DEVELOPMENT OF AN ACCIDENT DATABASE SYSTEM FOR HIGHWAY SAFETY

Final Year Project UG 2016

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ABSTRACT

The number of vehicles has been increasing day by day which has led to a drastic increase in the number of accidents. The development and the maintenance of the highways and roads hasn't kept up the pace with it and is far below par. There is a huge number of accidents that are occurring on the exact same place and that could have been avoided with proper safety measures. Outdated (conventional) methods are still being used.

In this project, an Accident Database System "ACCIDAT" is developed to overcome most of the challenges related to Highway safety. No such system exists in the country at the moment. The aim is to automate (digitalize) the accident reporting process to make the system robust and efficient, Employ the statistics (DATA) acquired from the Accident Database for making regulations to ensure efficient safety management.

Firstly, the RTA (Road Traffic Accident) data for Rawalpindi Region was acquired from Rescue 1122, as they are the first respondents at an accident site. That data was analyzed for extracting useful variables and information that can help us take necessary highway safety measures. Then, the database system was developed.

The Accident database system (named ACCIDAT) consists of two applications (android and desktop) and a database server. The android (mobile) app will be used by the Rescue 1122 workers or any respondents at an accident site. It fetches all the important information like pinpoint location, exact time and date, weather conditions etc. automatically with a single click. The other info e.g. patient credentials etc. can be added later. This data is then uploaded to the database with a single click. Whole process merely takes half a minute. The desktop app has two portals. One for the hospitals to add medical related data e.g.

Injury severity, type etc. and the other for the Data Analysis. The analysis portal is well-equipped with almost every feature that helps a transportation engineer extract valuable information. It can be used to find out the most accident-prone areas, possible reasons of accidents there etc. within minutes. The transportation engineer can then visit that site manually and suggest safety measures.

The RTA data previously obtained was entered in the database to check the validity and the usability of the accident database system. The copyrights for the Accident Database system have been attained and if need be, it will be given to higher authorities for implementation and use nationwide.

To conclude, this Accident database system, if implemented, will replace the old (conventional) methods of data acquisition and will allow the transportation engineers and authorities to take necessary Highway safety measures instantly, which will ultimately result in a significant decrease in fatalities due to road accidents.

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CHAPTER 1

1. INTRODUCTION

1.1 GENERAL

The desire of man to make his life luxurious and comfortable has led to the advancements in every walk of life. Likewise, the advancements in the modes of transportation are inevitable and over the decades a huge surge in vehicles has been on the roads. This increase in vehicles on the roads has led to an increase in traffic which eventually leads to accidents. A road accident is a situation in which two or more vehicles or a vehicle and a pedestrian collide which may lead to fatal or non-fatal injuries. There can be numerous causes of a road accident but minuscule efforts have been made to mitigate them.

Traffic accidents mitigation involves critically analyzing the causes and loopholes which leads to accidents causing both life-threatening and property damages.

1.2 PROBLEM STATEMENT

The number of vehicles has been increasing day by day which has led to a drastic increase in the number of accidents. The development and the maintenance of the highways and roads haven't kept up the pace with it and it is far below par. There is a huge number of accidents that are occurring in the same place and that could have been avoided with proper safety measures. In Pakistan, the accident data is still recorded manually on forms, and apart from that, the data recorded on it is not enough to further employ it for analysis and take proper safety measures. In Rescue 1122, the data is recorded in manual form, and it's added to their online database manually by their workers. This makes the whole process slower too. Moreover, that database is only for their (Rescue 1122's) record, and it is not

used or shared with the transportation department to make any improvements on the road network. Below is the accident data of Pakistan for the past 5 years (till 2018).

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19.4 Traffic Accidents

Year	Total number of accidents	Accident		Persons		Total number of vehicles involved
		Fatal	Non-Fatal	Killed	Injured	
PAKISTAN						
2012-13 *	8988	3884	5104	4719	9710	9876
2013-14*	8359	3500	4859	4348	9777	9423
2014-15*	7865	3214	4651	3954	9661	8949
2015-16*	9100	3591	5509	4448	11544	10636
2016-17*	9582	4036	5546	5047	12696	11317
2017-18	11121	4829	6292	5948	14489	13134

Figure 1 Traffic Accidents Data of Pakistan from 2012-18 (Source: Pakistan Bureau of Statistics (http://www.pbs.gov.pk/content/traffic-accidents-annual)

Above mentioned stats show that the number of injuries and fatalities have increased during the past 5 years. Given below are the accident trends of some areas of Rawalpindi for the past two years (2018-19). We can see how the number of accidents on the same locations has been increasing and no safety measures are taken for that.

1.3 AIMS AND OBJECTIVE

Numerous ways have been adopted to record and maintain road traffic accidents and utilize the recorded data to prepare an accident database.

The main objectives of this study are:

1. To automate (digitalize) the Accident reporting process to make the system robust and efficient.
2. Prepare an Accident Database System.
3. Embed the system to check its adequacy against the existing data.
4. Mitigate the severity of accidents by analyzing different parameters in the database.

5. Utilize the data acquired from the database to critically analyze the prevalent road conditions.
6. Create an analysis tool for Transportation Engineers for their ease to improve highway safety.

Our emphasis is on the development of an Accident Database system consisting of three components.

1. Mobile (Android) Application
2. Database (Analysis Application)
3. Desktop Application

The mobile application will be used to record the data at the accident site and that data will be uploaded to the database. This data could also be accessed by the desktop application for adding further information. As the number of accidents on the database increases, we'll be able to find a trend that will lead to the identification of **black spots** (Accident-prone areas).

1.4 PROJECT SCOPE

We aim to utilize the database to propose a solution by carrying out analysis based on different parameters. The use of the mobile app to fetch exact location and accurate accident data, use of the desktop app to be utilized by the hospitals to update accident data. Both applications will form a database that will be accessible by the admin to carry out the analysis using an analysis app.

CHAPTER 2

2. LITERATURE REVIEW

The current system used to collect road accident data using manual form records detail of those accidents that are reported. However, this provides no information on the injuries sustained nor does it account for all road accidents and casualties on account of them

There have been various studies on the methods of the collection of accident information in the past. The traffic police present at the location of the accident is called for the collection and the inquisition of all accident data, fatal or non-fatal (GIS-based Traffic Accident Data Collection of Abu Dhabi, 2004).

Road accidents are not dependably published globally but the most severe form of accidents which involve a fatality, are generally recorded more reliably and regularly than the other types.

Gathering correct, authentic, and error-free data collected over a period of time is needed. This allows us to observe the increase in the number of road accidents and injuries and comprehend the factors influencing them (Lyons et al., 2008).

2.1 ROAD ACCIDENT STATISTICS

World Health Organization(WHO) and the World Bank, mutually issued a report on the prevention of injuries related to road traffic accidents. This came out to be a primary major report on traffic safety repercussions related to crashes. According to the figures presented in this report, about 1.17 million people had been victims of road traffic accidents, and approximately 50 million sustain injuries each year (Uddin 2000).

Recent research with the aid of Transport Research Laboratory (TRL) (Jacobs et al, 2000) estimated the figures that the number of people that were killed globally in road accidents in 1999 amounted to 750,500. The figures suggested that there is a great need to direct our

efforts towards the Third World countries since about 640,000 of these 750,000 people killed, that is, 85 percent occurred in developing countries or emerging nations.

WHO estimated that around $US 70 billion is the global cost of road traffic accidents in developing countries each year which corresponds to 1.0%-1.5% of GNP (Uddin 2000).

	Fatalities per year	Per cent
Highly motorised countries	110,000	15%
Developing countries	640,000	85%
TOTAL	750,000	100%

Figure 2 - Estimate of Global Road AccideFigure 2nt Deaths, 1999

2.2 GIS DATABASE

GIS offers an advanced engine to drive, both area-wide and location-oriented investigations. With this system, the possibility to raise and solve accident problems related to street segments, intersections, and neighborhoods may ease much of the labor-intensive production effort. Thus, more emphasis may be given to complex analyses and in-depth investigations.

GIS (Geographic Information System) is a computer-based system which captures, stores, manipulate, manage, analyze, and visualize spatial and geographical data. Relating it with other data enhances spatial patterns and information. Therefore, it is used to solve complex spatial research, planning, and management problems. GIS is a great aid with extraordinary potential for improving the use of spatial data to keep track and assessment of road traffic accidents and aid in making related decisions (T.H. Law 2004).

2.2.1 GIS Use in Traffic:

GIS is a computer-based information system, which attempts to capture, store, manipulate, analyze and display spatially referenced and associated tabular attribute data, for solving complex research, planning, and management problems (Fischer and Nijkamp, 1991). In road safety research, GIS is a tool with great potential for structuring information to

improve monitoring and evaluation of road accident study and assist in related policy decisions.

To create a database with relationships between spatial reference and tabular attributes, this system employed (**google firebase**) Oracle Database 9i as spatial data storage, while RAV (**android studio)** was used for developing the user-interface and analysis tools.

2.2.2 Geo Referencing:

The capability of GIS to find connections and nodes of a road framework in two-dimensional coordinates and associate roadways together is the thing that made it useful to develop this field.

2.2.3 Use of non-traditional Databases:

Already manually built accident databases could be made useful by incorporating them and using them for road traffic accidents analysis. Data sets, especially accident location data could be transferred to the GIS system for spatial coordinates.

2.2.4 Visual Assessment:

One of the most beneficial features of a GIS-base framework is its ability to show figures or maps, which can be utilized to visually assess the issue.

2.2.5 User Interface

The quality of the system input has a direct impact on the output of the system. Therefore, input forms and screens should be designed with this critical relationship in mind. The design of the GIS user-interface and its application are discussed below. The Microsoft Visual Basic programming language has been used for developing the user-interface and analysis tools

2.3 ACCIDENT DATA RECORDING

The under-reporting of accidents is a rampant custom globally.

Road accidents are currently recorded on two one-of-a-kind paper forms; a four-page form for injury accident and one-page form for the non-injury accident. Despite the provision of many fields on the forms, not all statistics are recorded which results in incomplete and

inaccurate data. The same scrappy data is then transferred to the database (GIS-based Traffic Accident Data Collection of Abu Dhabi, 2004).

Nowadays GIS maps stored on MDT's are used collectively with GPS which has become a trend now for accident data recording (US Department of Transportation Federal Highway Administration, 2001).

A research was conducted in Karachi to develop a database needed to determine the severity of the accidents and further use it for the identification and detailed analysis of the black spots. This involved the collection of data acquired from the selected hospitals and the development of a primarily GIS-based accident database. The following cyclic order was followed to obtain the data and its analysis (Development and Analysis of GIS-based Road Traffic Injury Database for KARACHI, PAKISTAN 2007-2008).

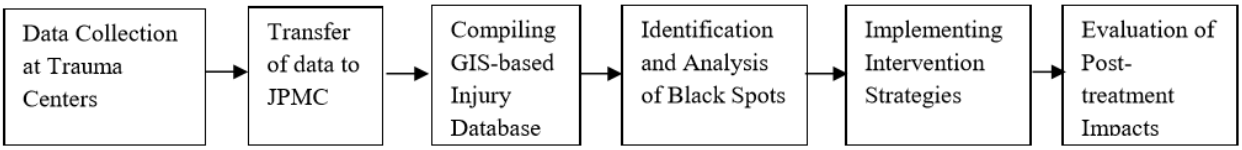

Figure 3 - Cyclic Order of Obtaining and Analysis of Data

2.4 ACCIDENT LOCATION ENCODING

The location of the accident was still being described in words in terms of the name of the road and the critical point being used. But pinpointing the location of an accident on road was quite difficult especially when the road was very long so there was no way to determine where along the road the accident took place. (GIS-based Traffic Accident Data Collection of Abu Dhabi, 2004).

National Y-Y coordinates are used with the aid of a GPS system to pinpoint the location and the critical point of the accident on an automated map. However, the locations are normally read off a paper map unless GPS is used to pinpoint the location of the accident (International Symposium on Traffic Safety Strengthening and Accident Prevention, Nanjing, China, Nov 28-30. 2001)

2.5 ACCIDENT REPORT FORM

The police report forms to record accident details should be easy to complete, use nationwide, and include significant details to meet the needs of all prospective accident data users (ADB, 1996).

However, the different operators designed their road accident report form with the different convenience and benefits as the subsequent examples.

2.5.1 CADaS

CADaS stands for Common Accident Data Set. A CADaS has been developed comprising a minimum set of standardized data elements, which allows for comparable road accident data to be accessible in Europe. More variables and values with a standard definition will be added to those within the CARE database, maximizing as a consequence the potential of CARE database and authorizing for Journal of Society for Transportation and Traffic Studies (JSTS) Vol.4 No.3 32 more detailed and reliable analyses at European level (Dimitri D.M., 2011). The latest version of CADaS is Version 3.11 publishing in January 2011 by European Road Safety Observatory (ERSO), European Commission.

2.5.2 STATS19

STATS19 is the set of data that has to be collected by a Police Officer in the UK whilst a road accident is reported to them. The STATS19 method of collecting road accident data is that the details of over a 1 / 4 of a million accidents a year are at first recorded by many thousands of policemen. These records are then organized by the nearly seventy different police forces, processed by the department of the environment statistics divisions and assembled on the transport and road research laboratory computer (Chapman D.P. et al., 1973). The STATS19 is developed by the Department of Transport, UK. STATS19 data is appropriate for road safety evaluation in numerous dimensions such as the rate of vehicle accidents involving pedestrians (Muirhead M. and Walter L.K., 2011).

2.6 ROAD ACCIDENT PREVENTION

The three E's which are globally followed to ameliorate road safety for its users are Education, Enforcement, and Engineering. Among these, Education and Enforcement are necessary to promote road safety among users and minimize accidents. They are as important as Engineering to highlight the critical aspects of road safety commonly ignored by the users. It has been observed through the assessment of traffic safety situation prevalent on the roads that's Education and Enforcement have been unsatisfactory in contrast to Engineering. It is likely one of the reasons that there is no organized regulation system for Education or Enforcement. (Nishida, 2009)

2.7 UTILIZATION AND ASSEMBLING OF TRAFFIC ACCIDENT DATABASE

Based on the literature review it has been concluded that the accident database can be used at three different levels.

1. At the national level, it can be used to help the government devise a safety policy e.g. compulsion to wear a seat belt or motorbike helmet.
2. At a regional level, it can be explored and studied in assisting authorities to devise a proper course of action e.g. campaigns to abstain drink-driving, child safety education.
3. At the local level, the database has been of most advantage where it can be used by local engineers to locate the main problem over the length of the road and similarly can be used for the identification of black spots.

Microcomputers have now become the ideal tool for storing, maintaining, and analyzing an accident database. They are robust, relatively cheap, and have become extremely powerful.

There are four basic elements or processes to how an accident database is accumulated and utilized and these are:

1. Reporting system

2. Recording system
3. Accidents analysis
4. Transmission of data

In figuring out and evaluating road safety, researchers and professionals are equipped with inadequate data now and then, about the important relevant facts with regards to accident cause and pattern (Mahmud et al., 1998).

Accident data is regarded to be the most suitable source for evidence but due to the lack of this evidence, the results drawn are rather subjective and drawn from uncertainty. To ease the use of accident data, an **application** that can analyze road accident data is needed to provide road safety intelligence (The Construction of Road Accident Analysis and Database System in Malaysia, 2009).

