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Design and Implementation of Accident Emergency SMS Tracking System

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Abstract: ***The accident emergency SMS tracking system is an electronic device designed to help victims of road accident get quick relief from rescue team in case of accident eventuality by sending tracking data to the mobile equipment of the rescue team which can be tracked using Google map Application Programming Interface (API). In this work, the design and implementation of accident emergency SMS tracking system is carried out, using common electronics components such as normally open switch placed in contact with glass forming an improvised crash sensor, GSM module SIM900, Atmega16 microcontroller, Liquid Crystal Display (LCD) and a matrix keypad are the major components used in the design. The designed circuit was installed in a car. Accident scenes were constructed by dropping loads of various sizes from a height and loads attached to a string to hit the car to shatter the glass as a method of determining minimum impart energy required to shatter the glass and the occurrence of severe or fatal accident. The assumption here is that severe or fatal accident must result to a bodily damage of the car. The microcontroller coordinates the SIM900 module which has both Global Position System (GPS) and Global system for mobile communication (GSM) functions. If there is a crash, the GPS engine gets the coordinates of the crash scene (crash information) which is sent by the GSM engine of the SIM900 module through a GSM frequency to the mobile equipment of the rescue team for tracking.***

The tracking accuracy of the system was tested by using a standard GPS device GERMIN with model Number GPSMAP78s to get the GPS coordinate of the scene where the tests were carried out and tracked with Google map API. The tracking information gotten by both devices in the form of decimal degree representing latitude and longitude showed exact and same location when tracked using Google map. This proved that the device can send accurate tracking information within a short period thereby saving lives.

Keywords: GPS, GSM, Crash Sensor, Mobile Equipment, Tracking Information, API.

I. INTRODUCTION

Transportation by road is one of the most common medium of transportation in Nigeria compared to other mediums of transportation such as air, rail and water transportation. This medium of transportation has the highest casualty in terms of fatality and severity. According to an online publication by the Nigeria Pilot (2016) road accident is the second highest source of violent death in Nigeria, ranking Nigeria as the second highest in the rate of road accidents amongst 193 countries of the world. According to world Health Organization one in every four road accident deaths in Africa occurs in Nigeria. Road accident is not limited to developing countries only; the developed countries of the world also have their share which has led to loss of lives and property. This work attempts to proffer solution on how victims of road accident can be helped within the shortest time in case of accident eventuality by designing an electronic hardware called "accident emergency SMS tracking system" fitted in a car to send SMS which contain tracking information whenever there is a crash. It should be noted that accident emergency SMS tracking system cannot prevent accident from occurring but can help save lives by sending crash information to a rescue team for quick relief.

II. RELATED WORK

Lots of work has been done relating to accident emergency SMS tracking system. Some of the most recent and relevant ones are; Seokju et al. (2014) proposed an efficient vehicle tracking system designed and implemented for tracking vehicle in any location. The system is just a proposal no design was carried out. The work proposes the use of Smartphone as the tracking device while Arduino board was used to coordinate the activities of GSM/GPS device. The design circuit using microcontroller and GSM/GPS module was installed in a car. The proposed system is inexpensive and easy to implement, the GSM/GPS module is used to transmit and update the vehicle location to a database. A Smartphone application is also developed for continuously monitoring the vehicle location. The Google Map API is used to display the vehicle on the map on the Smartphone application. Thus, the user is able to continuously monitor a moving vehicle on demand using the Smartphone application and determine the estimated distance and time for the vehicle to arrive at a given destination but failed to propose the type of sensor used in the work.

Khan and Mishra (2012) Proposed tracking system that uses the global positioning system to determine the exact location of an object, person or other asset to which it is attached and using GSM modem, this information can be transmitted to a remote user. In the design ARM processor was used to coordinate the activities GSM/GPS modem. The system can be controlled by sending SMS to query the system. Some of the merits in this work are; the GSM/GPS send the location information to a remote monitoring system, real time tracking, the activity of the monitored system can be check, the communication is instantaneous but failed to explain how the crashed is been detected.

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Sonika et al. (2014) introduces intelligent transportation system (ITS) in their work titled intelligent accident identification system using GPS, GSM modem. The work is just a proposal of how to locate accident scene, send message to a main server, the main server locate the nearest ambulance to the accident zone and send exact location of the accident to the ambulance. The control unit monitors the ambulance by providing the shortest path to the nearest health facility while using RF signal to control the traffic light to pass the ambulance thus saving time.

