

# Design of Arduino Based Smart Bag

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**Abstract**— Children have suffered untold plights because of the dehumanizing growth of kidnapping due to widening scale of insecurity in Nigeria. Many children had been abducted while going or coming from school making the abductees and their families traumatised by the ordeal of the kidnapping. Child tracking system is widely used all over in the world and it gives the assurance to the parents that their child is safe from suspicious action but they are not affordable for people in the lower economic class. This brought the need for the proposal of the low cost smart bag, which will be school child back pack bag with a real time tracking system attached to a secure place in the bag. The proposed system will make use of Neo-6M GPS module, Arduino Uno microcontroller, GSM800L and powered by Li ion battery. The Neo-6M GPS module to detect the location of the bag when it goes out of the geofence, that is the permitted area where the child can travel, and send it to the Arduino Uno microcontroller. The microcontroller will be activated from its sleep mode by the GPS message from the Neo-6M GPS module in form of latitude and longitude of the exact location of the bag. The microcontroller will also send the location as SMS to the parent's phone number via GSM800L module. The message will be sent every five (5) minutes to prolong the battery life and timely tracking of the location. The exact location will then be tracked on the Google map.

**Keywords**— Child, microcontroller, bag, message, tracking.

## I. INTRODUCTION

The widening scale of insecurity in Nigeria is a cause for concern as all are affected by it. This has led to the increase in series of organized crime such as kidnapping and abduction. Churches, mosques, markets, schools, homes and the highway, all are susceptible to this menace. The kidnapping of all manner of persons has gained ascendancy in Nigeria. A malady previously unknown to the people has rapidly become domesticated. According to Davidson (2010), a group of criminals armed with guns and cell phones apprehend unsuspecting victims and drag their victim into a secluded spot and begin to make phone calls to whomever and demand for a ransom.

The significant impact of kidnapping and other associated crimes is becoming worrisome and perplexing not only to Nigerians but to the international community (Ngwama, 2014). The victims were either kidnapped for ransom or rituals. Umanah (2009) opined that children have suffered untold plights due to the dehumanizing growth of kidnapping in Nigeria. Many children had been abducted while going or coming from school. The abductees and their families are traumatised by the ordeal of kidnapping.

Now a day's child tracking system is widely used all over in the world and it gives the assurance to the parents that their child is safe from suspicious action. This brought the need for the introduction of the smart bag which is a real time tracking system attached to a secure place in the back pack of school child.

The proposed smart bag is designed to track, monitor and locate an abducted child. This new technology is basically embedded system that is fitted on to the school bag mostly back pack, in such a manner that it is not visible to anyone. The permitted coverage area (geofence) is set for the system in form of latitude and longitude such that it can alert the parents or guardian when the child moved out of the permitted area. Geofencing can be used to confine someone to a particular area on the earth. The tracking can be done by sending SMS to

a designated phone number. The process will be repeated every five minutes. Thus, it is used as a covert unit which sends the location data to the monitoring unit i.e.- parent's mobile. The data will be used to locate the child on the Google maps.

The proposed system is a microcontroller based system that works by using GPS and GSM technology for tracking the bag thus the location of the child carrying the bag. All that the user has to do is install this embedded system at a secured and hidden place in the bag.

Several tracking devices have been reported but mostly of vehicle tracking (Maitanmi et al., 2013, Sanaiah et al. 2015,). Some other works have also been reported on luggage bag tracking (Dexter et al., 2017), child time table management and tracking (Athul et al., 2016)

## II. DESCRIPTION OF THE PROPOSED SYSTEM

### Global Positioning System

The Global Positioning System (GPS) is a fully-functional satellite navigation system. The GPS provides specially coded satellite signals that can be processed in a GPS receiver, enabling the receiver to compute position, velocity and time. The architectural components of GPS are typically referred to as the control segment (ground stations), the space segment (satellites) and the user segment (receivers).

Upon taking in all available satellite signals, the receiver compares the time that the satellite sent the signal to the time it was received for each of the available signals. Trilateration (similar to triangulation) then calculates the position by comparing the difference among the signals (Vinod et al., 2018). This GPS system can monitor and find out the location of an object to be known anywhere on the entire surface GPS systems can be used by anyone for free, provided they have the necessary equipment and software (Oktaf et al., 2019).

For the system, the NEO-6 module series is chosen, it is a family of stand-alone GPS receivers featuring the high-

performance u-box 6 positioning engine. These flexible and cost-effective receivers offer numerous connectivity options in a miniature 16 x 12.2 x 2.4 mm package. It has a greater advantage due to its innovative design and technology which suppresses jamming sources and mitigates multipath effects, this gives NEO-6 GPS receivers excellent navigation performance even in the most challenging environments.