CHAPTER 3

3. RESEARCH METHODOLOGY

3.1 INTRODUCTION

A research method is a systematic plan for conducting research. A variety of both qualitative and quantitative research methods, including experiments, survey research, participant observation, and secondary data. It involves the techniques and procedures to select, process, and analyze data.

3.2 ACQUISITION OF DATA

The information regarding the current accident reporting system was required to start with. For this purpose, the existing data from the Rescue 1122 (which is usually the first respondent at the accident site) was obtained. The figures acquired were accident data for the past year (2018-19) of the Rawalpindi region. Apart from the data acquisition, the information related to the current process used to report an accident came to our knowledge. We also got the Rescue form that is currently used to write all the accident-related details.

To enhance our research and data acquisition, we visited the National Transportation and Research Centre (NTRC) but couldn't find any competent authority to assist us in this regard. A formal request was placed with the concerned authorities of the traffic police to acquire road accident data but due to the prevailing health crisis, our request couldn't be processed. Hence, we had to rely on the data acquired from Rescue 1122.

3.3 ANALYZING DATA

The Rescue form was thoroughly reviewed and the most important variables to use in the application were fetched. A lot of variables that could be quite useful for the studies and for taking relevant safety measures were absent in the form. This is also another bottleneck in the existing system. So, we gathered all the possible variables to include in the application which will be thoroughly explained in the next chapter.

The past year (2018-19) data from Rescue 1122 was analyzed to perceive the existing trends of accidents in certain locations of the Rawalpindi region are and how the undergoing changes. We identified the locations with the most number of accidents during this period. However, the data acquired didn't pinpoint the exact location of the accident but rather it only mentioned the name of the road where the accident occurred. So if the road was very long, such vague data couldn't help the concerned authorities to prepare a prompt response to the situation and hence result in casualties that otherwise could be avoided. To find a solution to this problem, we have developed an accident database system that would help the authorities to fetch the on-ground real-time data with the help of GPS. So, the exact location of the accident site will automatically be fetched by the mobile application.

3.4 DEVELOPMENT OF MOBILE APP

The mobile app has been developed on the Android Platform. We chose android because most people in Pakistan have Android phones due to its affordability. In this way, we can make the application accessible to most of the people (if needed). We used **Android Studio** to develop the application.

The application includes all the possible variables regarding the accident data that can be useful for analyzing trends, identifying the blackspots, taking safety measures to reduce the number of accidents, and for further studies.

We have made the application in a way that the most important data i.e. Exact Location (Geographical Coordinates), Time, and the Weather Conditions will be auto-fetched using the mobile GPS with one click, thus making the process more efficient and accurate. The

rest of the relevant information can be entered afterward. Moreover, the application also includes a "Track an Accident" section which will enable the users to check the status of the accidents they have reported.

A "Safety Tips and Public Awareness" section has also been added in the application which will contain traffic rules, safety tips, driving tips, and other guides to ensure the safety of the people while driving.

3.5 DEVELOPMENT OF DESKTOP APP

We developed the Desktop application that can be used in hospitals to add medical information related to the accident. This information would include the victim's injury status, accident severity, etc. This data automatically gets uploaded to the Database under that specific Accident ID. The desktop application can then be used to update the information which couldn't be added in the mobile application before. In this way, all the possible data related to an accident can be reported and this whole process is automated. We used C# (C-Sharp) for developing this application and then connected it to the database.

3.6 DATABASE AND ANALYSIS

The data entered in the mobile and desktop application goes straight into the database which can be accessed by the admin and utilize that data for analysis and road safety. The important thing to keep in mind is that all the data used for the analysis was acquired for the validation of our applications and to cognize the proper functioning of the applications which can be used for many different types of analysis. The application provides the option to carry out the analysis based on different parameters. This can be done by the admin part of the desktop application that serves as an analysis tool. The functioning of the application and its capabilities will be further explained comprehensively in the subsequent chapter.

3.7 SELECTING REGION FOR CASE STUDY

After developing the app completely, we set out to test its adequacy and the practical application against the existing system. We have selected the Rawalpindi region for that purpose. We used the data acquired from the Rescue 1122 for this purpose.

3.8 CASE STUDY

To get the data uploaded on the database, we had to enter the data manually in the application, as the use of the mobile application for accident data reporting and its implementation as a system is not possible without proper permission from the relevant authorities. We had the data of around 12000 accidents that occurred in the vicinity of the Rawalpindi region in a year. We chose a sample population of the last 4 months of the year and put in the data of around 3500 accidents on the database. All entries were done manually using ACCIDAT. This gave us a rough sketch of all the locations where accidents occurred in the last year. But we couldn't pinpoint the exact location because of the vague information present in the data. This problem can be overcome by the use of the mobile application which will be able to fetch the exact location of the accident site using GPS. Once all the data has been uploaded, the admin part of the database could be used to observe the trends and utilize them for analysis. It will give us the following data automatically:

- Number of accidents in a certain period
- Number of accidents in a certain area
- Accident-prone areas **(Black Spots)**
- The severity of accidents in a certain area
- The probable reason for the accident
- Types of vehicles involved in most accidents
- And other information

We had decided to pick one such **Black Spot** and analyze it for possible reasons for accidents in that area. Our scope included visiting the most accident-prone location and using the highway safety checklist by NHA to see for ourselves, the possible reason for the high number of accidents in that area. But due to the unprecedented health situation in the country, we couldn't do so and had to abridge our scope. We tried utilizing the Google Earth PRO to visualize the fault, if any, in the geometry and for the analysis of the intersection. Based on the data on hand and the analysis, carelessness and over speeding came out to be some major causes of accident

3.8.1 ANALYSIS

After completing the development of ACCIDAT, we had to ensure its validation and usability. For this purpose, we decided to use it for determining potential blackspots in the Rawalpindi region using the RTA data previously acquired. Now the only thing we needed to do was sit back and use the analysis portal in the desktop app and identify the blackspots. The RTA data from Rescue 1122 was vague, it didn't provide the exact location of the accidents. So, we decided to analyze one of the intersections, that was a blackspot.

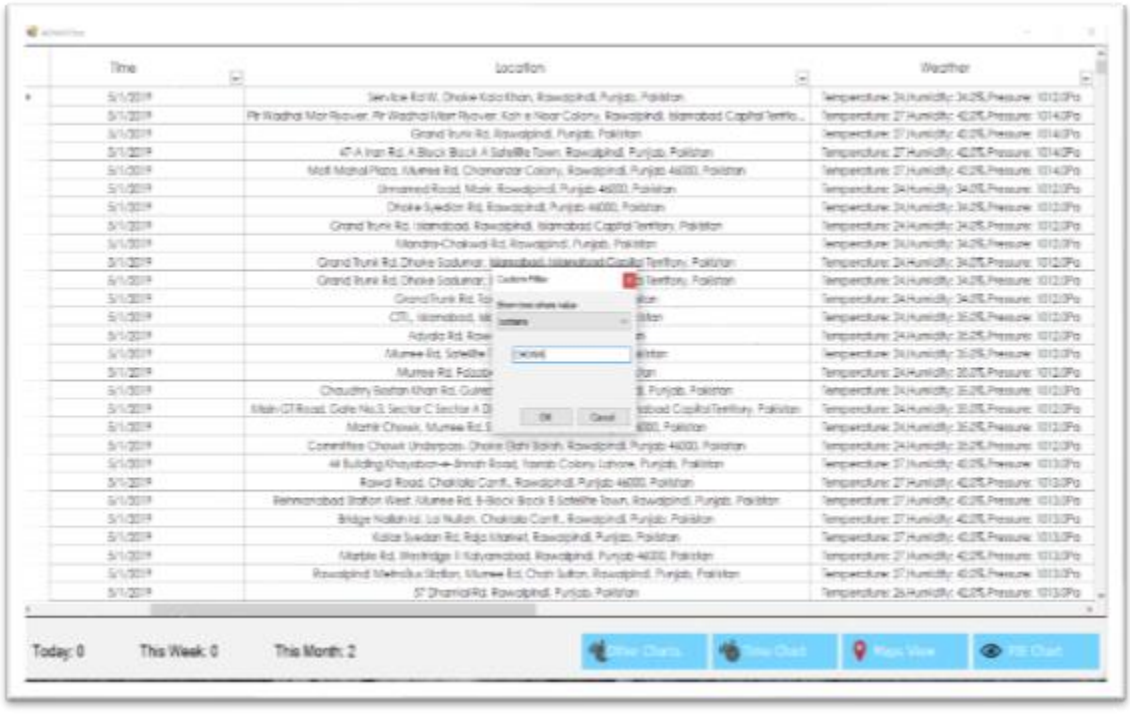

Figure 4 Location Filter For Case Study

Firstly, we used the custom filter feature in the desktop app to search for all the accident locations that contained the word “CHOWK” in it. It gave us the list of all the accidents on the intersections or chowks.

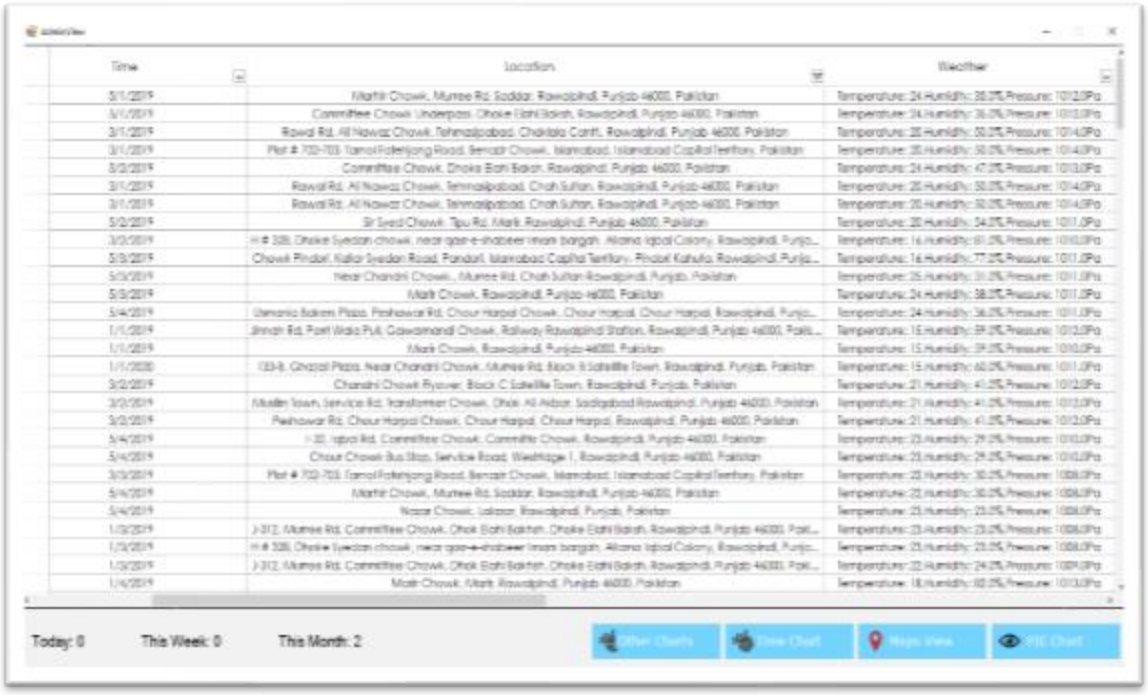

Figure 5 All Locations Containing The Word "Chowk"

Then, we opened the Other Charts page in the app. On that page, we used the feature “TOP Accident Prone Areas” feature and entered the number 4. That gave us top 4 most accident-prone intersections.

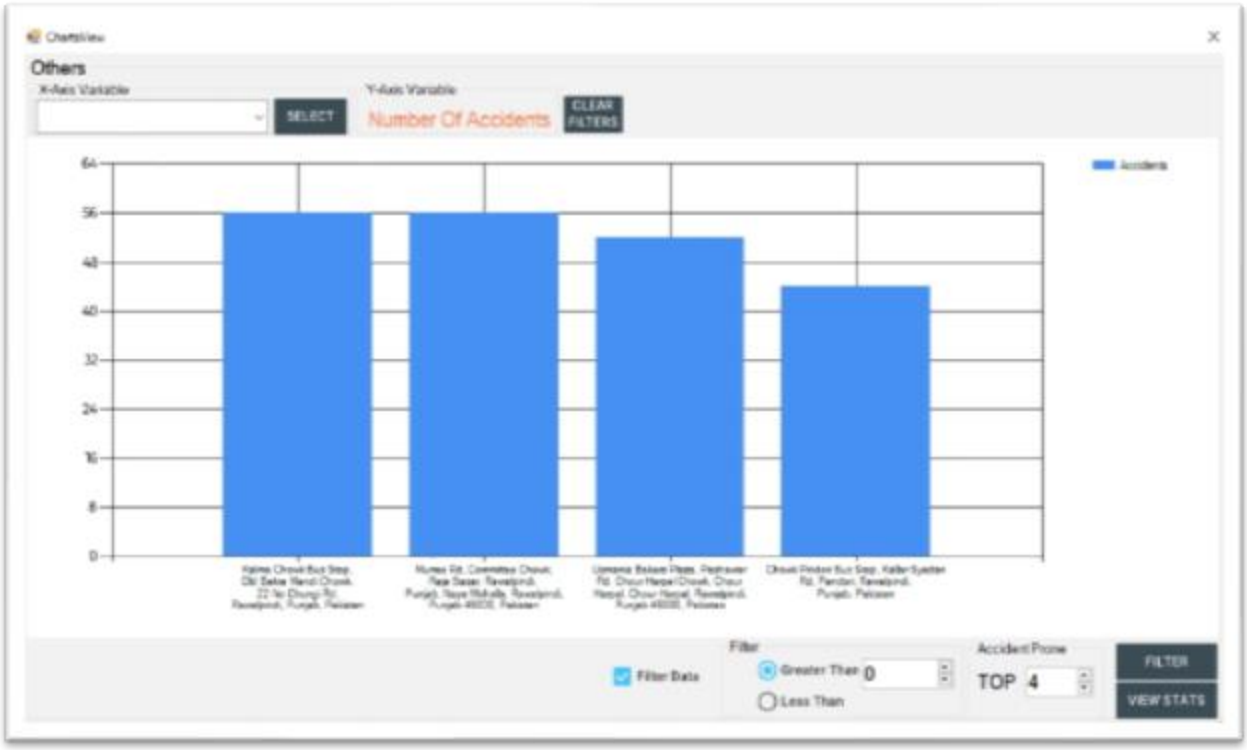

Figure 6 Top 4 Most Accident Prone Intersections

Now, it's clear from the graph that Kalma Chowk and Committee Chowk were the most accident-prone intersections based on the RTA data. So, we decided to choose Kalma Chowk to analyze it for possible safety problems. We used our references to acquire NHA Highway Safety Checklist which we would use while analyzing the location. We tried to acquire formal permission to visit that problematic intersection, but due to the prevailing health conditions and strict lockdown in the country, we weren't allowed to do so. We even tried to use Google Earth PRO for analyzing the location remotely, but we couldn't fetch any useful information. So, we decided to limit our scope and get as much information as we could using the app.

