Real Time Accident Analytics

Vighnesh S, Uppu Sriharsha, Jamuna Devi C*, Srinivas V and Rakesh U.P
Department Electronics and Communication Engineering, Rajalakshmi Engineering College, Thandalam
***Corresponding author: E-Mail: jamunadevi.c@rajalakshmi.edu.in**

ABSTRACT

'Real time Accident Analytics', a system to detect accidents and generate a real time heat map to identify accident prone zones. With the recent developments in the field of Internet of Things, which is popularly known as IoT, gathering data remotely has never been easier. The objective of our desired system is to simplify the identification of the accidental zones and to save lives. Using the IoT application to monitor the acceleration changes, the occurrence of an accident is detected. The geographic area (place) of the accident is then sent to the remote storage location. It is hard to visualize this data if the form as tables and numbers, so the data is processed to plot the 'heat maps'. Heat map allow for the easy identification of the accidental black spots. This heat map shows the frequencies of accidents occurring in a zone.

KEY WORDS: Internet of Things, heat maps, accidental analytics, black spots.

1. INTRODUCTION

Road accidents are one among the leading cause of deaths in the world. In 2007, it is estimated that road accidents caused about 114,600 fatalities in India and with motorised vehicle numbers steadily increasing, the number of road accidents are also sure to increase. The total number of road accident related fatalities has been increasing at a steady rate of about 8% per and has since to 8% per year since 2013. Analysing accidents manually is a laborious task and is time consuming. The First investigation records of the police have to be analysed and then the findings have to be cross verified with the local hospital. This system is slow and it is a major disadvantage. It takes many years and accidents for that area to be noticed as an accident prone zone. Also the correctness of the data is not very high as they are referenced with respect to some landmark. Internet of Things (IoT) is a recent technological trend by which we can send and acquire data remotely over the cloud. This enables us to automate this process. It replaces the process of manually scavenging through the data with a system that identifies the accident and plots the heat map .Use of IoT makes the process more real time than the manual method and very accurate as it makes use of the GPS data. This is achieved using an Android app to collect the required data and detect the crash and java script to plot the heat maps.

Literature Survey: The identification of the black spots is very importance. Only after the identification of the accidental prone zones can we take the necessary measures to prevent them. As of today, the identification of the 'accidental black spots' is a manual process. It involves going through piles of police ledgers to identify the locations. These data are then cross verified with the hospital records. Even after all this data is not the most accurate, as the locations of the accidents are noted relative to the nearest landmark. So the accident location data is always a little of the actual accidental location. Knowing the precise location of the accident is very useful. The entire process of identifying the black spots is a time consuming and a lengthy process. Sometimes it can take even a few years to identify these locations. But during this time, accidents continue to happen. Only after the occurrences of many of accidents do these black spots come to notice.

2. PROPOSED WORK

The proposed system consists of an application which is installed on the driver's phone. This application, developed over Android platform, is used to constantly monitor the accelerometer and the gyroscope readings.

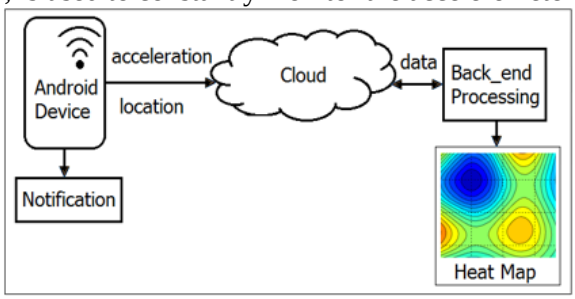

Fig.1. Block diagram representation of the Live Accident Analytics

The data stored in the cloud provide the necessary information to develop the heat map through the back end processing. The source data is also collected from the app user with the help of the app user gyroscope, acclerometer and the GPS location of it.

If an accident occurs, there is a distinct spike in the accelerometer readings which will be detected by the application which is shown in fig.2. The GPS co-ordinates of the location of the accident is sent to the cloud based storage. Using cloud makes the data remotely accessible and secure.

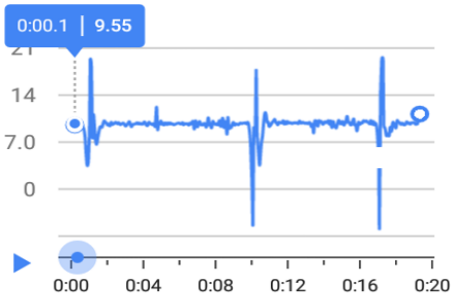

Fig.2. Acceleration as a function of time in the z axis showing 3 spikes

The data in the cloud is then moved to a web server and using the Java script API. This API uses the location data to plot the 'heat map'. The heat map is used to highlight the locations of accidents and also their frequencies by varying the colour intensity. This heat map can be made available on a webpage accessible to all.

