Smart Accident Notification and Tracker (SANAT)

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Abstract- Road accident is a major concern in automobile powered world and road safety. Most of the accidents are not attended or treated quickly due to the lack of best emergency facilities and late information of the accident to rescue team especially in rural area. This paper aims to design Smart Accident Notification and Tracker (SANAT) by using Arduino Uno as a microcontroller with Global Positioning System (GPS) via Global System for Mobile communication (GSM) technology. This system detects an accident immediately after an impact sense by shock sensor and notified the emergency contact list as well as the rescue team with the precise location of the accident covering geographical coordinates in which a vehicle accident had occurred obtain from the GPS module after the shock sensor receive an impact from the accident. Signal from the sensor would be send to microcontroller and compares with the threshold set value and immediately sends an alert message using GSM modem to the first aid centre as a receiver. The receiver would receive the location in a link that could directly view the location and start navigate through Google Maps. This system would provide an optimum alert that could help reducing the loss of life due to vehicle accident.

1. Introduction

Nowadays, the road accidents are very common in Malaysia. The rate of accident keeps increasing and most are caused by human fault for example driving over the speed limit, driving under the influence of alcohol and reckless driving. In some cases, the accidents had led to fatality due to an inaccurate location detection which causes the delay of emergency help, without a proper first aid, a simple injury could become severe and might lead to fatalities.

Many researchers carried out their studies on accident detection system. This section discusses about the existing vehicle tracking and accident alert systems. Bankar el al. [1] presented the review on Intelligent System for Vehicular Accident Detection and Notification and enunciated an idea to use flex sensor and acceleration to detect the accident. Then the GSM would send GPS location, time and vehicle number as alert message. Thus, this paper emphasizes on post-accident system for detecting and informing about the accident. Authors in [2] reported an Accident Alert and Vehicle Tracking System. The main aim for this project is to early accident detection. ARM7 microcontroller has been used as the brain of his project. This system works when the accelerometer detects accident. Then, the ARM7 microcontroller would read location from GPS and send alert to receiver.

An Android app usage in [3] which has been initialized in the system submitted in the article of Accident detection depending on the vehicle position and vehicle theft tracking, reporting system. The application specifies the location of the accident. Thus, help could be immediately dispatched and detection of the accident is done by using crash sensor. A web-based accident reporting and tracking system (ARTSYS) uses sensor technology has been developed by Azeez et al. In this article, he has
designed a system for the most difficult problem associated with vehicle tracking which there is the occlusion effect among vehicles. In order to solve this problem, they developed an algorithm, referred to as spatiotemporal Markov random field (MRF), for traffic images at intersections. This algorithm models a tracking problem by determining the state of each pixel in an image and its transit, and how such states transit along both the image axes as well as the time axes [4].

Shanmugasundaram el al. [5] has presented a Smart Accident Alert and Toll Pay System to notify each and every helping hand to save an individual life during accident and in tough situations. This article has used Arduino in interfaced along with GSM (SIM 300) and GPS (PMB-648), which passes messages to a helpline and reducing the burden of waiting in line at the toll plaza by developing auto toll pay system. This system also uses a speed sensor which sends a notification if a vehicle is caught over speeding.

This paper proposed the development of Smart Accident Notification and Tracker (SANAT). The proposed system could detect an accident immediately after an impact sense by shock sensor and notified the emergency contact list as well as the rescue team with the precise location of the accident. When an accident occurred, the impact that faced by the vehicle would be detected by the shock sensor. Thus, it would trigger the microcontroller to send an alert message. It sends the alert message to a receiver via Global System for Mobile communication (GSM) modem that provides current Global Positioning System (GPS) location of vehicle in terms of latitude and longitude [6]. The receiver would receive the location in a direct link so that they could directly view the location and start navigation through Google Map [7]. This application provides an alternative to help emergency rescue team to map the locations of road accidents and reduce the response time by utilizing Global System for Mobile communication (GSM) technology [8].

2. SANAT Architecture

The Arduino Uno act as the microcontroller receive the signal from sensor immediately after sensing a shock and the Arduino Uno would trigger the GSM to send an alert message along with GPS location to the receiver in form of longitude and latitude. The shock sensor is used to detect an impact applied to the vehicle body.

