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REPORTING AND ANALYZING ROAD ACCIDENTS THROUGH MOBILE APPLICATION

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Abstract: Road accidents are the cause of major concern today. Not only the lives are lost, but they also cause substantial damage to road and highway infrastructure. Our application is developed for the users who wish to complain about the accidents and bad condition of roads. Users are provided with an interface to describe the condition of the accident site including the location and image of the spot, extent of loss and other parameters addressing the severity of the accident. The data so obtained, is stored in SQLite database and analyzed using RapidMiner tool so that the concerned authority can get complete overview of the database provided by the users from different sites in the form of pie charts, tables, bar graph and line graphs of different accident prone spots. The application also allows the users to report on poor conditions of roads so that accidents can be avoided beforehand.
Keywords: Android Studio; Data Analysis; Rapid Miner Server; Rapid Miner Studio; SQLite; Software Development Kit.

1. INTRODUCTION

Road safety happens to be a primary concern all over the world considering the fact that it affects every individual nation, people within the nation and consequent impact on the economy and public health of the nations across the globe. Major reasons for accidents are unruly traffic and bad condition of roads, absence of sign board, unauthorized median cuts etc. Thus, preventive measures should be taken and modern technology can be used to address the issue. As per the data published by the Ministry of Road Transport and Highway, India [1], the total number of accidents increased by 2.5 percent within the span from 2014 to 2015 and the rate of deaths because of accidents is 400 deaths every day. Another report on Road Accidents in India 2016, published by Transport Research wing under Ministry of Road Transport & Highways, Government of India [2], has revealed that more people died on roads accidents in India last year, as compared to the number of deaths in 2015. The data has further revealed that the states of Uttar Pradesh and Tamil Nadu have accounted for maximum number of deaths.

We feel, the solution of the problem of road accidents is multidimensional. Firstly, a mechanism is required to report the accident so that help can be provided to the people involved in accident. Secondly, mechanism to identify owners of the vehicle involved in the accident so that their families can be informed about the mishap, thirdly mechanism to identify accident prone spots and take measures to avoid accidents in future. Although lots of initiatives have been taken by the governments across the globe for addressing the issue, our literature survey indicates that more needs to be done to address the third aspect. As of now, web and mobile applications are developed to report accidents and identification of vehicles involved. However, the tough task of accurately reporting, analyzing and helping the authorities in managing the highway infrastructure practically to avoid accidents, has not been dealt with.

2. LITERATURE SURVEY

Over the years, different governments and researchers have tried to address different the issue of road accidents and infrastructure management in manner ranging from study and identification of Road Safety levels in different regions, identification of black spots based on accident severity, analysis of different parameters for predicting accident severity across different regions and development of hot lines and applications for reporting accidents.

Chakraborty and Roy [3] researched on the road safety level in Kolkata city of India. They developed a model for predicting future accidents considering parameters like accident severity index, accident fatality rate, accident fatality risk and accident risk.

Chand and Alex[4] worked on different accident indicators and combined them to propose accident risk index and accident severity index (ASI) for all the states in India.

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Michael Sorensen [5] proposed a novel approach for identification of black spots based on injury severity method and compared it with frequency-rate identification. Ranking is done based on injury severity weighted accident rather than normal accident rate. Weightage is considered by taking into account factors such as accident location, a combination of vehicles involved and accident location. Finally, weightage for each factor is calculated on the basis of the socioeconomic cost of injuries. Thus, the proposal gave better results than other traditional methods as it gives more importance to the accident location with severity.

Snehal U Bobade, et al. [6] ranked the parameters based on severity and calculated severity index for identification of accident prone regions. In their work, parameters causing maximum accidents were assigned highest weight and hence raked higher. The weights were then added to compute total severity. Severity index is then calculate by dividing the sum of weight ages of each parameter by total severity. The entire experiment was carried out for the data pertaining to two highways, Mumbai-Pune and Pune-Solapur.

3. HAMARI SADAK APP

In order to develop a medium through which the authorities can ensure the proper safety of road users, we follow a slogan" OUR ROAD, OUR RESPONSIBILTY". The application is developed using Android platform and RapidMiner tool. It features all the facilities for the user to lodge a complaint from accident prone spot and the analysis part includes all the facilities required by the authority to judge a complaint and analyze its severity. The application facilitates various activities like login, register, location, etc and the output of the analyzing tool is in the form of pie charts, tables, bar graphs, line graphs, etc. All the data needed by the analyzer is submitted by the android application to the database from where it is collected for analysis. The database consists of image captured by the user, text and numbers. Various Android Studio platforms such as android sdk, android virtual device manager, emulator, etc are used for testing and capturing the data. Rapid Miner platforms such as Rapid Miner studio and Rapid Miner server are primarily used for analysis purpose. The data flow for the application is as shown in figure 1.