A complete GPS module with an active antenna integrated, and a built-in EEPROM to save configuration parameter data. It is built-in 25 x 25 x 4mm ceramic active antenna provides strong satellite search capability. It is also equipped with power and signal indicator lights and data backup battery and uses 3-5V power supply. The default baud rate of 9600bps with interface RS232 TTL.



Fig. 1. Neo-6M GPS module

#### GSM Modem

The acronym GSM mean Global System for Mobile Communications. GSM modem a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone (Oktaf et al., 2019). Also they have IMEI (International Mobile Equipment Identity) number similar to mobile phones for their identification.

GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. It operates at either the 900 MHz or 1,800 MHz frequency band. It supports voice calls and data transfer speeds of up to 9.6 Kbit/s, together with the transmission of SMS (Short Message Service) (Vinod et al., 2018)

The MODEM needs AT commands, for interacting with processor or controller, which are communicated through serial communication. These commands are sent by the controller/processor. The modem sends back a result after it receives a command. Different AT commands supported by the modem can be sent by the processor/controller/computer to interact with the GSM and GPRS cellular network.

The SIM 800L is chosen for the smart bag system, it has an ability to carry 64 kbps to 120 Mbps of data rates. The power supply voltage is between 3.8V - 4.2V while the recommended supply voltage is 4V. Its power consumption in the sleep mode is less than 2.0mA and in an idle mode, the power consumption is less than 7.0mA. The GSM transmission (avg) is 350 mA and GSM transmission (peak) is 2000mA. The module is of compact size 25 x 23 mm and has UART (max. 2.8V) interface and AT commands. The SIM card socket supports micro SIM Quad Band frequency of 850 / 950 / 1800 /1900 MHz. It comes with IPX antenna connector

and status signaling LED. The working temperature range between -40°C to 85 ° C.



Fig. 2. SIM800L GSM module

#### Microcontroller

Microcontroller is a small computer on single integrated circuits containing processor core, memory and programmable input/output reference. For this system Arduino UNO3 microcontroller is chosen, because it can easily interface with the system and it can easily programmed for operation of desired performance. It is microcontroller board and based on the Atmel's ATmega328 microcontroller, it has a 16 MHz ceramic resonator, a USB connection, a power jack with a AC-to-DC adapter or battery to get started, an ICSP header, a reset button, 6 analog inputs and 14 digital input/output pins (of which 6 can be used as PWM outputs). The board has 32 KB flash memory of which 0.5 KB is used by boot-loader, 2 KB of SRAM and 1 KB of EEPROM. The Arduino system offers a set of analog and digital pins that can be integrated to many other boards and circuits which absolutely have different functions in a design. Arduino board provides a USB serial communication interfaces for loading the codes from computer. For the uploading of the codes, Arduino has prepared its own software called integrated development environment (IDE) which completely supports C and C++ programming languages (May and Htay, 2020).



Fig. 3. Arduino Uno R3

### III. OPERATION THE PROPOSED SYSTEM

The location of the child's school as well as the child's route home is programmed into the Arduino Uno microcontroller in term of its longitude and latitude. The permitted route for the child also set in form of longitude and latitude (geofencing).

The microcontroller is set the sleep mode to minimize power consumption from the battery. If the bag is moved outside the geofence, the Neo-6M GPS module will detect the longitude and latitude of the location and send it to the

microcontroller, the microcontroller will be triggered on by the GPS message. Then microcontroller will send an SMS alert of the location received from the GPS module to the dedicated phone number via SIM800L GSM module.

For prompt action, and management of the power consumption, the location can be found out sending SMS (“Location”) from the dedicated number to the GSM which is interfaced with microcontroller and as microcontroller received SMS, then through the GPS, microcontroller sends the coordinates to number as an SMS. Google Maps Application is then used for finding the location of the child. It provides the information and exact location of child to the accuracy of 10 m.

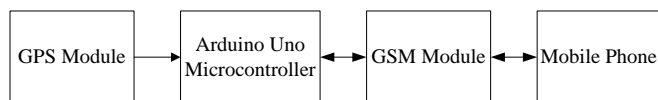


Fig. 4. The Block Diagram of the Proposed Smart Bag

#### IV. CONCLUSION

It is very important to monitor the movement of children when they are outside their homes, most especially in the era of incessant kidnap. Since most of the available technologies for child tracking are expensive and are not affordable to the common masses. The components proposed for this design are cheap and readily available in the market and does not required sophisticated software coding.

The paper is written to design a cheap and affordable system for child tracking with GPS and GSM system and understanding of the components used in the system. The system will be able to locate a child carrying the smart bag in case of event of kidnap or moving out of the permitted area.

#### Recommendation

The designed system has not reached its peak point, better technologies could still be applied to deign wearable trackers with micro components.

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