System Definition: This system has three major modules which is shown in the fig.3, as a data flow, which are predictive system, preventive system and access control and data visualization modules. The predictive module collects the required data using the sensors and compute the value required accordingly and it will be available in the cloud which can be accessed by the app user. The data available which is the source of the heat map generation provide the necessary information for the prevention of the accidents for the app user and also alert them about the black spots which are the accident prone zone. The third module is the access control and data visualization module through which the user interacts and can gain the knowledge of the environment.

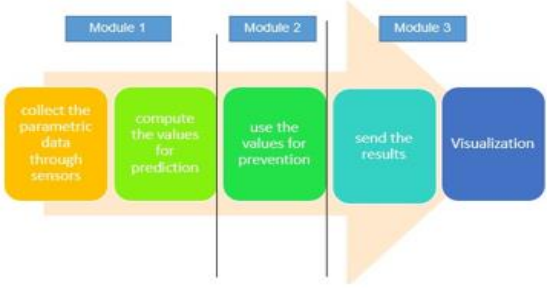

Fig.3. Data Flow Diagram

Data Collection: The Android mobile nodes constantly monitor the change in acceleration based on the orientation. On the event of an accident, there will be a huge change in acceleration on comparison of past and present value. In fig.3, it can be noted that the three spikes denote the sharp change in acceleration as seen when an accident occurs and is relatively constant otherwise.

If the change is above a threshold the mobile node is triggered to wrap up all the necessary data like location, level of accident, IMEI number and mobile number in a JSON Array and populate it in a file offline. Once the node comes online, this file will be sent to the cloud for further processing.

Online data storage: Remote data storage is used for holding the accident location data. Online storage enables the access of data from any location. This simplifies the process of retrieving the data.

The online data storage offers many security features. The first feature is confidentiality. This means that the data is not shared or disclosed to any unauthorized users. Online storage also provides access controllability by limiting access of the data to only the desired users and doesn't allow third party users to snoop the data. Online storage also provides encryption services such as Attribute-Based Encryption Algorithm and Fully homomorphic encryption (FHE).

On an average the location data of an accident requires around 115 bytes of storage space. So in one gigabyte we can store the location data of 10 million accidents.

The reliability that online storage offers is one of its major advantages. As the data to be retrieved is quite small it provides fast and remote access of data.

RESTful Web Services: The cloud services that are being used for data storing and retrieval is equipped with RESTful web services with stateless REST APIs from the http protocols such as GET, POST etc. to access and modify data. A RESTful call to the cloud stack with appropriate GET, POST messages irrespective of the platform fetches or posts data appropriately in a data interchange format called JSON.

System Architecture: The Real Time Accident Analysis system has been set up and running which monitors the accidents happening all over the world with the help of the Android App provided by us and the data collected from the App has been directed to be sent to a server which is responsible for generating the heat map. The fig.4, shows the flow diagram of the proposed system from the inputs of the accelerometer &GPS to the android which checks for the prediction and prevention, if prediction occurs the data is stored over the cloud and it update the heat zone map and if prevention needed it alert the system via the android app.

The mobile has been programmed to sense a sudden fall as an accident and the GPS co-ordinates of the location of the fall will be collected and sent to the server. The server takes care of processing the heat map with the collected data. The accident data of a single accident is not enough to mark a place as an accident prone zone. Hence a process of data collection has been previously done to generate the heat map.