The works discussed so far, they fail to show how accident scene is detected, if the information sent by various systems was tested for accuracy by representing the exact location.

Our designed circuit (Accident emergency SMS tracking system) addresses how accident scene is detected by using an improvised sensor which can discriminate between severe and fatal accident, it shows time taking for the tracking information to get to the rescue team.

III. PROPOSED UNIT

The proposed unit is divided into two parts which ensure accident victims are resced within the shortest time possible. These units are;

- The Accident Detecting / Lob cation Unit.
- Rescue Team Mobile Equipment.

The accident detecting / Location unit is installed in a car which is the accident emergency SMS tracking system while the rescue team mobile equipment can be a laptop, android phone or devices that has internet facility with Google Map app installed in it. Figure1 below shows the communication network of the proposed unit.

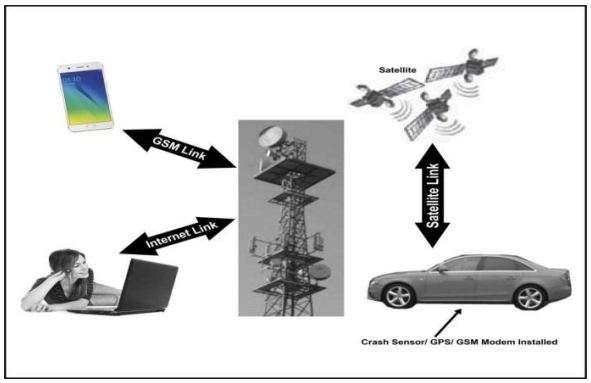

Fig. 1. Communication Link of Accident Emergency SMS Tracking System

IV. CIRCUIT CONSTRUCTION/OPERATION

The block diagram below shows that the sensors are connected to the microcontroller, the microcontroller continuously checks its input if there is a change from logic zero to logic one. The function of the LCD screen is to indicate the working status of the device and display the inputted number of the rescue team. The matrix keypad helps to input numbers while the SIM900 helps to get GPS coordinate of the crash scene.

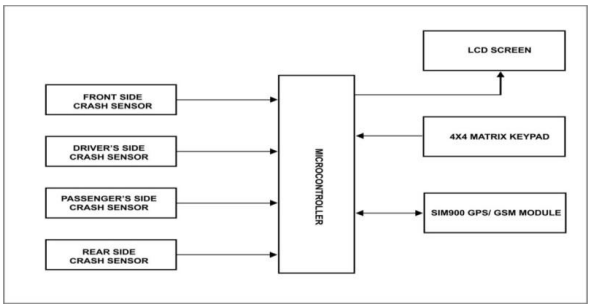

Fig. 2. Block Diagram of Accident Emergency SMS Tracking System

The accident emergency SMS tracking system is constructed using available electronic components such as resistor, capacitor, SIM900 GSM module, Atmega16, matrix keypad, LCD Screen. These components are joined together on a Vero-board. Figure 3 shows the circuit diagram for accident emergency SMS tracking system. The circuit is powered by the 12VDC from the car battery, which is step down to 5VDC reason been that the circuit is a digital circuit and the GSM module connection pins is TTL compactible. The crash sensor is a combination of a normally open switch and a glass. The output pin of the switch is connected to Atmega16. Figure 3 below shows the circuit diagram for accident emergency SMS tracking system.

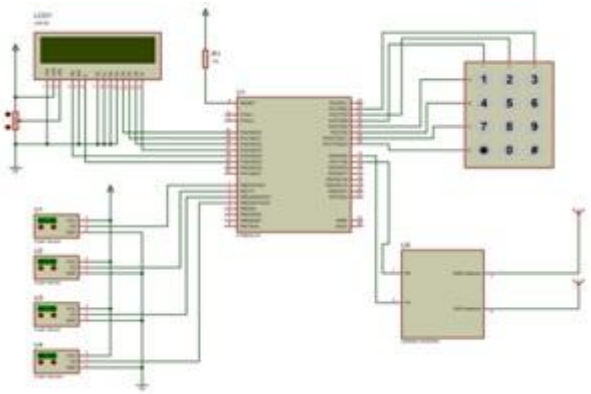

Fig. 3. Circuit Diagram for Accident Emergency SMS Tracking System

The crashed sensors are connected to the PORTB pins of the microcontroller. The microcontroller is connected to SIM900 through its UART terminal, the LCD screen and the matrix keypad is connected to PORTA and PORTC pins of the microcontroller pins respectively. The function of the keypad is to input the identification number of the mobile equipment of the rescue team while the number is been displayed on the screen to ensure that the actual number is inputted. The assumption in the design is that severe or fatal accident cannot occur without causing bodily damage to the car.