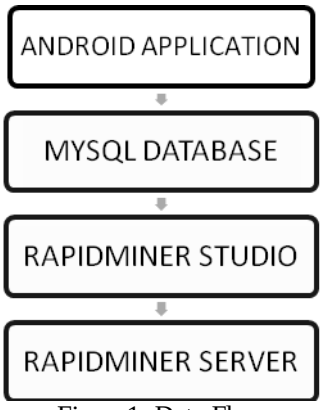

Figure1: Data Flow

3.1 The application is composed of two modules:

Module 1: An android application so that any registered user can lodge a complaints from any road within city limits or highway. This module provides two functionalities. First, it handles the complaint for accidents, if any. Second, the complaint regarding bad road condition is also reported. Thus, the database consists of two different types of complaints. Figure 2 shows this aspect of functionality.

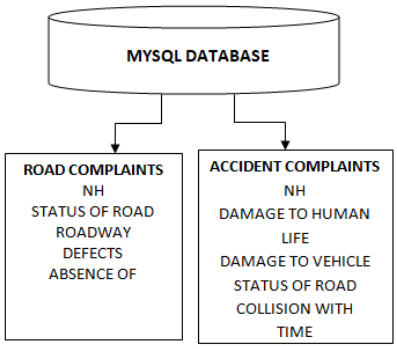

Figure2: Two types of complaints in Database

3.2 Road Complaint Database:
In today's world it has become very difficult to maintain ambient road quality due to the heavy traffic, bad quality of road and climate conditions. We provide the facility for the user to report following data under this category:
NH: It gives data of number assigned to national highway.
STATUS: It gives data about the general status of the road whether the road is usually have busy traffic, moderate traffic or is idle.
ROADWAY: It gives data about the type of roadway where the user found defect such as curve, intersection, slope, plain.
DEFECT: It gives data about different type of road defects possible which are classified under broad categories such as fractures on road, fencing issues, broken dividers and speed breakers.
ABSENCE OF: It gives data about absence of different objects on road such as signboards, dividers, speed breakers and street light.
In the road accident module, we analyze the data based on above parameters.

3.3 Accident Complaint Database:
For the accident complaints, the user is required to use the following fields:
NH: It gives data of number assigned to national highway.
STATUS: It gives data about the status of the road at the time of accident (busy, moderate traffic or idle).
VEHICLE TYPE: It gives the information about which type of vehicle were involved in the accident such as 2, 4, 6 or 8 wheeler.
TIME: It gives the information about the time of day when accident took place such as morning, night, afternoon.
COLLISION WITH: It gives data about the object vehicle collided with in accident, it can be other vehicle, divider, pole, etc.
OTHER: It gives data about any other conditions that lead to an accident such as natural phenomenon.
DAMAGE TO HUMAN LIFE: It gives information about damaged caused to human life such as death, injuries or none of these.
Module 2: This module deals with analysis of data obtained through Module 1. It allows the authority to take action based on the severity of complaints.

4. IMPLEMENTATION DETAILS
This section explains the steps from collecting the raw data from user, storing in database and actually creating analysis reports and dashboards based on the data received. The implementation results in meaningful dashboards to make analysis and take decisions. The reports can be drilled to various levels of Geographical hierarchy. The major part of this phase was making the data useful. The implementation is done majorly in 2 parts: An Android App and Data Mining Tool.

Android App:
The preferred environment for developing Android based application is Android Studio IDE [7]. The environment provides editor for developing applications. Android uses XML representation for configuration files. The editor allows for switching between XLM file representation and normal data entry through the user interface. We have used Android Studio for developing the application. We are using SQLite database for storing data. SQLite is a relational database management system contained in a C programming library in contrast to other database management systems, SQLite is not a client–server database engine [8]. Figure 3 shows the title and login screens of our application. In order to report an accident or road condition, the user first registers himself and then logs in with his login and password details. This process authenticates the user. Location can be either taken from the user or he can use the online GPS system to accurately select and specify the location. Figure 4 specifies the functionality of taking location from user. After login, user is provided with reporting screen which allows him to report an incident. Figure 5 shows the report screen. Among other fields, it contains type field which distinguishes between accident and bad road report. Once user specifies the type of report, he is presented with screen corresponding to each type. Figure 6 shows the screens corresponding to each type.