Again, we used the Other graphs page and opened the graph **"Possible reason vs Number of accidents"**

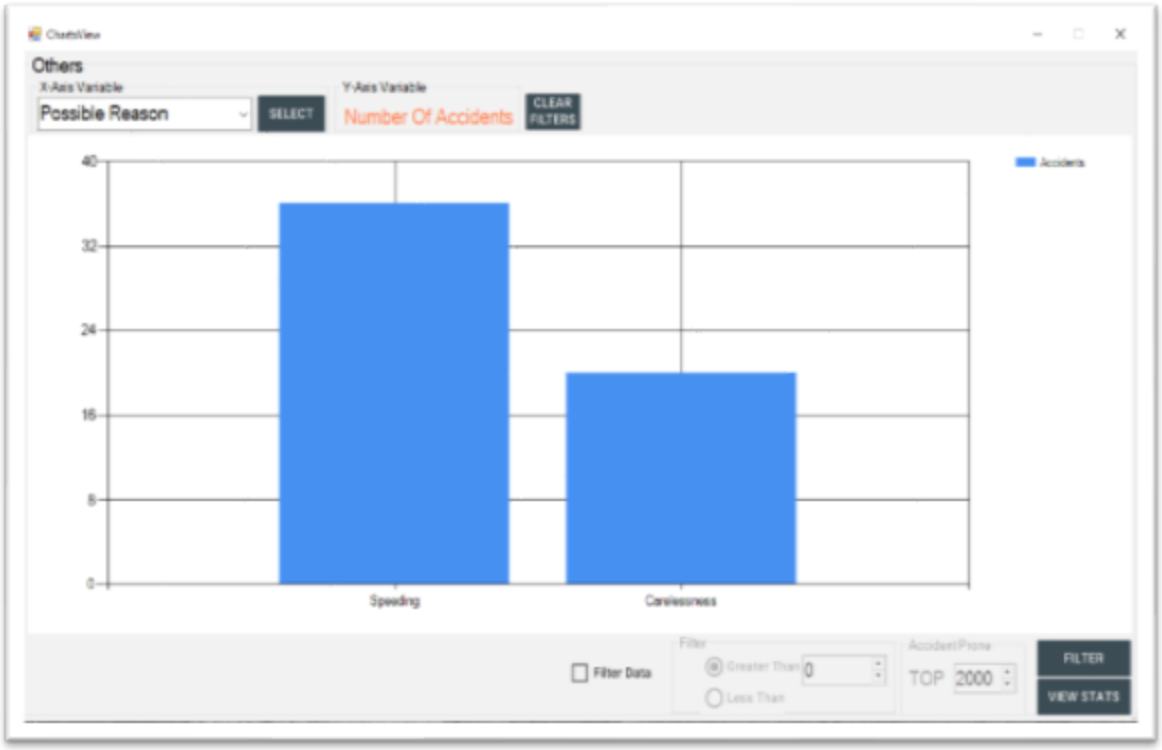

Figure 7 Possible Reason Vs Number Of Accidents

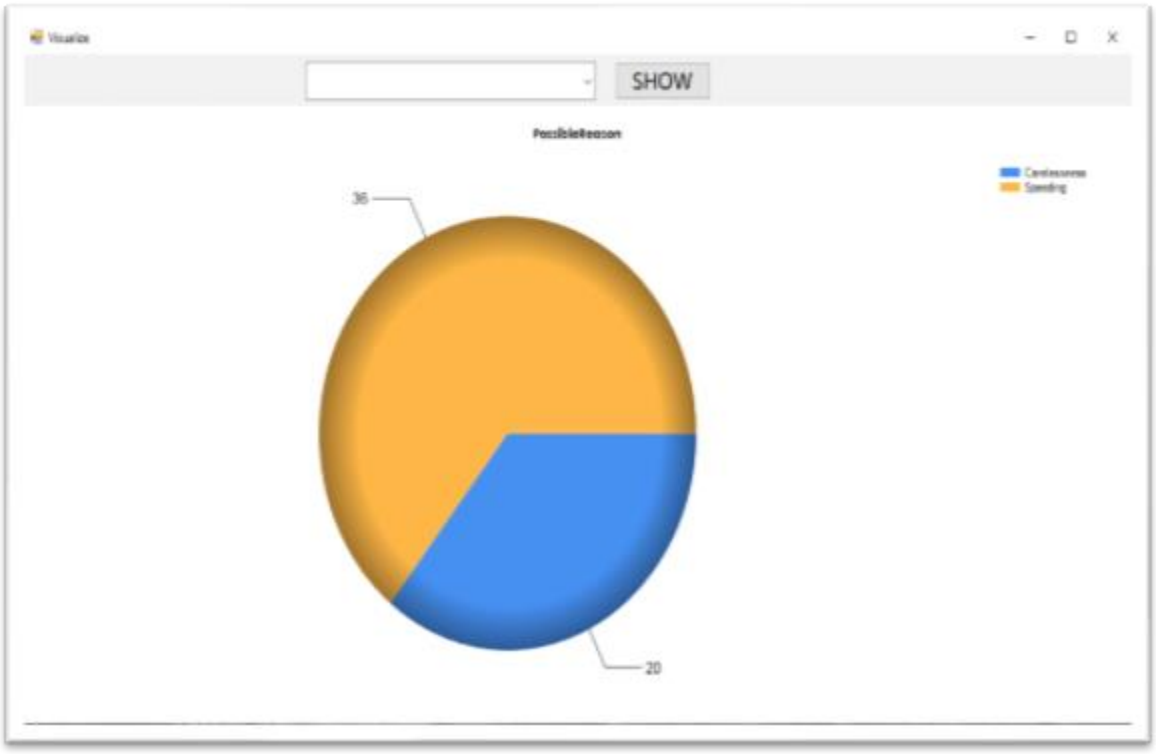

Figure 8 Pie Chart Of Possible Reason

It is clear from the graph and the chart that the possible reason in most of the accidents was Over-speeding. We couldn't analyze the intersection by visiting but we could anticipate a few conclusions from this data. Accidents due to Over-speeding isn't a Geometric issue in most cases. It could either be due to improper placement of Speed limit signs near the intersection, or most probably because of poor traffic signal timings etc.

ACCIDAT lets the users identify the blackspots instantly and take necessary safety measures, which can result in the decrease in number of accidents ultimately.

CHAPTER 4

4. INTRODUCTION TO ACCIDAT

This Accident Database system is based on 2 applications (Android and Desktop) and a Database server. It was designed keeping in mind the adequacy and ease-of-use for Transportation engineers, Rescue/Traffic Police workers, and even general public (if needed). Over the course of this chapter, we will elaborate every aspect of it in detail.

4.1 Mobile Application:

Figure 9 - Splash Screen

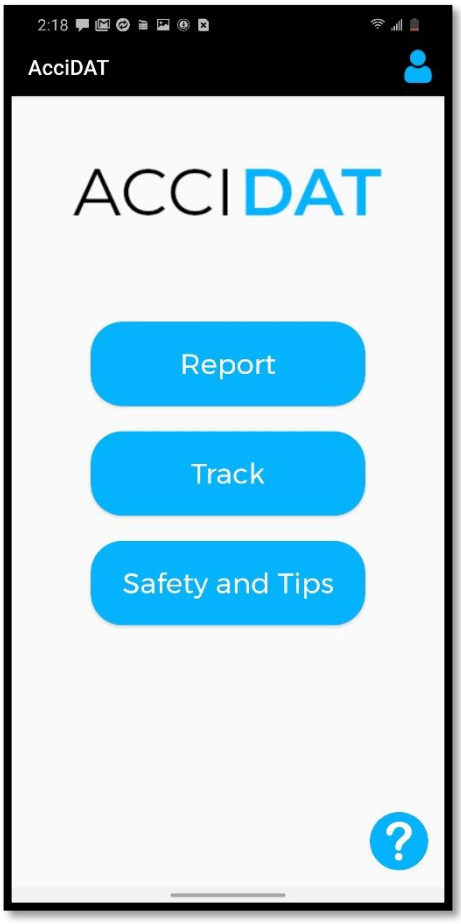

Figure 10 - Home Screen

The mobile application is based on Android. The reason for choosing android is that 93.68% (https://gs.statcounter.com/os-market-share/mobile/pakistan) of the smartphones used in Pakistan are Android phones, and when it comes to the Rescue/Traffic Police workers, this percentage rises even more. In short, it is more accessible to the people in the Pakistani market. This application is to be used at the accident site by the first respondents (i.e. Rescue/Traffic Police or even general public). It serves the primary function of replacing the old/conventional method of data acquisition and automates the whole process. In addition to that, the data acquired by this app will be accurate, precise, and the whole process will take seconds. This accident data will be uploaded the database server instantly. Now, we will go through the complete features and working of this application:

On the home screen, the users can Report an accident, Track (Check the Status) of the accidents submitted from that account and access the Safety and Tips section. They can also learn how to use the application by clicking on the Question mark icon at the bottom right corner.

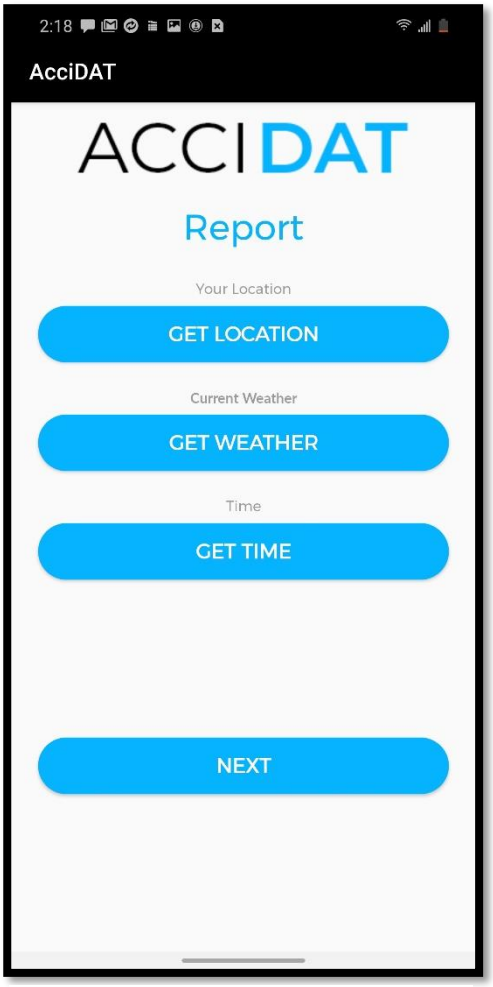

Figure 11 - Report an Accident Screen

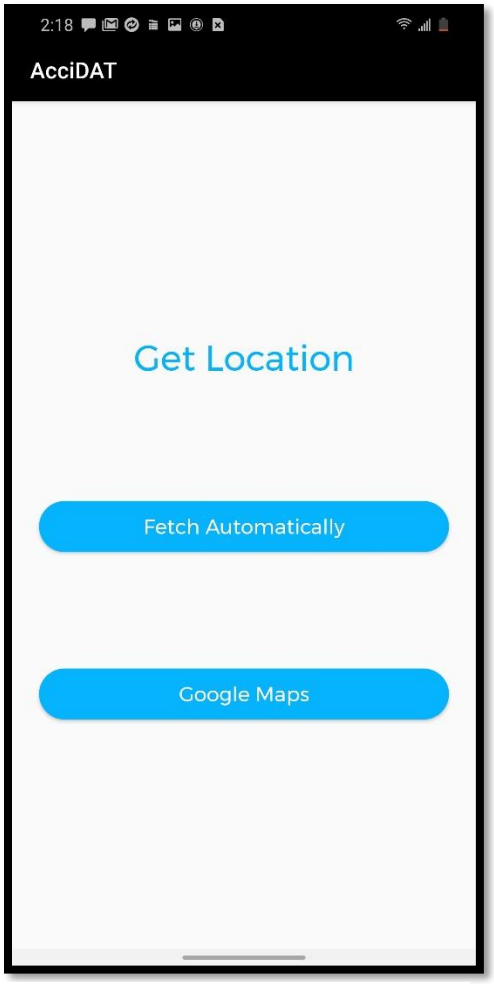

Figure 12 - Get location screen

By clicking Report button on the Home screen, this Report screen opens. Here, the user just has the options to get the Location, Weather and Time information. The Get location screen further gives the flexibility to the user to fetch the Location Data automatically with one click or use google maps and drop the pin at the accident location.

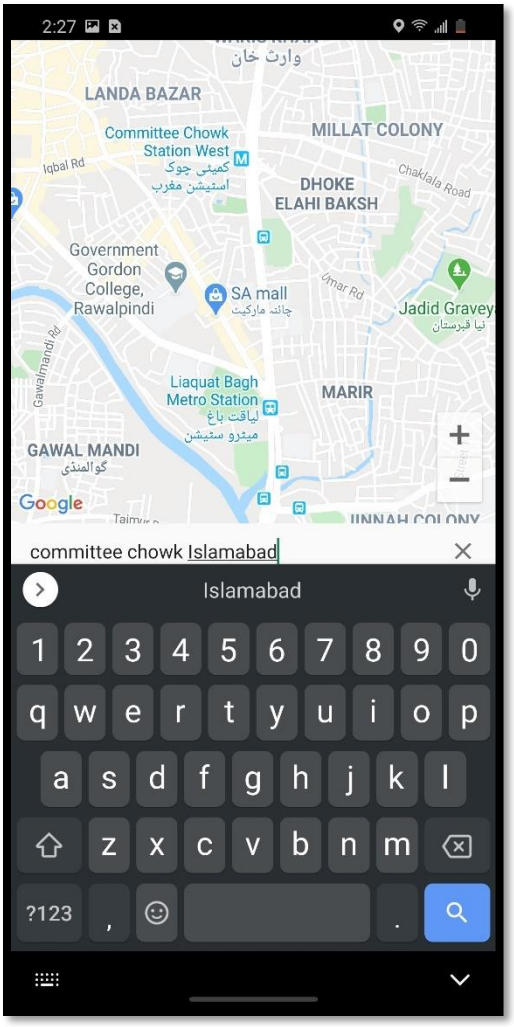

Figure 14 - Google maps Screen

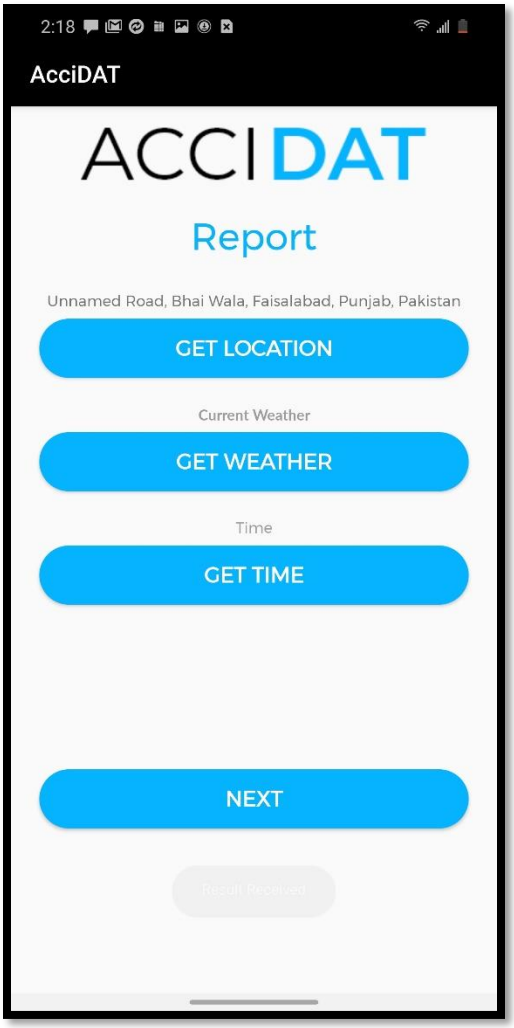

Figure 13 - Fetched Location

Users can also search for that specific location and drop the pin. The next image shows the fetched location, using either of the options mentioned above. Using the "Fetch Automatically" feature will reduce the chance of error in the data and will save time. The reason for providing the inbuilt Google maps option is we had to validate the application and check its accuracy against the existing RTA data. It wasn't feasible for us to go to each location individually and fetch the location. So, we came up with this option.