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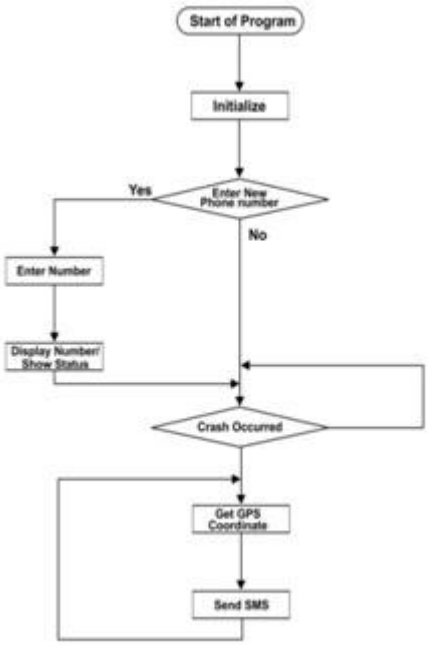

Fig. 4. Program Flow Chart of Accident Emergency SMS Tracking System

Hence the choice for the improvised crashed sensor. The crashed sensor is a normally open switch which is closed by bringing it in contact with a glass. This car bodily damage is used as a threshold to determine either severe or fatal accident by placing a glass in contact with a normally open switch to form a crashed sensor. The crashed sensors are placed under the bonnet, the two sides and the rear side of the car. When there is a car crash or accident, the glass shatters thereby releasing the switch from closed state to open state. The microcontroller input connected to the crashed sensor changes state from logic 1 to logic 0 indicating accident has occurred. The microcontroller then sends an AT command to SIM900 through it UART terminal commanding it to get GPS coordinates of that location because an accident has occurred and send an SMS to the mobile equipment of the rescue team. The SIM900 has two parts the GPS engine and the GSM engine, the GPS engine gets the coordinate passes it to the GSM engine which then send the location coordinate and Google Map link for easy tracking to the mobile equipment of the rescue team. The LCD screen also displays the device working status. The software program embedded in the microcontroller help to instruct the microcontroller. The diagram below is the flow chart diagram for accident emergency SMS tracking system program.

V. TESTING / RESULTS

The accident emergency SMS tracking system was tested after it was fully constructed. The time it takes for the SMS to deliver and tracked the crashed scene was measured with a stop watch, the minimum impact energy required to shatter the glass was also tested. The approach uses are [1] One of the switches was open while the rescue team mobile equipment was many kilometers away.

One of the normally open switches was open to indicate accident occurrence and check if the coordinate sent actually represent the crashed scene location, time taking for the SMS to deliver and track the location were measured using stop watch. The tracking information was validated by using GPS device GARMIN with model number GPSMAP78s to get the GPS coordinate of that location where the device is being tested and this information is tracked with Google map. It was observed that both devices gave exact location when tracked. The table below shows the readings of five different locations from several readings taking within Benin metropolis a state in Nigeria, Africa.

Table 1 SMS Recived and Reading of Test Location Using GPS Device

No.	SMS Alart on Smartphone	Garmin GPS Reading	Time Taken HH:MN:SS	Tracking Accuracy
1	Crash detected! https://maps.google.com/maps?q=6.433988+5.599273 Lat:0626Σ0393.0393N Long:00535.9564E	N06^{0}26'02.5'' E005^{0}35'57.5''	00:00:55	Exact location tracked using Google map
2	Crash detected! https://maps.google.com/maps?q=6.348974+5.631308 Lat:0629385.9385N Long:00537.8785E	N06^{0}20'56.5'' E005^{0}37'51.9''	00:01:00	Exact location tracked using Google map
3	Crash detected! https://maps.google.com/maps?q=6.321841+5.635893 Lat:0613105.3105N Long:00538.1536E	N06^{0}19'18.6'' E005^{0}38'08.9''	00:00:49	Exact location tracked using Google map

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4	Crash detected! https://maps.google.com/maps?q=6.246749+5.624749 Lat:0618050.8050N Long:00537.4850E	N06^{0}14'46.6'' E005^{0}37'35.0''	00:00:57	Unable to tracked area. (Area not mapped out un Google map
5	Crash detected! https://maps.google.com/maps?q=6.391893+5.616095 Lat:0623Σ5136.5136N Long:00536.9657E	N06^{0}23'30.5'' E005^{0}36'57.7''	00:01:02	Exact location tracked using Google map

The diagram below is a screenshot of the SMS sent to the mobile equipment and track scene, the red spot on the tracked scene indicate crashed location. The mobile equipment used is an andriod phone.