GPS SKM 53 is used to provide an exact location to the GSM module. In hence, the GSM SIM 900 used to send an alert message in the form of direct link to the receiver informing that the accident had occurred. Figure 1 shows the block diagram of SANAT and Figure 2 shows the operation of SANAT.
3. Hardware prototype

Coding and schematic had been analysed and troubleshoot to ensure the effectiveness of this system. Several tests had been carried out in order to calibrate GPS reading and sensitivity of the sensor [9].

Shock sensor is used as input that would detect an impact whenever accident occurred. For further usage of this sensor, sensitivity must be determined so that ratio of actual force to experimental force can be calculated. Hence, to determine the sensitivity of the sensor, a fixed weight is used and being applied with different acceleration. In this test, weight of 5 kg is used to be tested with shock generator [10].

Force is calculated by using equation (1) [11], where F is force (N), m is mass (kg) and a is acceleration (m/s²)

\[ F = ma \] (1)
Table 1 indicates the force value of impact tested by using shock generator. This observation is conducted to identify force value needed for each shock sensor reading value, range between 0 to 5V. When an impact detected, the value of shock sensor reading is at 0V which is equal to 588.40N.

In the meantime, the ratio of the actual force to experimental force, the average actual force had to be determined by using equation (2) [12].

\[
F_{av} = \frac{1}{2}mv^2/d
\]

\(F_{av}\) = force (N)
\(m\) = mass (kg)
\(v\) = velocity (m/s)
\(d\) = distance of the car stopped after collision (m)

Assume that a car weighted at 1000kg moving at a speed of 80km/h involve in a road accident that halt the car motion at distance of 2.0m. Hence, by using equation in (2), the average force of actual road accident faced by a car is at 123.46kN. Therefore, the ratio of mass actual car to mass of experimental weight is = 1000/5 which is approximately at 200:1. With that ratio, the experimental average force to shock sensor is calculated as below.

\[F_{av} = 200 \times 588.40N = 117.68k\]

Thus, it could be concluded that the value of the average force of the experimental (117.68kN) approximately approaching the actual car at 123.46kN. Hence, for SANAT this ratio could be used to illustrate the impact of actual car to system.

| Shock sensor reading (V) | Force (N) | Acceleration (m/s\(^2\)) |
|--------------------------|-----------|--------------------------|
| 0                        | 588.40    | 117.68                   |
| 2                        | 294.20    | 58.84                    |
| 3                        | 147.10    | 29.42                    |
| 4                        | 49.03     | 9.81                     |
| 5                        | 4.93      | 0.99                     |
When an impact had detected on the vehicle body by the shock sensor, the GSM modem would send an alert message in the form of direct link that consists of longitude and latitude of location to the receiver in order to warn that the owner of the vehicle had involved in an accident as shown in Figure 3.

![Alert message received on Android](image)

**Figure 3.** Alert message received on Android

4. SANAT Prototype

Figure 4(a) and (b) show the front view and side view of SANAT, respectively. Figure 5 shows the top view of SANAT with completed labelling of components used. The location of the accident will be sent instantly through alert message by GSM with link of the location provide by GPS. This system is developed by using GSM modem that have capability to send message to mobile phone. Arduino Uno act as microcontroller that used to control this system. Shock sensor as input of the system whereas the outputs are GSM modem and GPS tracking system.

When the shock sensor detects impact which reaches set value, microcontroller will collect the data sent by shock sensor and give the instruction to GSM module to send alert message in mobile phone as a notification of accidents. Receiver will be notified about the accident and navigate to the location with the aid of the GPS tracking system. This system can reduce the number of undetected road accident by alerting the people and rescue team that an accident has occurred at a specific location through application that can be monitor through GSM technology connected to mobile phone. Hence, the safety features of the vehicles are significantly improved by implementing the project of Smart Accident Notification and Tracker (SANAT). Besides, hit and run or broken into car cases may also be prevented by using this system. In addition, with the help of this system, accidents that occur in rural area will immediately be revealed.
5. Conclusion

As a conclusion, SANAT could be used as an alternative to help emergency rescue team to map the locations of road accidents and notified users of any accident happen to vehicle. The use of Accident Alert System that integrates both GSM modem and GPS tracking system should be practiced and implemented into vehicle to always ensure safety of vehicles and its owners.

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