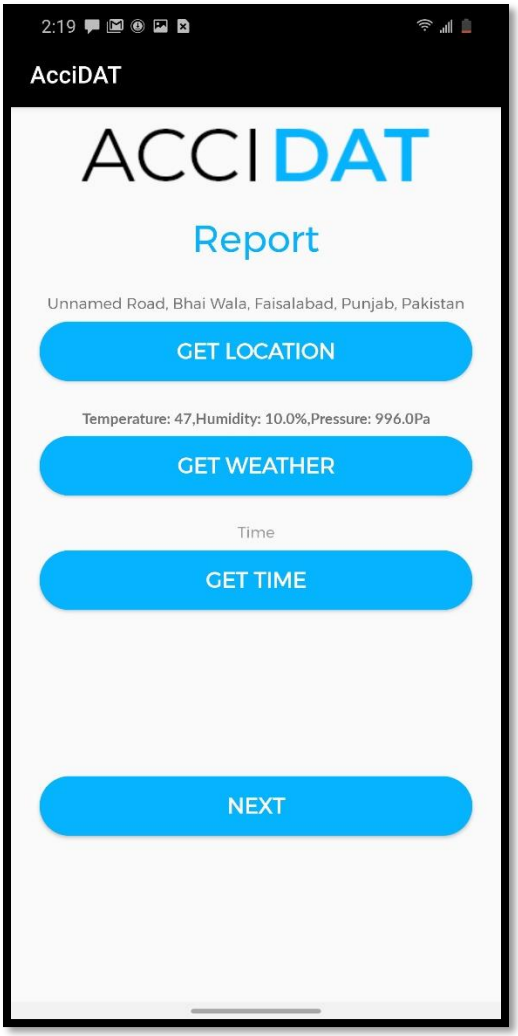

Figure 16 - Get Weather Data

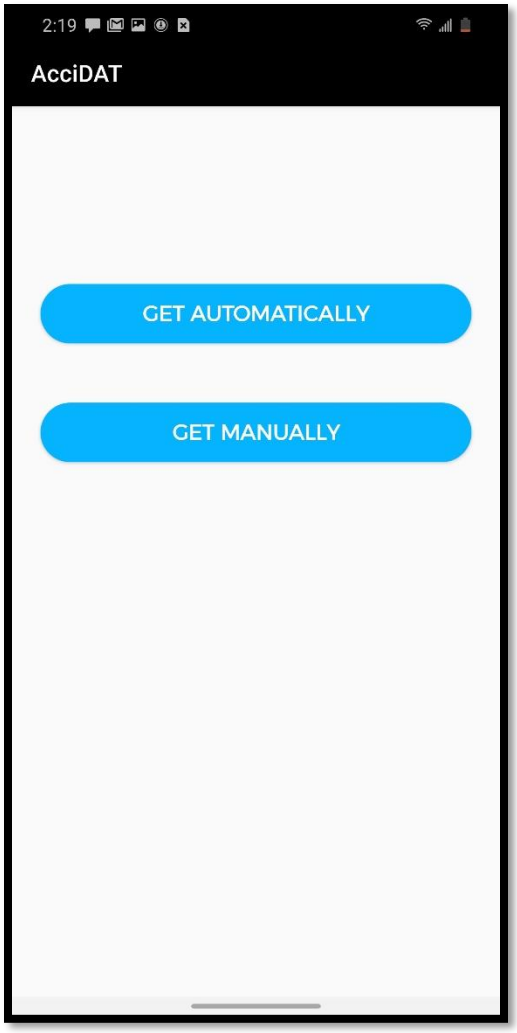

Figure 15 - Get Time Data

Getting the Weather and Time Data is as easy as clicking those two buttons. But we also have added the functionality to add the date and time manually. The reason is again the same, while entering the data to the database, all the accidents would give the same time and date if we let it auto-fetch that. So, similar the Get Location page, we added two options in the Get Time page, "Fetch Automatically" or "Get Manually" as shown in the figure below:

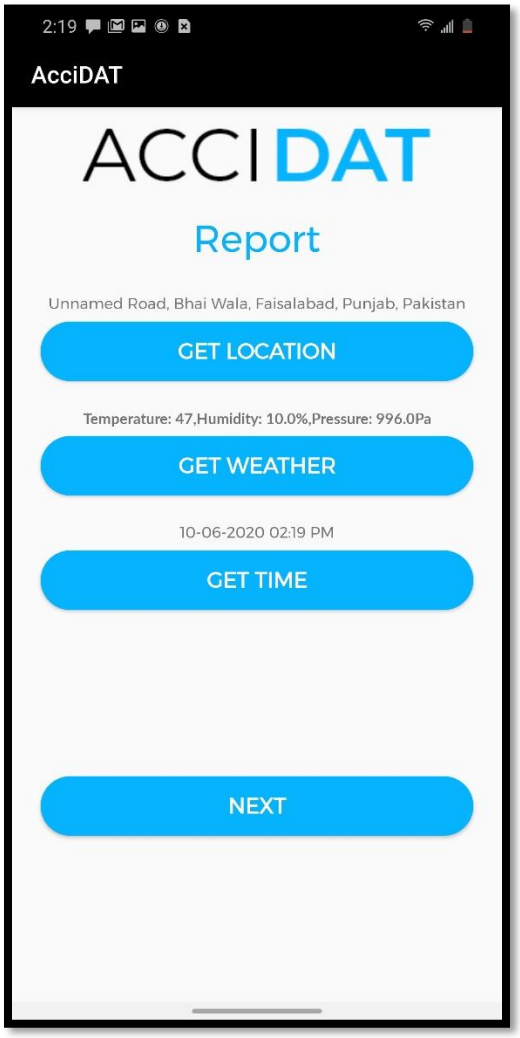

Figure 17 - Auto-Fetched Data

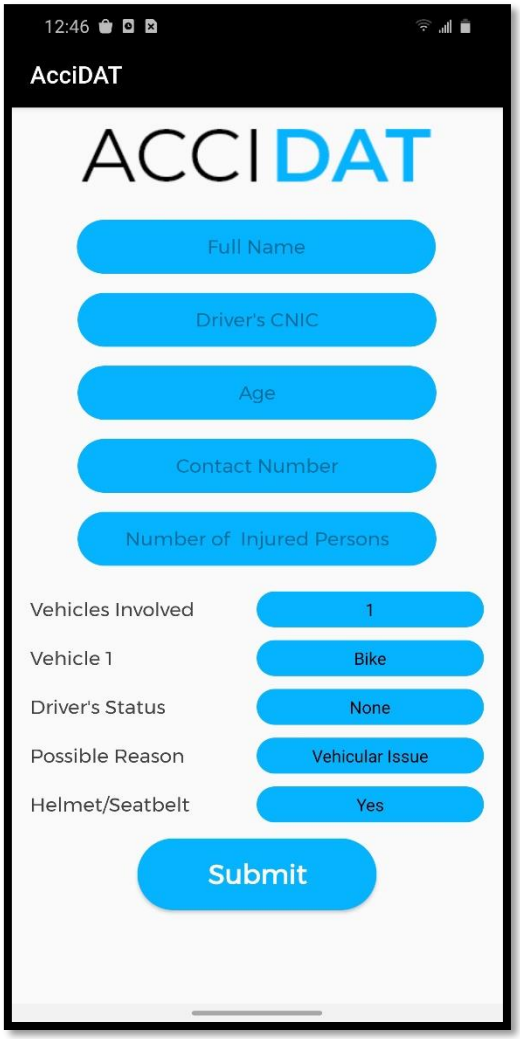

Figure 13 1- Other Information

After all the necessary information i.e. Location, Weather and Time is auto fetched, the user can go to the next screen where the other information can be added. Here, the user has the options to add the victim's Name, CNIC, Age, Contact number etc. One of these Four must be added, the other two can be added later. The other accident related data will also be added here. That data includes Number of injured persons in that accident, Vehicles involved, Possible reason, Driver's licensing status, Helmet/Seatbelt etc. When the user enters the number of vehicles involved, the Vehicle type option will very. For instance, if two vehicles are involved in an accident, one bike and a car, then the user will

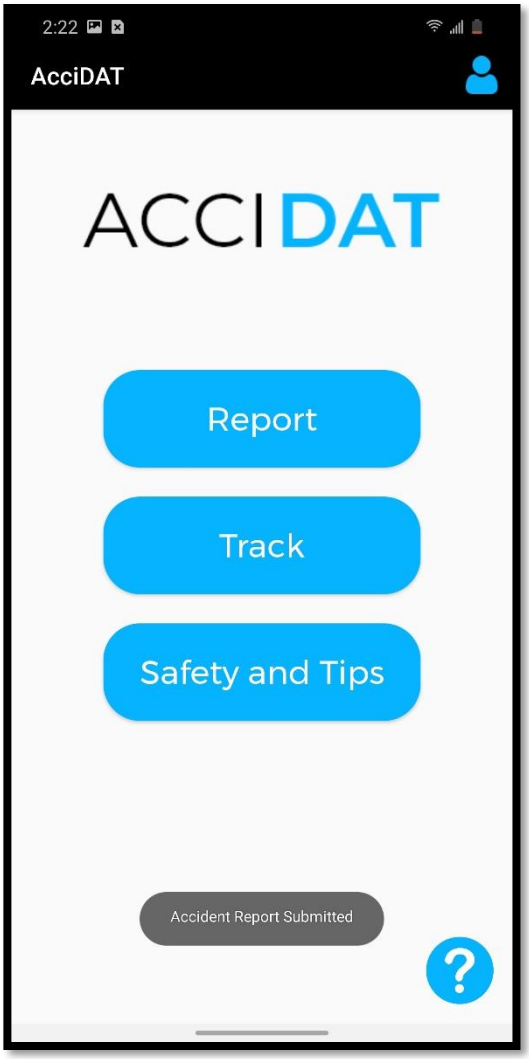

Figure 18 - Accident Report Submitted

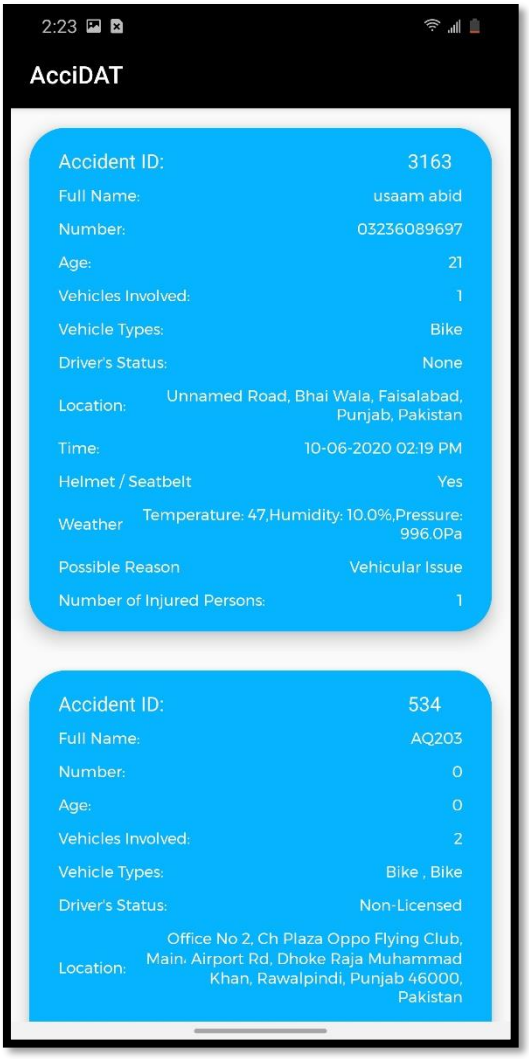

Figure 14 1 - Track an accident Page

enter "2" in Vehicles involved section and two options will appear to select the vehicle type, one to be added in each one. Once the user clicks Submit, all the data is uploaded to the database server instantly.

The sequence of the data being collected was set keeping in mind the value of time (as there are human lives at stake) and the accuracy of the data required. So, the most important data that has to be fetched on- site is placed on the first screen, so that it can be auto fetched instantly with 3 clicks. The other data can be added afterwards in the ambulance/ police car while going to the hospital.

All the accidents submitted from the account can be tracked using “Track an Accident” option. It lists all the data related to the accident along with the Accident ID. This accident ID is a unique for every accident and can be later used to access the accident data on the desktop app to enter further information.