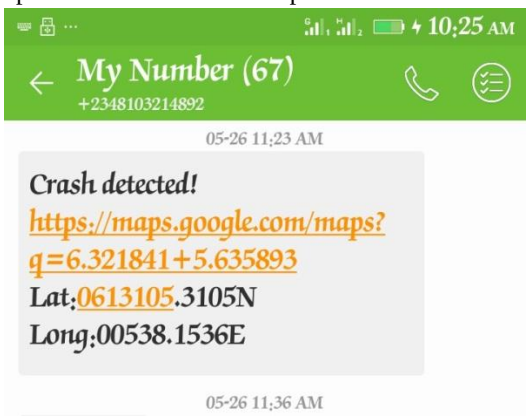

Fig. 5. SMS Received From a Crashed Scene

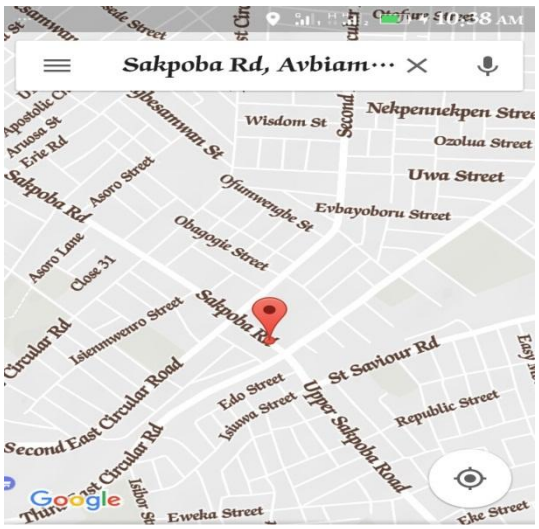

Fig 6 Tracked Crashed Scene

[2] Loads were drop on the car to determine minimum impact energy required to shatter the glass. The minimum impart energy required to shatter the glass was tested for, by dropping loads of various weight on the bonnet and striking the driver's side with loads of various weight. The assumption here is that either severe or fatal accident cannot occur without causing bodily damage to the car. Load weight of 35kg from a height of 5m was found to shatter the glass when dropped.

From Potential Energy Equation

E_p = mg x h where;

E_p = Potential Energy, m = mass = 35kg,

g = acceleration due to free fall = $10ms^{-2}$,

h = falling height = 5m.

$Ep = mg X h$ (1)

E_P = 30kg x $10ms^{-2}$ x 5m = 1500J

A rope was hung from a height of 8m strong enough to suspend weight up to 100kg was used to form simple pendulum and various loads were attached to it. The simple pendulum swung to strike the car from the driver's side in order to shatter the glass attached. The loads swung through a height of 0.4m from the ground. From law of conservation of mechanical energy;

$E_k = E_p$ where

E_k = Kinetic Energy.

E_p = Potential energy.

$E_k + E_p$ = constant

Or $E_k + E_p$ = at any point

= $E_k + E_p$ at another point

(Okeke et al 2011:22)

$1/2mv^2 = mg$ (2)

From the test, load of 20kg shatters the glass.

E_p = from a height of 8m = 20x 10 x8 = 1600J

E_p = from a height of 0.4m = 20 x 10 x 0.4 = 80J

$E_p + E_k$ = 1600J

E_k + 80J = 1600J

E_k =1520J.

The impact energy needed to shatter the glass from the side is1520J.

VI. LIMITATION

The sensor used in the work is based on the assumption that there is no severe or fatal accident without causing bodily damage to the car. This work did not consider a car falling in a pit or river where the sensor will not crash. In such a scene the sensor may not sense accident

scene. Difficulty in tracking rural areas that are not map out on Google map.

VII. CONCLUSION

Accident emergency SMS tracking system cannot prevent accident from occurring but can help save lives when there is a car crash by sending quick relief to accident victims. The design of the accident detecting unit is cost effective with the ability to send accurate tracking information. The improvised sensor which shatters only when there is a crash has eliminated false triggering with the aid of a suspension spring, the suspension spring hold the glass and prevent it from shattering when the car drives through rough roads. The key feature of the tracking process is a device that has Google map installed in the mobile equipment, which makes the tracking process cheap and flexible to use. For area map out on Google map the exact location is seen on the map.

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