Data Mining Tool:
Rapid Miner Studio [9] is used as the mining tool for the implementation of processes that are used to draw conclusion. Rapid Miner provides a GUI to design and execute analytical workflows. These workflows are called "Processes" in Rapid Miner and they consist of multiple "Operators". Each operator performs a single task within the process. Rapid Miner Server [10] is a scalable collaboration environment for deploying advanced analytic processes into frontline apps. Rapid Miner Web Apps [11] are one of the ways to present results to end users. Web Apps are web interfaces where users can see, explore, and change the data. They can also trigger Rapid Miner processes to update the results.

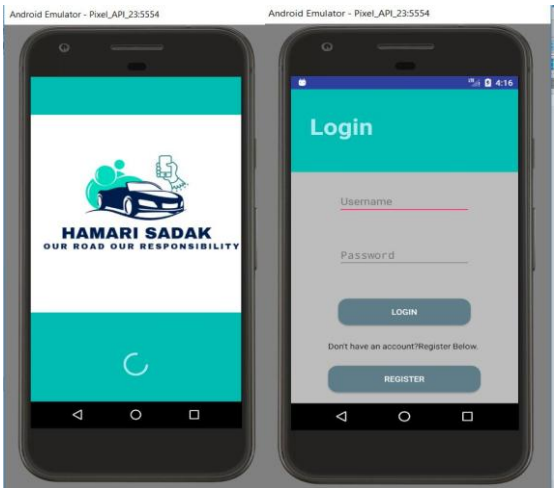

Figure3: Title and Login Screens

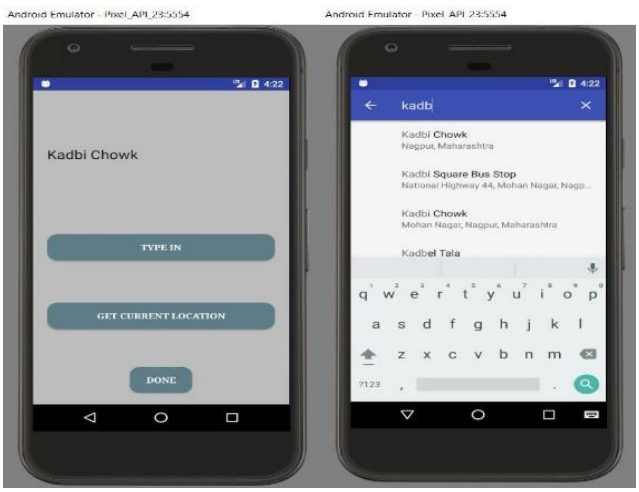

Figure4: Location functionality

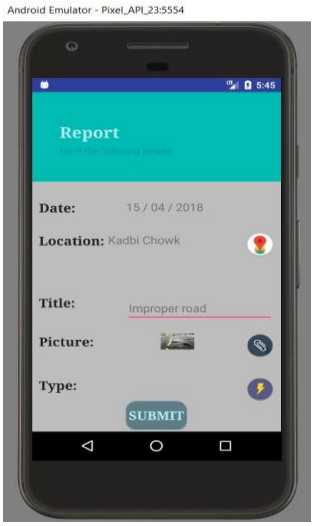

Figure5: Report screen

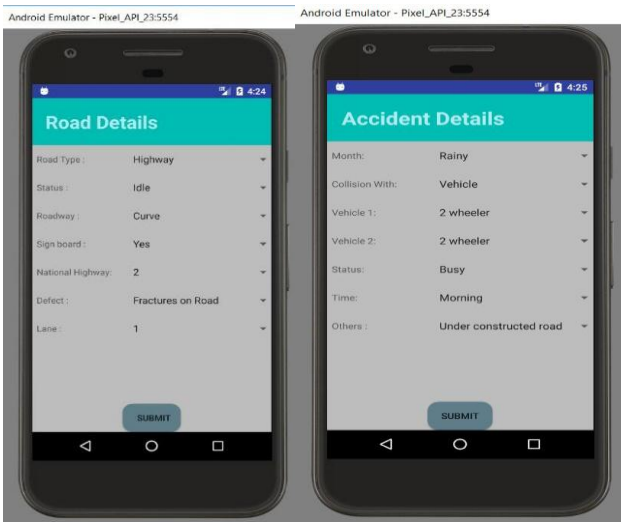

Figure6: Fields for Accident and Road report

4.1 Process Implementation:

We have implemented authority side dashboard using Web Apps provided by Rapid Miner Server where, authority can visualize results. Conclusions are drawn by interaction of server and studio through processes. A process consists of various operators. We have used the operators in different processes to draw different types of conclusion which can be further displayed using various visualization techniques. A simple process implementation using operators is shown in figure 7.