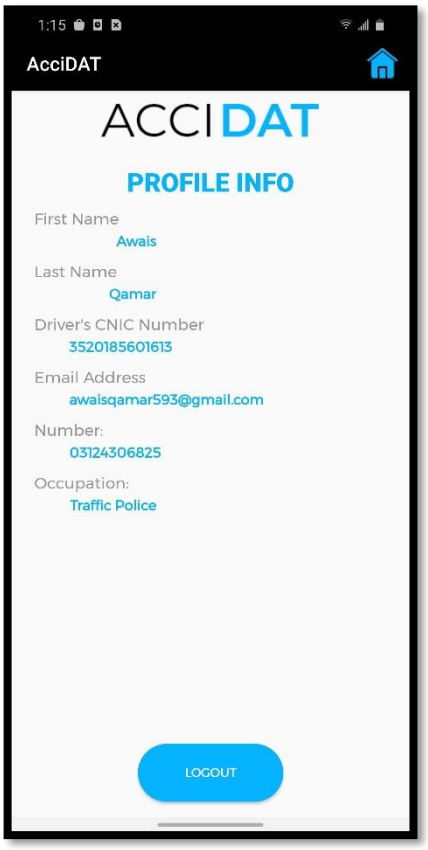

Figure 19 - Profile Info and Logout Screen

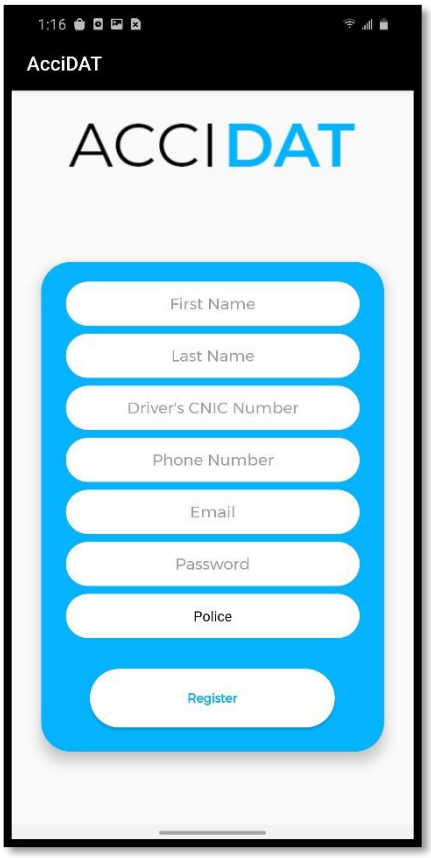

Figure 20 - Register Screen

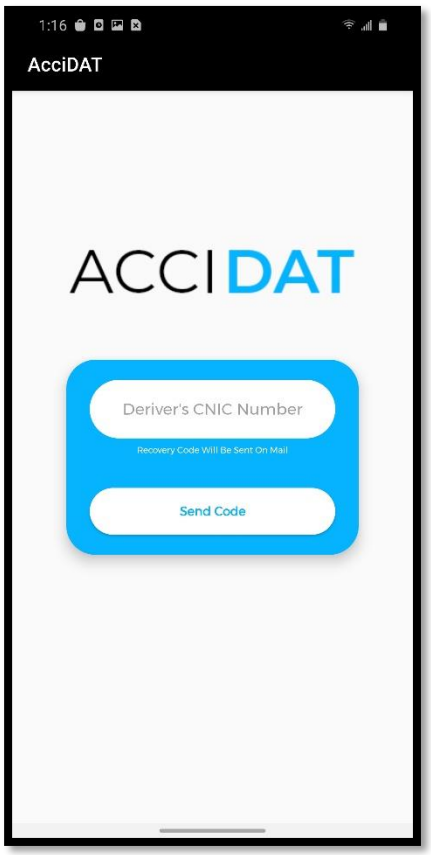

Figure 22 - Login Screen

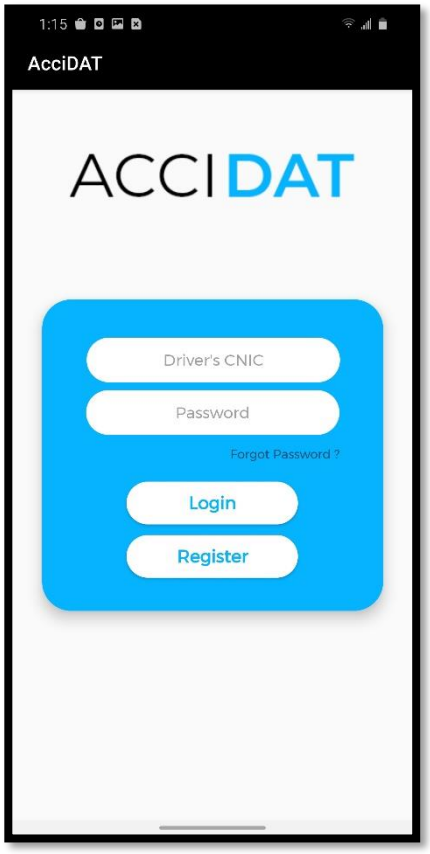

Figure 21 - Forgot Password Screen

Other pages of the application are basic stuff like the Login screen where the users can log into their account and access the stuff, forgot password screen where the users can recover the password. The Register screen will allow the users to create an account. The Profile Info screen can be accessed from the top right corner on the home screen. The user can log out from here too.

4.2 DATABASE:

The database is based on MySQL. It gives us the flexibility to keep the data in rows and columns format (which is more convenient). The database is hosted on a Premium server Hosted by SiteGround (which is the best hosting out there in terms of speed, CS etc.) All the Accident data from the Mobile App and the Desktop App is hosted on this database

under a unique ID. Database is just for the backend and technical aspects of the Accident Database system, users won't have access to it. All the stuff that is required by the users, and detailed access that is required by the Transportation Engineers is available on the Frontend in the form of those two apps.

4.3 DESKTOP APPLICATION:

The desktop application is based on C# (C-Sharp). This application has two portals, or we can say it serves two different functionalities. We'll discuss each in detail:

4.3.1 For Hospital Use:

This portal of the desktop application serves the main purpose of entering the medical related data of the accident to the database. That includes Injury Type, Injury Severity etc. Apart from this, it is also used to add the remaining data that was not entered in the mobile application. Here are the complete features of this application:

Figure 23 - Login Screen

The previously showed image is the login screen for the Desktop application. Here, the registered users can login using the Email/CNIC and Password. Users can also Register here. On the top right corner, there's the Admin portal i.e. Other part of this desktop app.

Figure 24 - Accident Search Directory

The above image shows the main Search directory. Here, the users (i.e. in hospitals) can search an accident using either the Accident ID or the CNIC of the patient so that they can add the medical related information to that Accident's data.

Once the user searches for an accident, this screen opens where they can add the medical related info like Injury Type, Accident Severity, Comments etc. If the number of injured persons is more, then these two variable fields (Injury Type and Accident Severity) will adjust accordingly. For instance, if there are two injured persons, then there will be 2 places for the user to enter the Injury type and Accident severity. When the user clicks Submit, the data is uploaded to the same accident under that Accident ID. Hence, we get all the required data related to that accident.

Only this portal of the application will be accessible to the Hospitals.

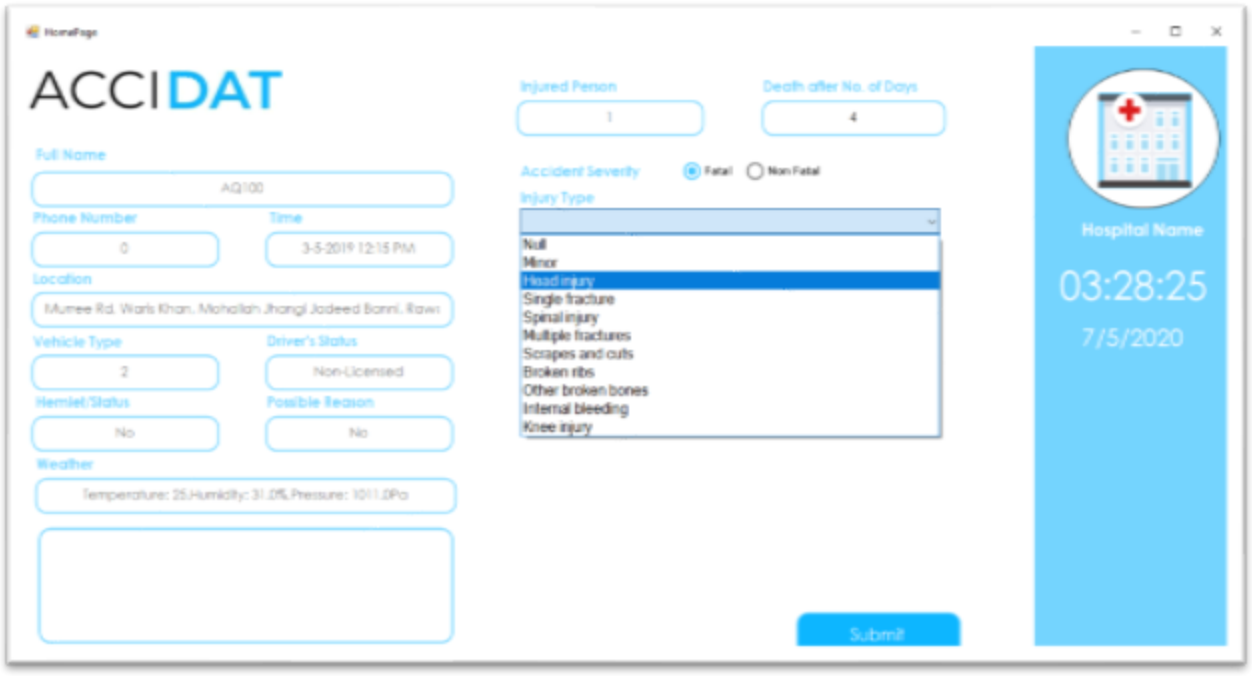

Figure 26 - Accident Data

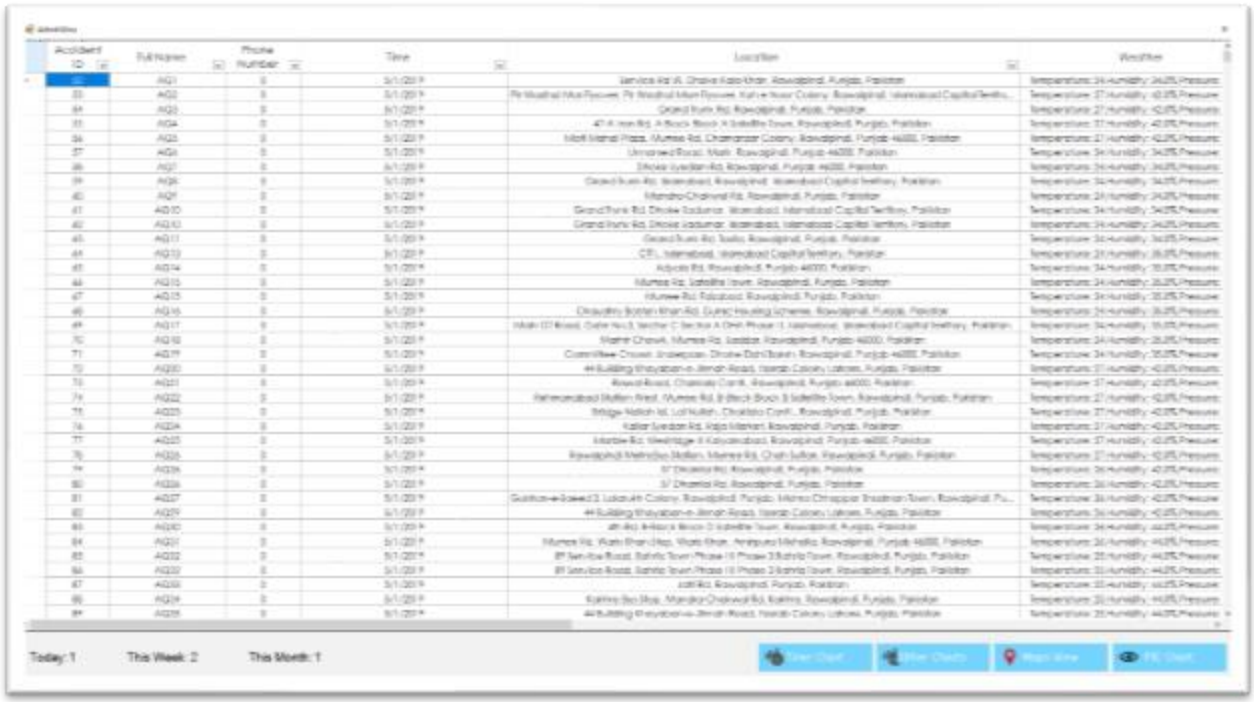

Figure 25 - Main Screen 1

4.3.2 For Transportation Engineers: (Admin Portal)

This portal of the desktop application is for analyzing the RTA data collected in the database. The analysis portal is well-equipped with almost every feature that helps a transportation engineer extract valuable information. It can be used to find out the most accident-prone areas, possible reasons of accidents there etc. within minutes. Shown below are some useful features of the admin portal:

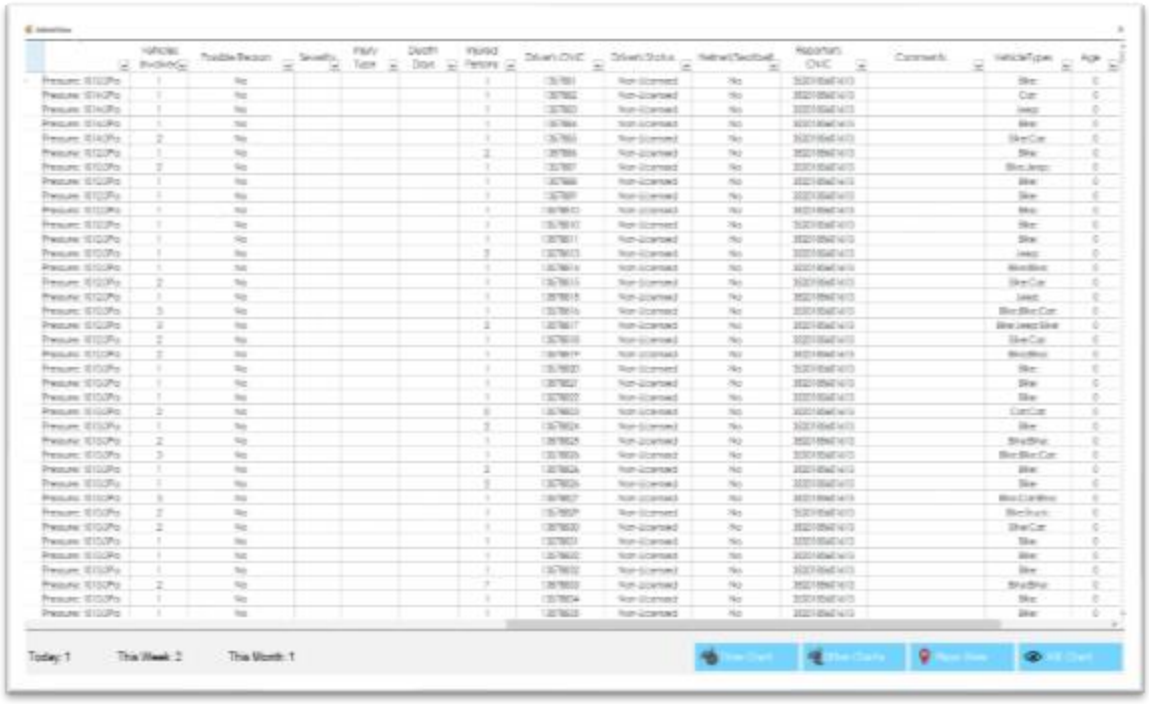

Figure 27- Main Screen 2

This page lists all the accidents on the database. All the possible variables related to the accident are shown at the top (from left to right). These variables include:

- Accident ID
- Full Name
- Phone Number
- Time and Date

- Location
- Weather
- Vehicles Involved
- Possible Reason
- Severity
- Injury Type
- Death After Number of days (If any)
- Number of Injured Persons
- Driver's CNIC
- Driver's Licensing Status
- Helmet/Seatbelt
- Reporter's CNIC
- Vehicle Types
- Age
- Longitude & Latitude
- Comments

4.3.2.1 Filters And Sorting:

It has all the flexibility to work with the data as the user wants. It has a set of Filters and Sort options that makes it easier for the users to analyze the data and jump to a conclusion. There is a set of predefined filters in the application that varies according to the variable. But if the user can't find his desired filter there, he can make his own custom filter. Custom Filter allows the user to select one of these commands and make his own filter:

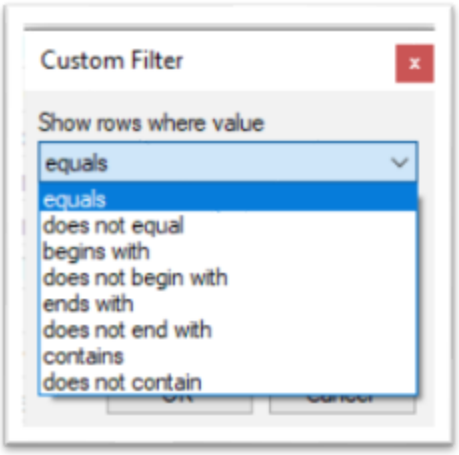

Figure 28 - Custom Filter Commands

Below is an example of Filtered location using custom filter. A custom filter was made to show every location that "CONTAINS" the word "CHOWK" in it.