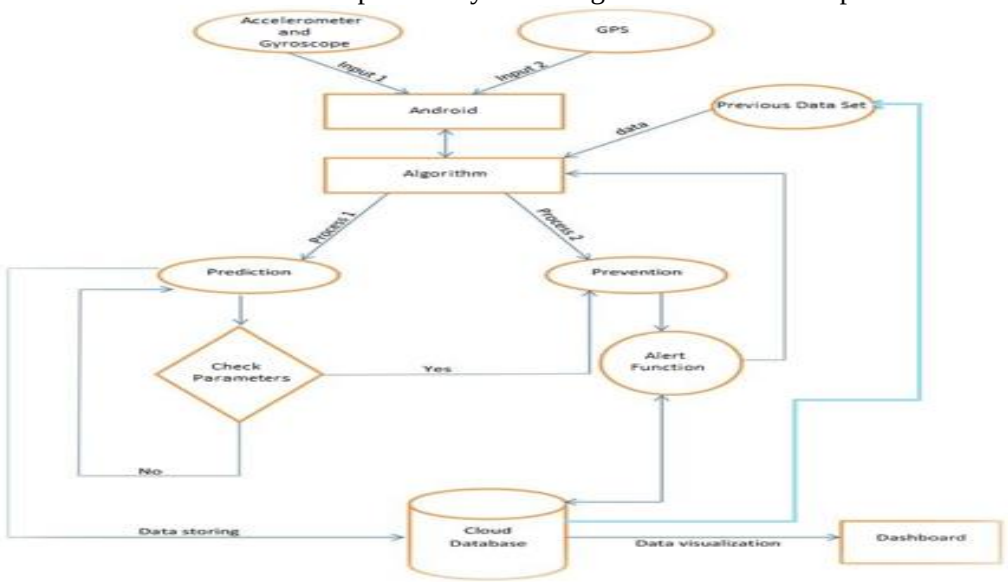

Fig.4. Block diagram of the proposed method

Developing the heat map: The data is retrieved from the cloud. This data is in the JSON format. JSON format is used to represent a table in the form of a string with key- representing a column name and value – representing the value at that column.

Syntax :[{"Key":value}]

For example : [{"timestamp":"21-Mar-2017 21:02:30","imei1":"911432002681735","imei2": "911432003481739", phonenumber":"+918148285956","latitude":"12.9732","longitude":"80.22795166666667", "xacc":"-0.469","yacc": "0.249","zacc":"9.864","xgyro":"- 0.004256757","ygyro":"0.0021283785", "zgyro":"0.004256757}].

In the above example, the JSON holds one accident data containing timestamp of accident, IMEI of device, phone number of the device holder, Latitude, Longitude accelerometer and gyroscope sensor data.

A table of numbers won't mean anything unless we visualize it in a form which makes sense. This is where maps come in handy. Maps help for a clear understanding of the data. There are a wide variety of maps which can be employed here. We have Pie Chart Map, Histogram Map etc. The heat map suits the application well because by varying the intensity of the colors present in the map, we can denote the frequencies of the accident and thus better visualization. The colors vary from Green denoting less accidental zones to Red denoting highly accidental zones. Thus just by looking at the map an observer can identify the high accident zones easily.

3. RESULTS AND DISCUSSIONS

Fig.5. Accident heat map

The above figure shows us the heat map of all the accident zones based on number of accidents occurred in the area, we could see that in downtown the level of accidents is more hence the red color and rest all have blue with lesser accidents.

Table.1, depicts the timestamp and the location of some accident that has occurred in Chicago. It can be inferred from these details that there are more number of accidents occurring around the location 41.896926, -87.6414526 (Downtown). This is why heat map is a helpful way to visualize data and interpret the results.

Table.1. Timestamp and Location

Timestamp	Location (Latitude, Longitude)	Timestamp	Location (Latitude, Longitude)
21-Mar-2017 09:13:46	12.896926, 80.6416489	25-Mar-2017 07:44:19	12.896476, 80.6419871
21-Mar-2017 12:23:40	12.965372, 80.664669	25-Mar-2017 13:27:52	12.947140, 80.663322
21-Mar-2017 21:14:32	12.896926, 80.6414526	25-Mar-2017 05:34:53	12.896925, 80.6411234
23-Mar-2017 12:54:10	12.92065, 80.707895	25-Mar-2017 09:55:52	12.803361, 80.634256
23-Mar-2017 17:31:29	12.896586, 80.6414521	25-Mar-2017 12:30:41	12.858926,80.6417468
23-Mar-2017 21:11:58	12.803361, 80.639875	25-Mar-2017 12:20:47	12.926933, 80.7022256
25-Mar-2017 02:44:48	12.896926, 80.6466321	25-Mar-2017 11:45:36	12.012650, 80.691452
25-Mar-2017 23:31:52	12.920253, 80.7025693	25-Mar-2017 10:10:25	12.896156, 80.6411234
25-Mar-2017 10:49:14	12.965314, 80.667456	26-Mar-2017 21:06:15	12.896996, 80.6417895
25-Mar-2017 21:16:47	12.806991, 80.637425	26-Mar-2017 22:40:30	12.896586, 80.6411235
25-Mar-2017 20:26:37	12.958372, 80.661258		

4. CONCLUSION

The current system helps gather the accidental data and plot it in the form a heat map. This provides many benefits over the current system. It provides real time heat maps. This system eliminates the need of hard and laborious manual work. The automated heat map system is more accurate than the manually plotted heat maps.

This real time analysis accidental system can be used in conjunction with many futuristic applications such as driverless cars to alert them that they are entering a potentially accidental zone and take the necessary precautionary measures.

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