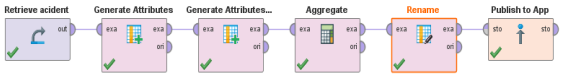

Figure7: Rapid Miner Operators used to implement a process

4.2 Visualization:

The data received from users is stored in database and processed using Rapid Miner frame work. We then use a classifier to obtain number of observations from the data. Certain attributes from database are used to draw priorities, conclusion and create visual representation of these conclusions on dash board for the authority to take appropriate action on priority, for complaints received from users over a period of time. For example, through implementation of our road view web app we display complete information received from the users, a pie chart and a bar graph. The pie chart shows road wise information about number of road defects like absence of street lights, vehicle speed, poor condition of road or under construction road and bar graph shows information about total number of complaints received, Road or NH (National Highway) wise. Similarly, through our accident view web app we provide visualized report of accidents' severity, road or NH wise. All the above information can then be used by the authority to draw conclusions on where to take actions on priority, to improve conditions of road and in turn, reduce the rate of road accident. Figures 8, 9 and 10 shows different views and report obtained by us for the data received from the users (A data set of 100 records).

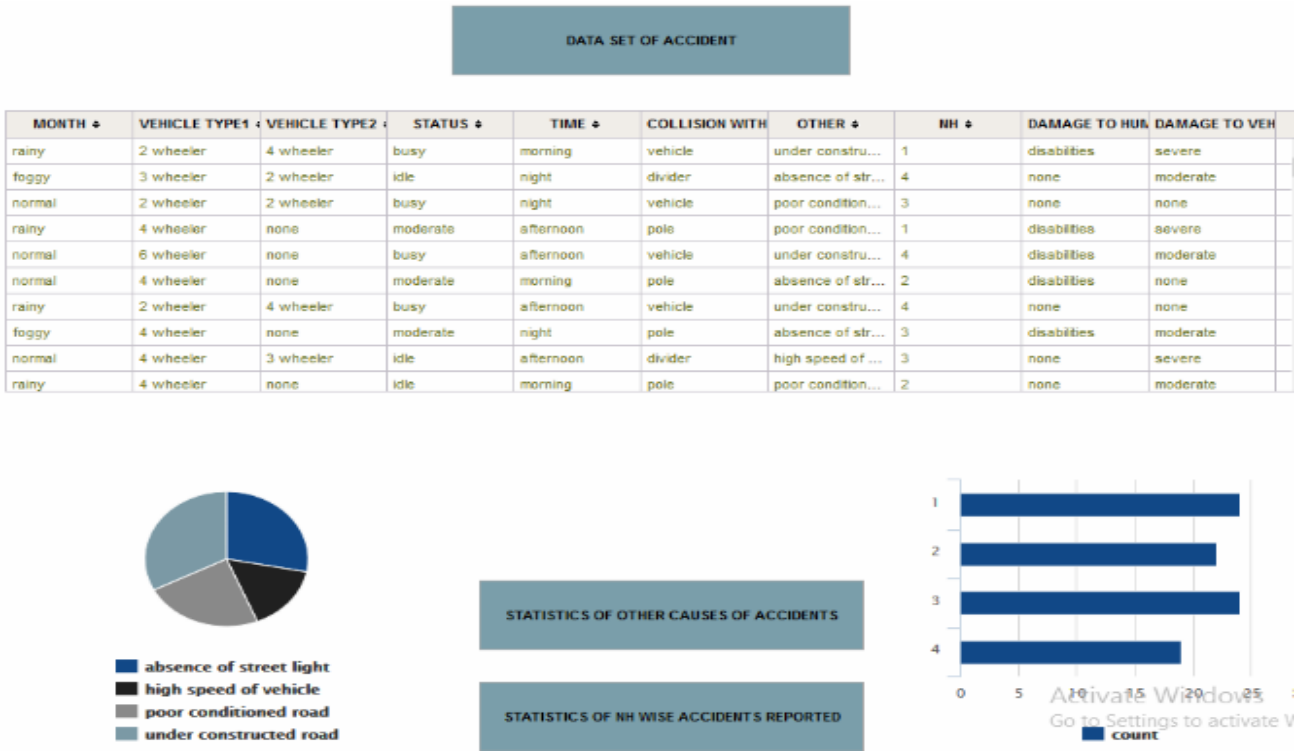

Figure8: Road View

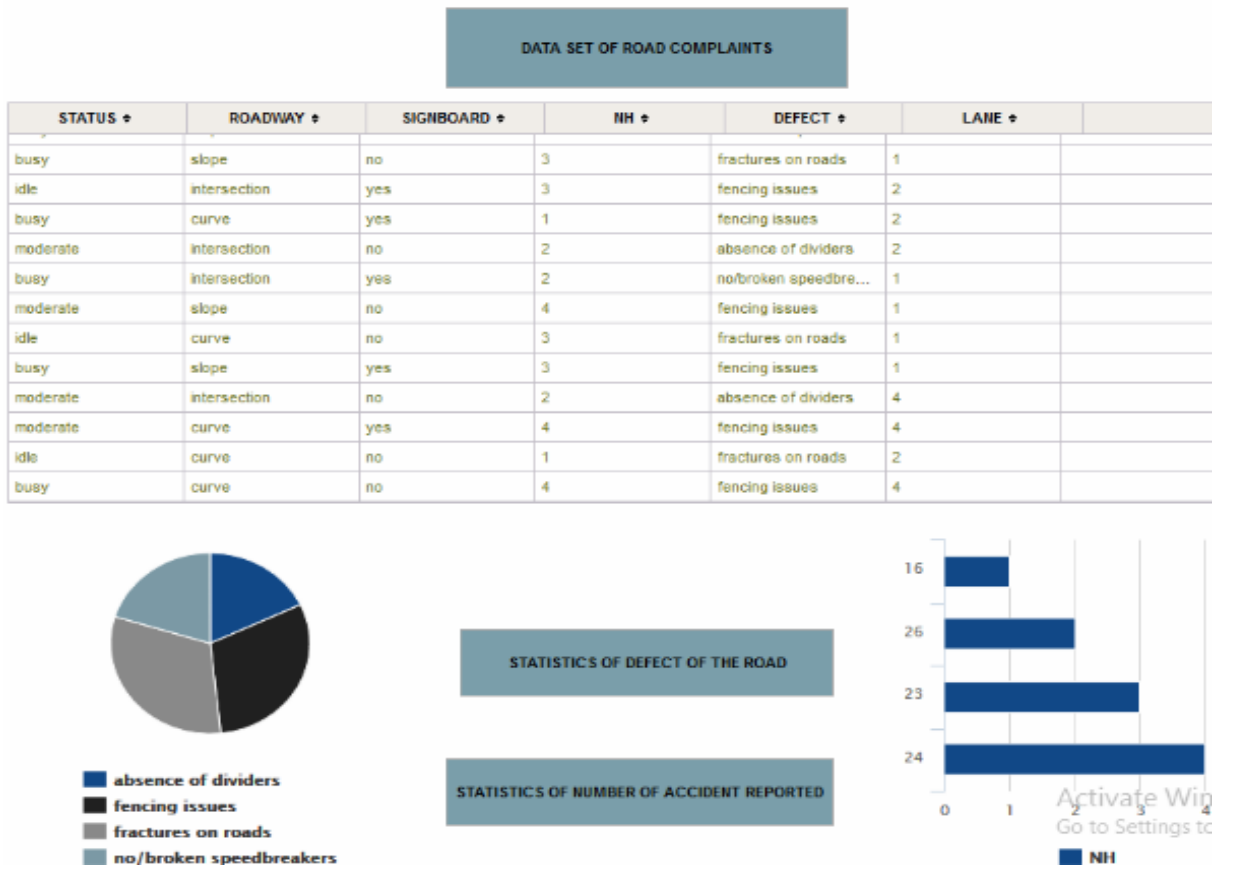

Figure9: Accident View

Figure10: Visualization Report on NH / Road wise severity of accidents and road defects

5. CONCLUSION AND FUTURE WORK

Road safety is a multi-dimensional topic which encompasses issues like manufacturing of vehicles with safety features, better management of our roads and effective and prompt response to any untoward event. Keeping this view in mind, we have developed an application which caters to not only reporting accidents but also reporting the bad health of roads to avoid probable loss of lives and damage to road infrastructure. The capabilities of application are extended through analysis of the data in the back end to provide useful reports to highway authorities. These reports should enable the authorities to prioritize their response for handling the problem either after the occurrence of accident or before it based on road status. The application developed by us allows for reporting for events (accident or road condition) through predefined fields in application. Similarly, useful reports are also successfully generated in the back end based on our data analysis. As a future work we would like to first of all test our application on bigger data set. We would also like to add a facility of notifying the user about the status of his / her complaint. Similarly, we would like to apply machine learning techniques for providing prediction module to prepare higher level reports for authorities.

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