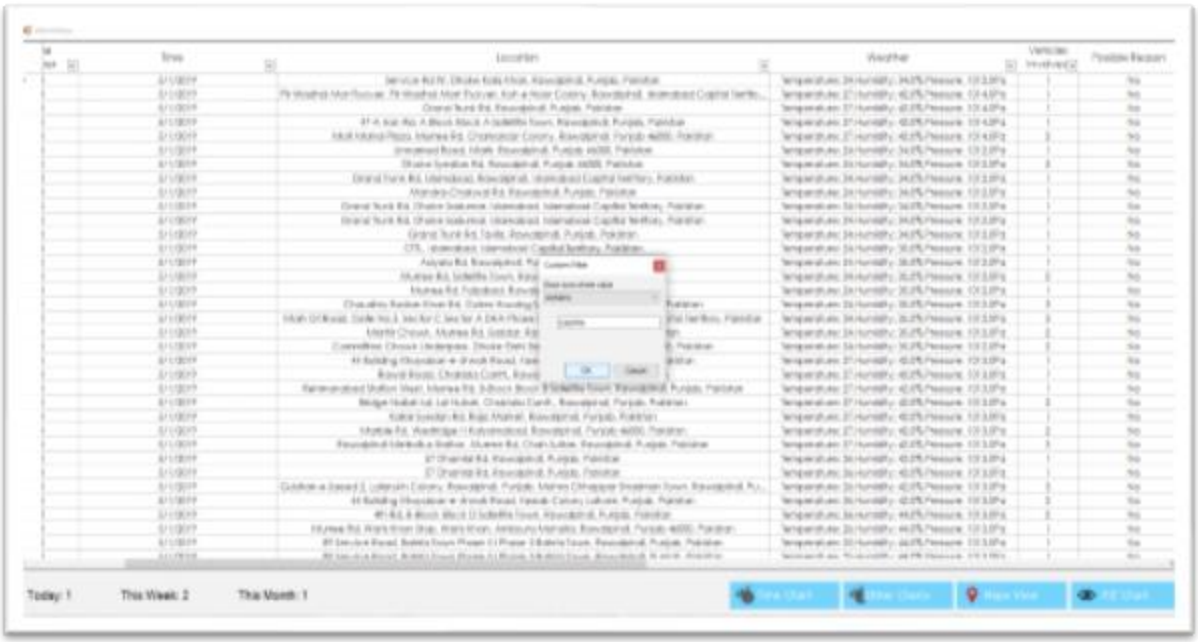

Figure 29 - Custom Location Filter

Similarly, here the time is filtered to show the accidents occurred only in February and March of 2019.

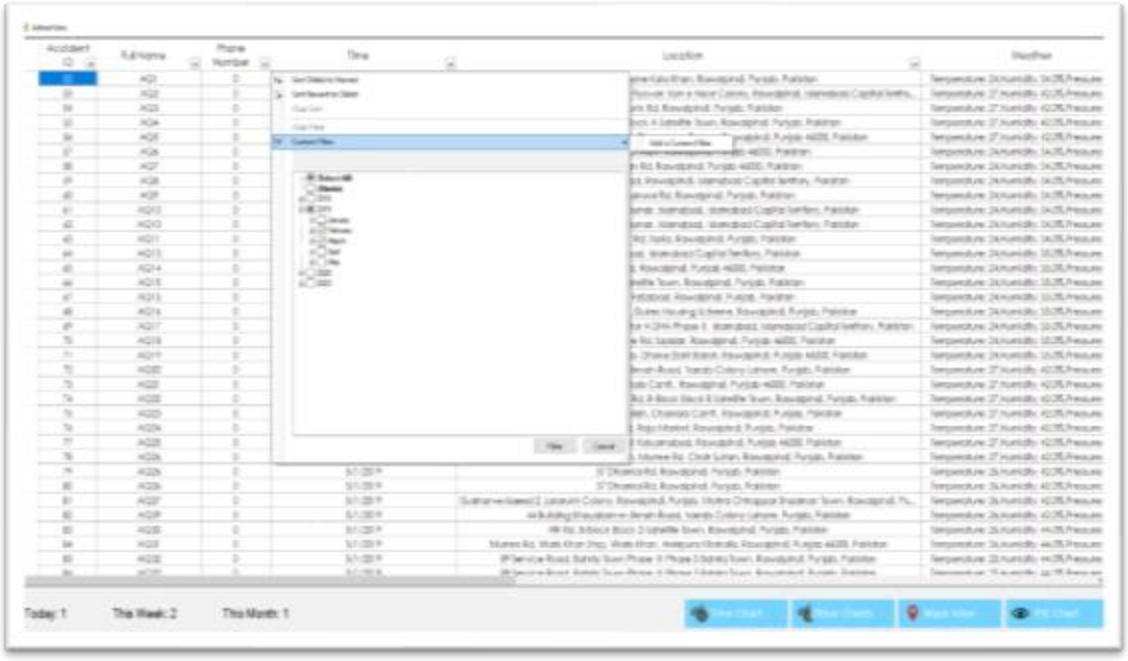

Figure 30 - Time Filter

Here, the vehicle type is filtered to show the accidents involving a bike and a car only.

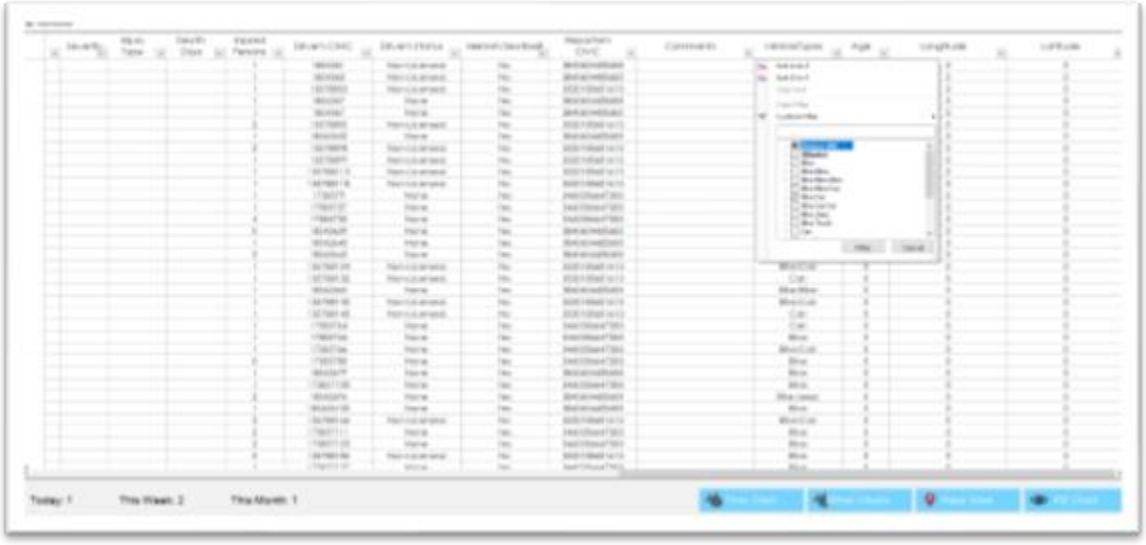

Figure 31- Vehicle Type Filter

Here, the Possible Reason variable is filtered to show the accidents where the possible reason was U-turn.

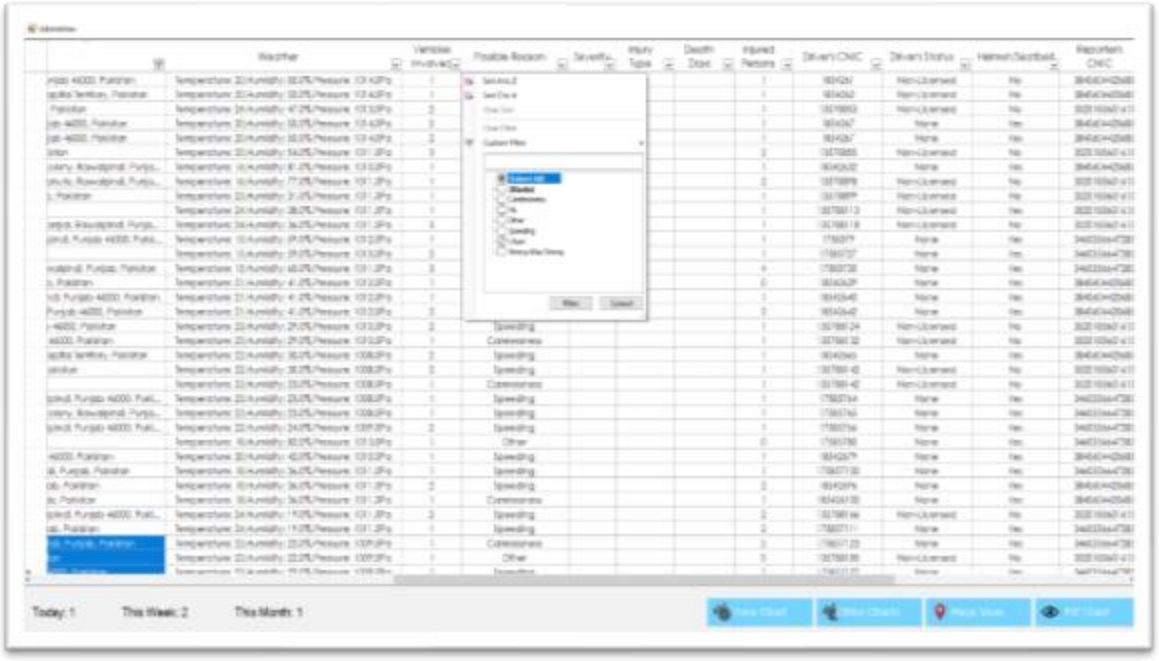

Figure 32- Possible Reason Filter

Not only that, these filters also work on multiple variables in combination with each other. For example, we want to get the accidents on any Chowk in which the driver wasn't wearing a helmet and the possible reason is over-speeding. We can do that easily using these filters.

4.3.2.2 Time Graphs:

This application also supports the Time Graph View. This feature allows the users to show the previously filtered accidents in daily, weekly or monthly graph view. It also allows the users to select a custom date range and show the accidents only between them. It shows the graph in descending order, thus making it easy for the users to identify which dates has the greatest number of accidents. There is a "View Stats" option at the bottom left corner which shows the graphically showed data in List form, so It's easier to interpret or get the exact number.

Following are the images of the Time graphs from the application:

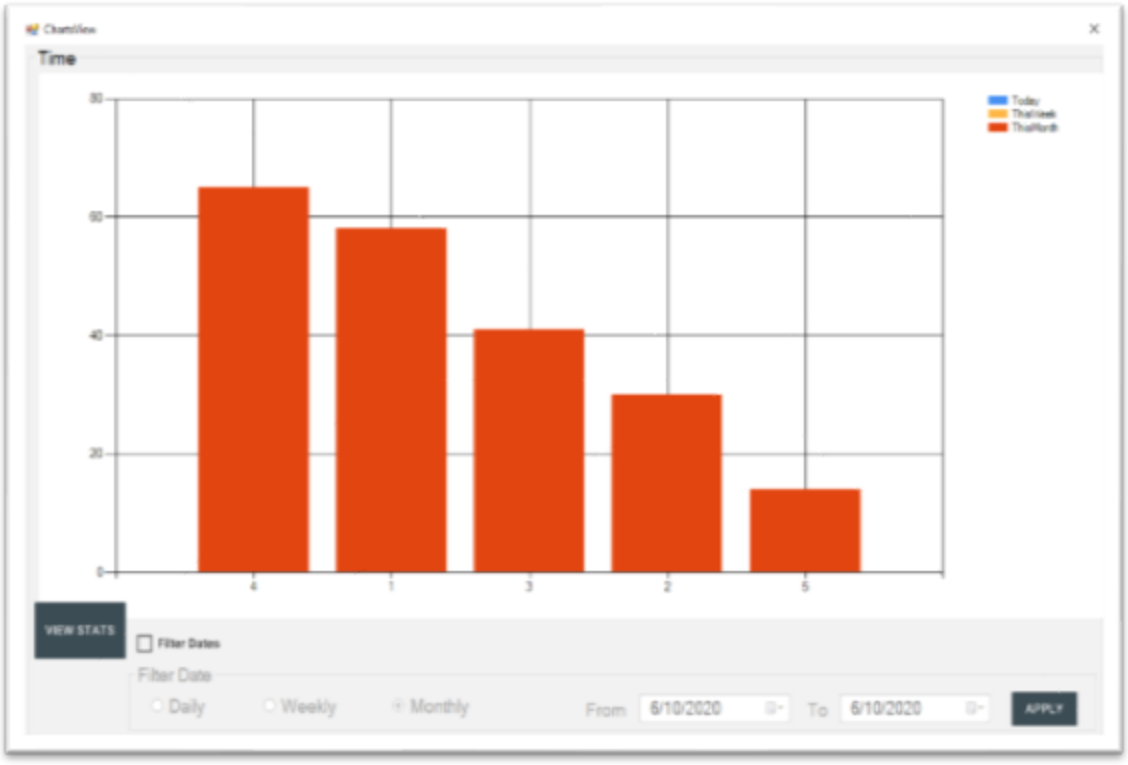

Figure 33 – Time graph (Monthly)

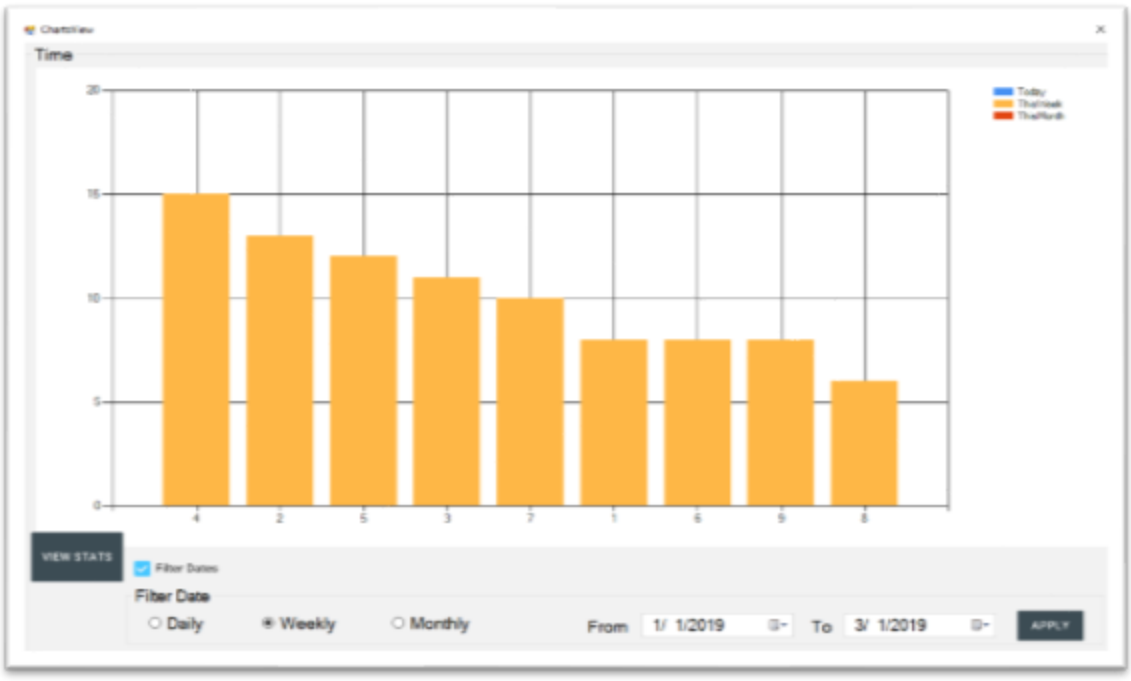

Figure 34- Time graph (Weekly)

The previous picture shows the time graph from date 1/1/2019 to 3/1/2019 grouped weekly. Below image shows the same data in statistical form so the user can get the accurate number.

