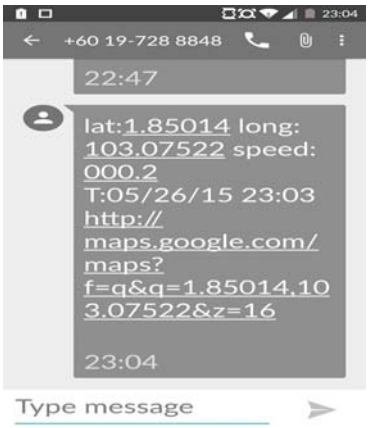

Figure-6. The received SMS.

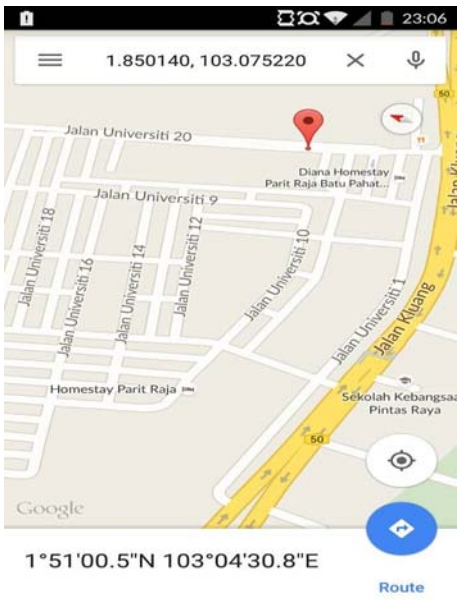

Figure-7. Location of the handbag is shown in Google maps.

CONCLUSIONS

In a nutshell, smart handbag with location tracker was designed to provide mobile security system, especially for women in order to prevent the snatch theft crime. This smart handbag system has wireless alarm, GPS location tracking module and the ability to send SMS through GSM system.

However, there are a few improvements that can be done by future researchers. The power source could be changed into solar power for more eco-friendly system. Since the device is installed inside the handbag, the size of the device needs to be scaled down for making the device more users friendly. To save the power supply, an automatic switch could be implemented. This will switch off the circuit when the handbag is static.

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