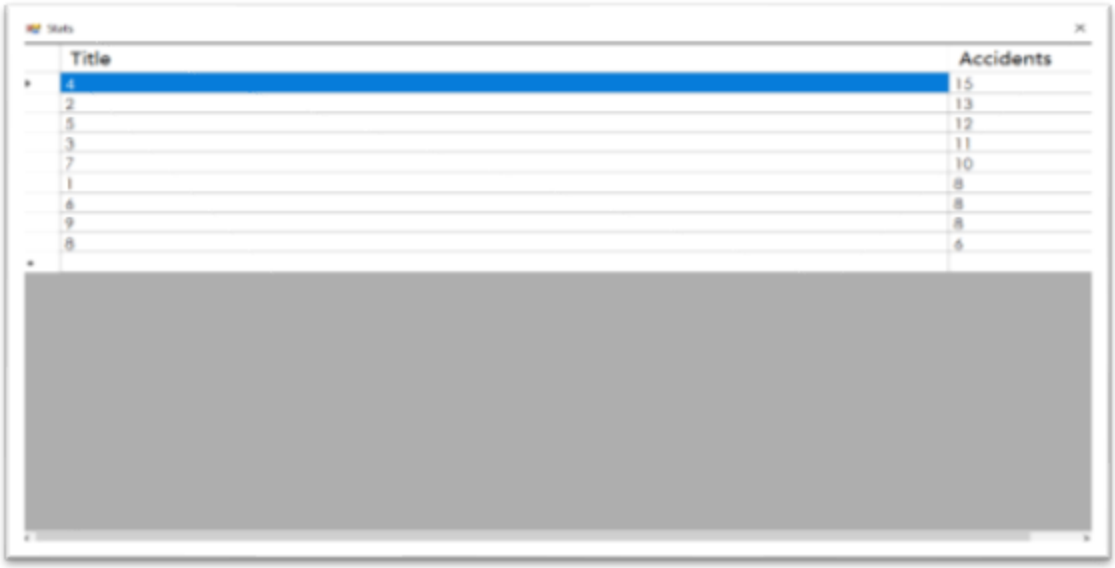

Figure 35 – Monthly stats

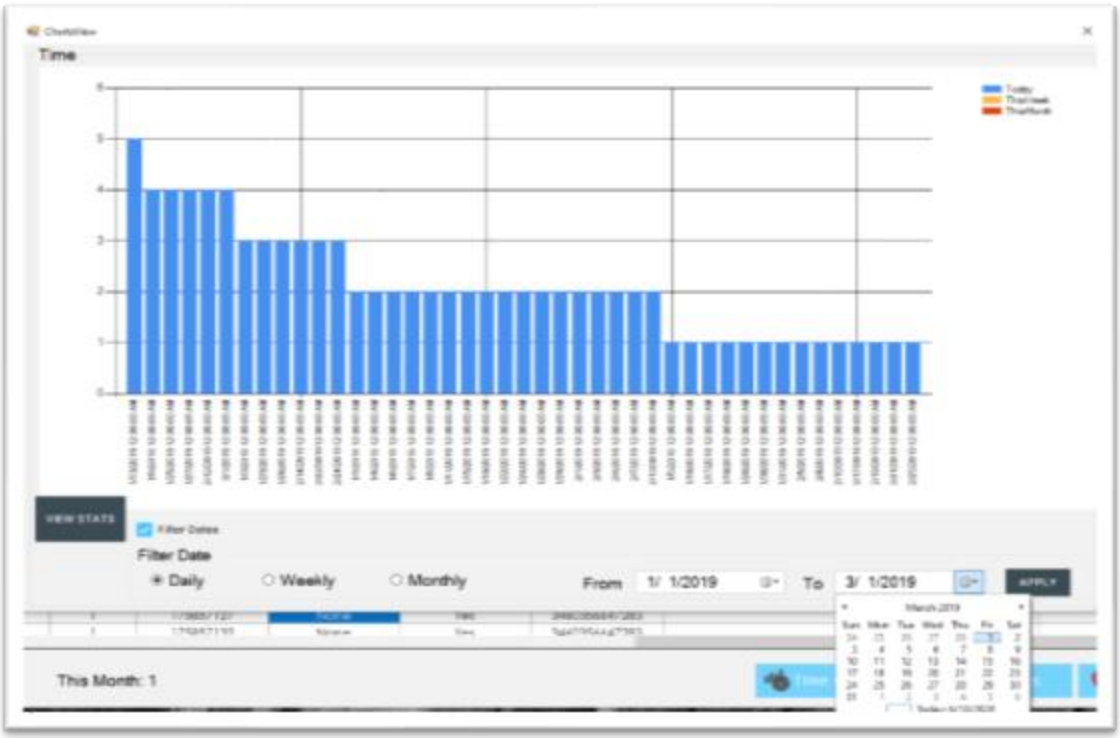

Figure 36- Time Graph (Daily)

4.3.2.3 Other Graphs:

These include all the useful graphs between the other variables and the Number of accidents. It gives users the flexibility to choose the X-axis variable themselves and see its graph with the no. of accidents on the Y-axis. Again, this shows the graph of the previously filtered data.

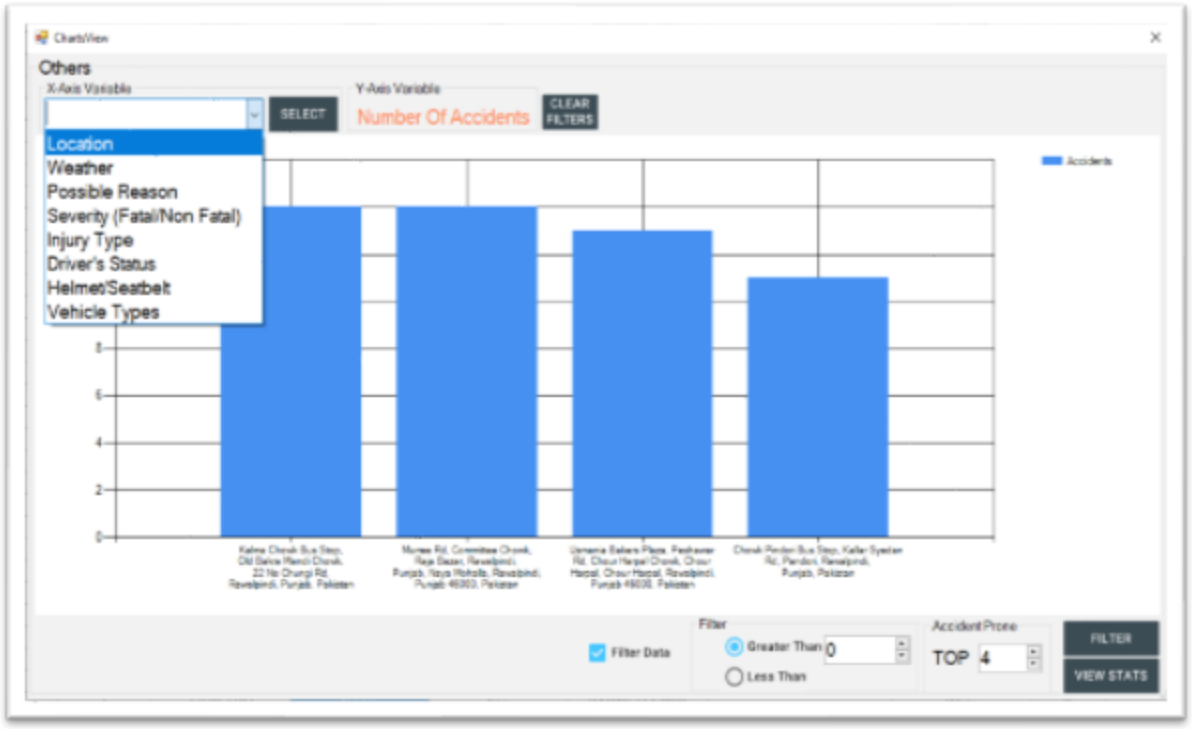

Figure 37- Other graphs main screen

In the above image, the variables are shown which can be used on X-axis to get their graph with the number of accidents. These variables were chosen after careful consideration of all the possibilities, and the most useful combinations were used which would yield some useful conclusion or provide the transportation engineer with some useful insights. These graphs include:

- Location vs Number of Accidents
- Weather vs Number of Accidents
- Severity vs Number of Accidents

- Injury type vs Number of Accidents
- Driver's (Licensing) Status vs Number of Accidents
- Helmet/Seatbelt vs Number of Accidents
- Vehicle Types vs Number of Accidents

The other graphs screen also provides "Greater than/ less than" feature to the users. This feature can be extremely useful when the user wants to see only those locations that have the number of accidents Greater than or less than a specific number. For instance, if we want to show only those locations on the graph which have more than 50 accidents, we can use this "Greater than" feature.

On the bottom right corner, there's the "TOP Accident Prone Areas" feature. This is one of the most useful and handy features of this application. For instance, if we as transportation engineers want to see the top 4 areas with the greatest number of accidents, then we can use this feature. This will help the engineers pinpoint the most accident-prone areas instantly and take necessary safety measures.

Besides this, there's the View Stats button, which lists the graphical data in statistical form, so the users can get the exact number. Here are some of the other graphs:

Figure 38- Possible Reason vs Number of Accidents

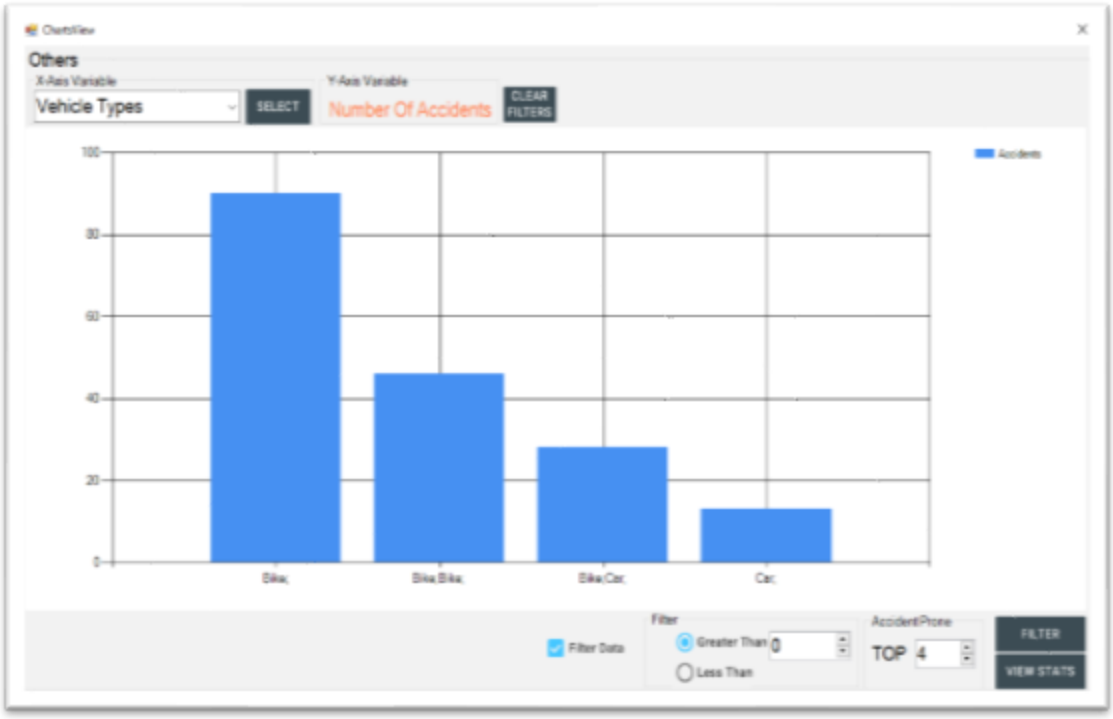

Figure 39- Vehicle Types vs Number of Accidents

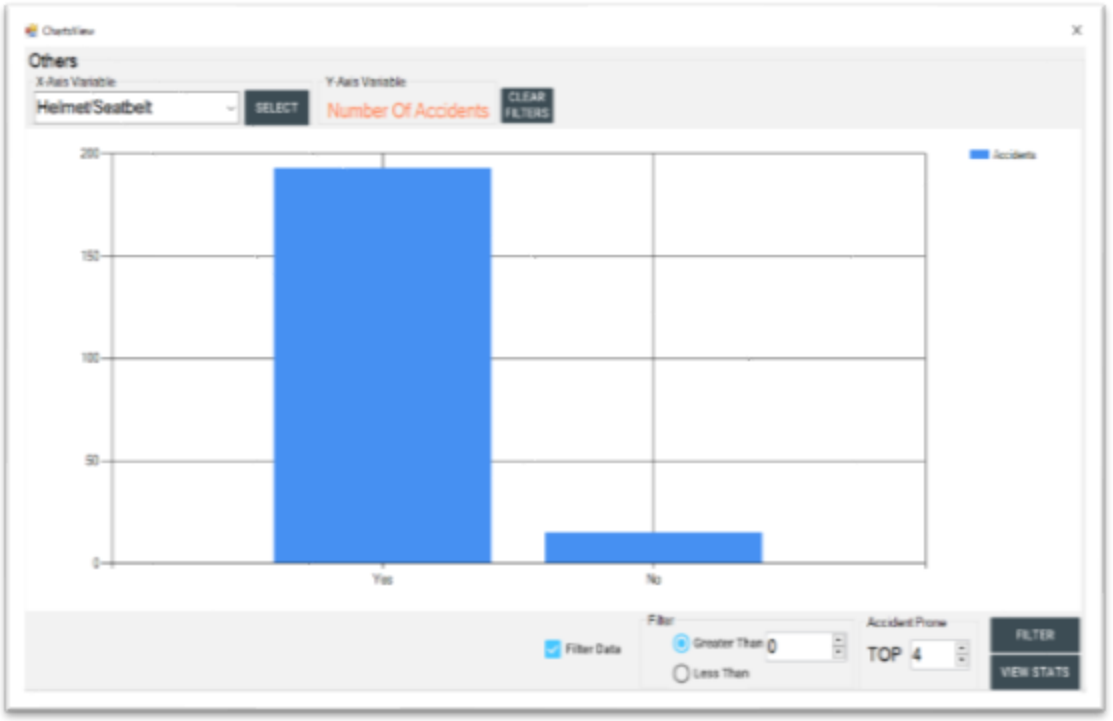

Figure 40 - Helmet/Seatbelt vs Number of accidents

4.3.2.4 Maps View:

As it is rightly said "A picture is worth a thousand words", this map view feature enables its users to visually interpret the data in Maps. All the filtered accident data is shown on the map (A pin shown at each accident location). By Zooming In, the user can clearly see where the accident density is greater and which areas must be inspected first for taking safety measures. "Top Accident-Prone Areas" feature does the same thing with much more accuracy, but this map view also gives the user an overall idea. The only chance of error here can be from the user end in interpretation of the visual data.

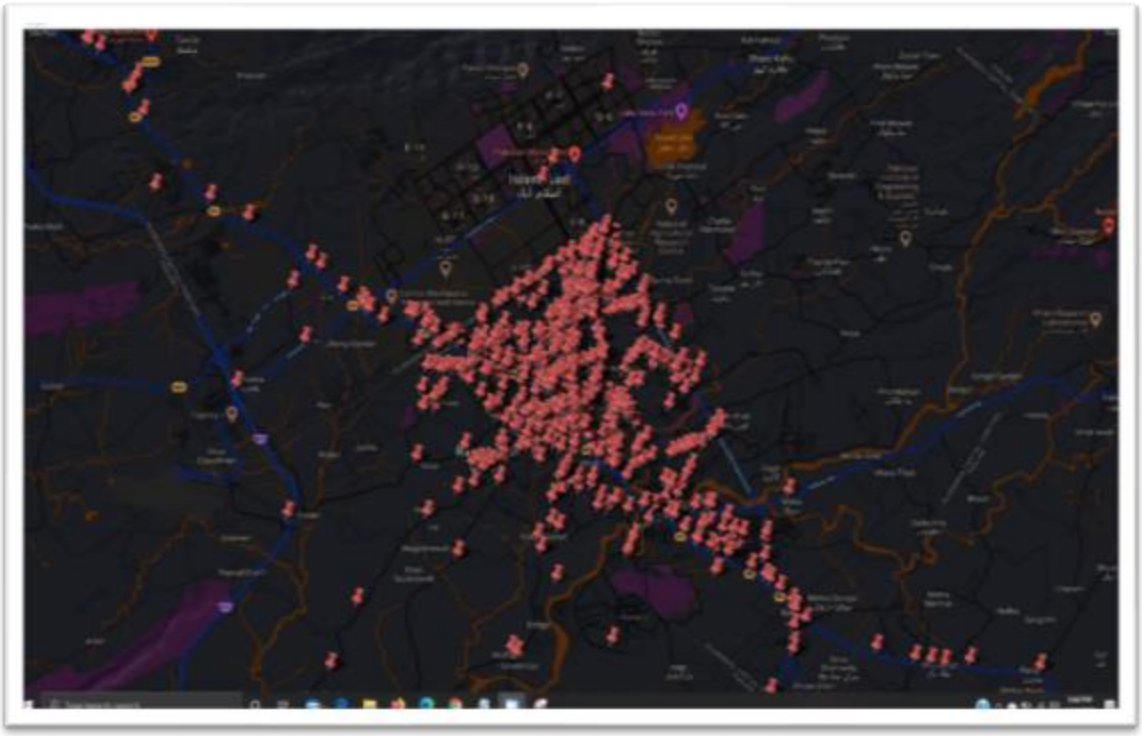

Figure 41- Map View

The above image is showing the filtered data of the accidents. We can't get a clear idea of the accident density on certain location in the **Zoomed-out** view. But **zooming in** further makes the data clearer and more analyzable.

4.3.2.5 Pie Charts:

Another feature of this application is the Pie chart. Pie charts are useful when we want to analyze the data in comparison to each other. All those variables mentioned in the other

graphs can he analyzed here using the Pie Chart too. It serves as an additional feature to visualize the data. Following are some of the Pie charts from the application:

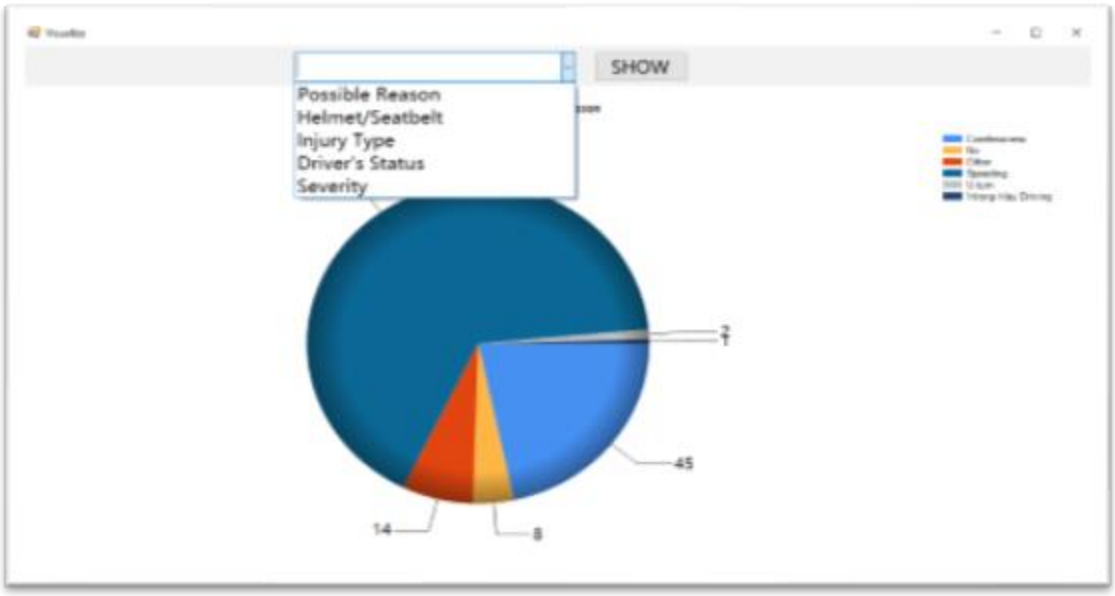

Figure 42 - Pie Chart main screen

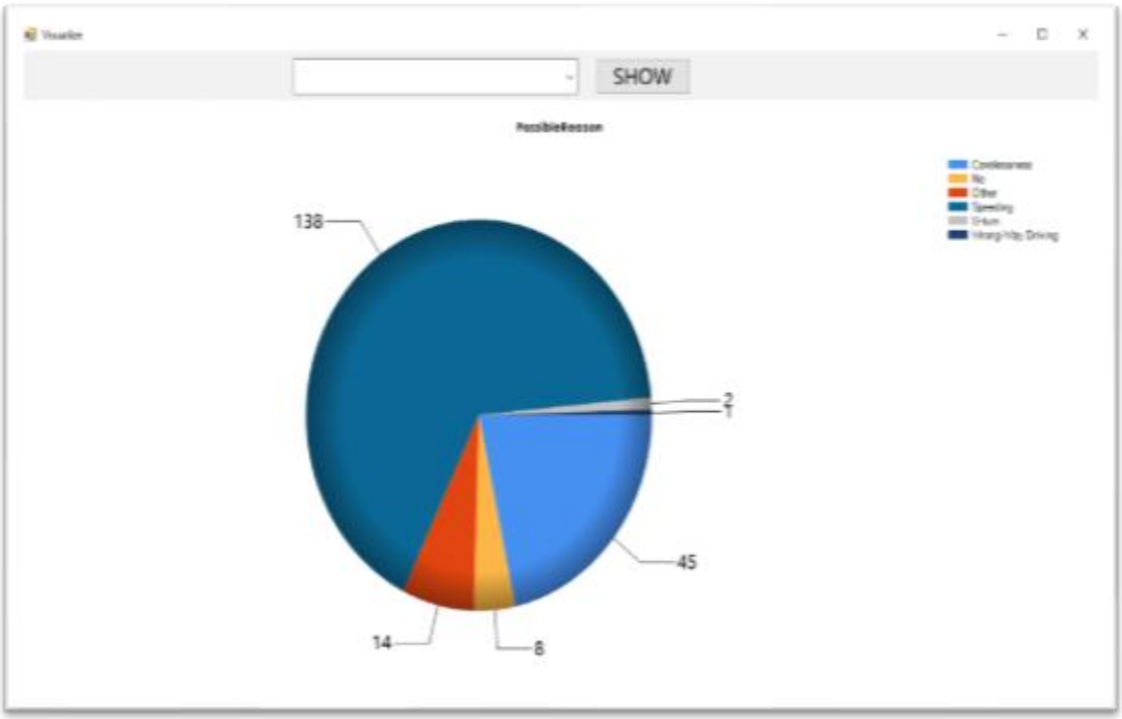

Figure 43- Possible Reason Pie Chart

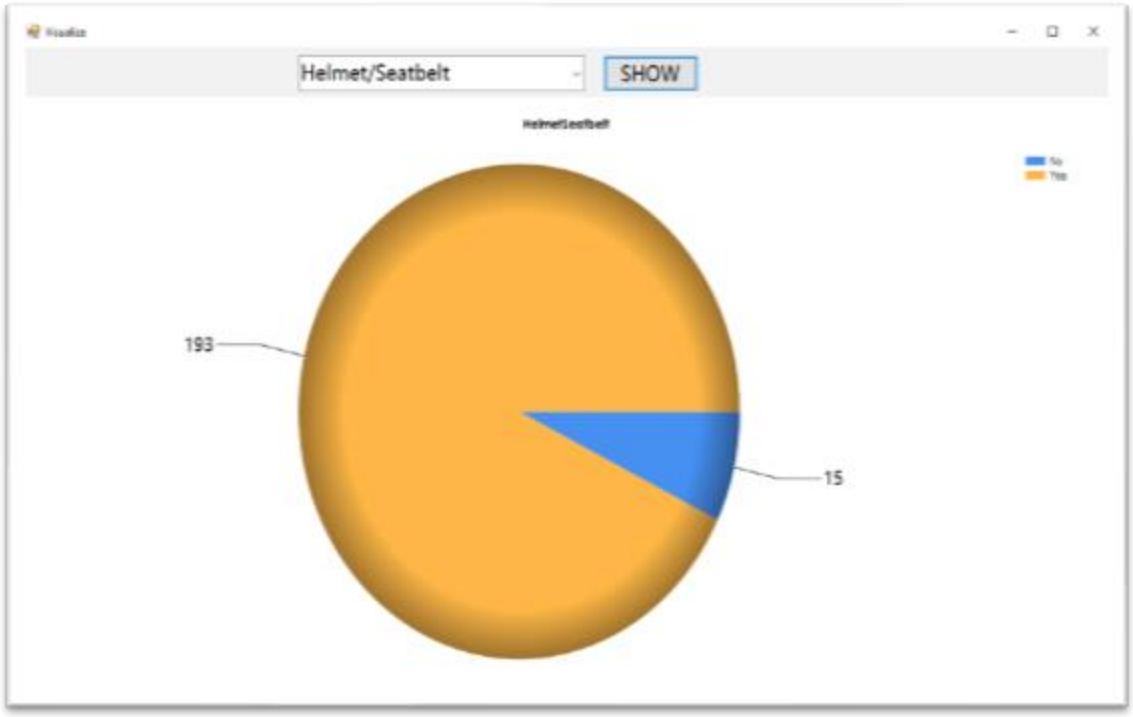

Figure 44- Helmet/ Seatbelt Pie Chart

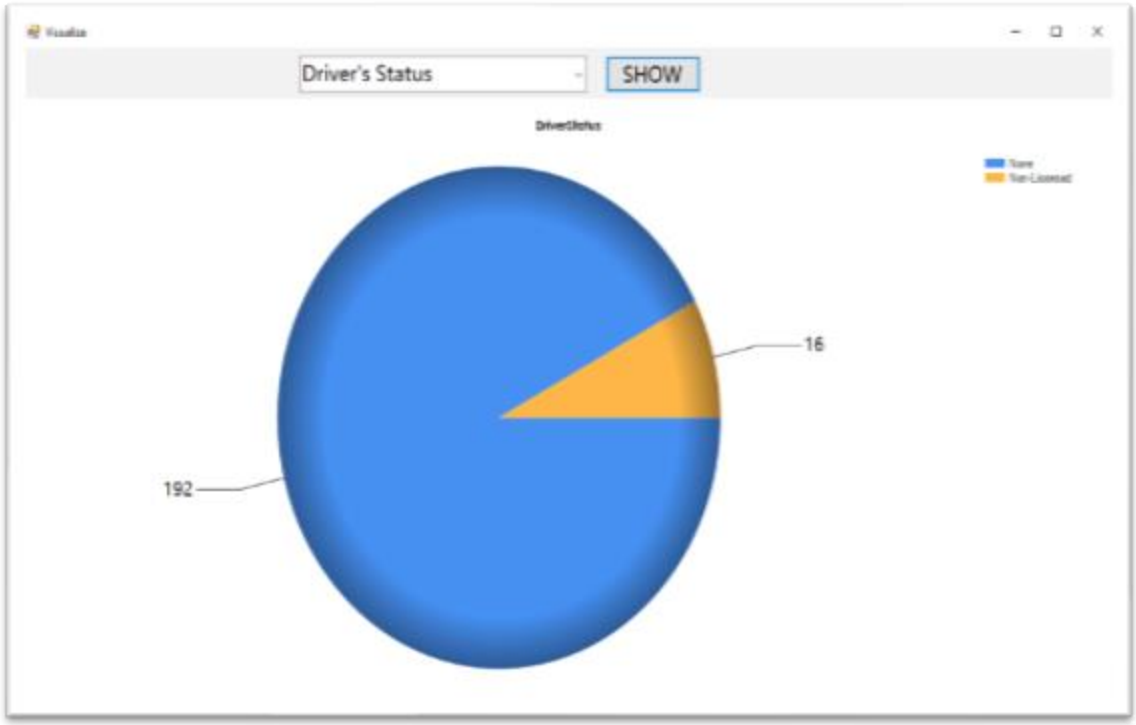

Figure 45- Driver's Status Pie Chart

CHAPTER 5

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The increase in the number of accidents day by day and its impacts on human life as well as public and private property cannot be ignored. The number of accidents occurring in developing countries is much greater than in developed countries due to the absence of an effective system that can fetch and analyze accident data to mitigate the severity of accidents.

There is a dire need to replace the primitive methods of acquiring accident data and to move the authorities to play their part in mitigating this grave problem. While transportation is a need of every citizen, the impending life-threatening situation on our roads is being left unnoticed at the behest of luxury.

Every year hundreds of people die and millions of rupees are lost to cover damage to public properties. Numerous factors play their part in this regard so the need to improve this deteriorating situation an effective system is needed.

This is where our project comes in. We have designed an effective Accident Database system which, keeping in view the prevalent situation, covers every aspect from fetching data to numerous features to analyze that data.

ACCIDAT, if employed properly by the authorities, can be a game-changer which would ameliorate the primitive methods and enhance the capability of every person using it, from a policeman to a traffic engineer.

Furthermore, the validity and usability of the accident database system have been checked. The copyrights for the Accident Database system have been acquired and if need be, it will be given to higher authorities for implementation and use, nationwide.

We have played our part in achieving all our objectives and developed an Accident Database system. Now, it's up to the authorities to play theirs by adopting this Accident Database system and make the highway system safe and efficient.

5.2 RECOMMENDATIONS

There are a few recommendations that are necessary for the proposed system to work efficiently.

First of all, replace the practice of recording data on a paper manually by equipping the concerned authority with ACCIDAT.

Secondly, all major hospitals must be equipped with the desktop version of ACCIDAT to record data which may be used by any concerned authority.

Thirdly, make sure that the traffic engineers utilize the data acquired from this database to mitigate road accidents and improve road safety.

Finally, this database must be employed in every field concerned with the road safety to bring about a change to make our roads safe for all users.

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