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Road Accident Prediction Using Machine Learning

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ABSTRACT

Despite the greatest efforts of the car industry's engineers and researchers, traffic accidents will continue to occur. In order to better understand the causes of risky traffic occurrences, it would be helpful to design a prediction system that can automatically categorize the severity of injuries sustained in various traffic accidents. Knowing these road and behavioral patterns may help with traffic safety policy making. For policies to be effective, they must be based on rigorous scientific research into the root causes of accidents and the extent of injuries. Multiple machine learning-based injury severity prediction algorithms are available inside the system. In this research, we propose a prediction model for the early identification of traffic accidents using machine learning techniques such as decision trees, Random forests, and support vector machines. We used Kaggle's dataset of traffic accidents. Our proposed approaches to accident prediction have a 98 percent accuracy rate in pinpointing hotspots.

Keywords- Road accident, Machine Learning, Python, Dataset, Testing.

I. INTRODUCTION

Concerns about road accidents have been widespread throughout the Indian subcontinent. More than 151,000 people lost their lives in car accidents in the United States in 2019. The annual cost of road accidents was between three and five percent of GDP. Despite having just around 1% of the world's automobiles, India was responsible for roughly 6% of all traffic incidents in 2013. Young Indians were involved in almost 70% of the accidents. According to traffic studies, the number of fatalities and injuries caused by automobile accidents will increase. Because of its importance, traffic management and planning are now being carried out using cutting-edge techniques. Laws and interventions based on the assumption of traffic dangers will reduce the number of accidents that occur on the road. Having a set of assumptions built with the use of existing data and potential threats will be helpful. [1] Computer vision-based road traffic accident and anomaly detection in the context of Bangladesh, by M. M. L. Elahi, R. Yasir, M. A. Syrus, M. S. Q. Z. Nine, I. Hossain, and N. Ahmed. The researchers detailed a system for foreseeing traffic accidents in Bangladesh that relies on computer vision. They were able to learn specific scenarios with an accuracy of 85% by watching roadside camera footage.

Recent years have seen an uptick in the amount of research conducted by students interested in the causes of traffic accidents. In order to identify potentially dangerous driving habits, students conducted research on driver behavior and strategy across the whole dynamic lane system. According to studies examining the link between road conditions and car accidents, a steep street slope poses a significant risk to drivers and pedestrians. In addition, no other research has ever looked at the dangers posed by climate change or the shifting demographics of tourists. However, the majority of these reports have only looked at one factor (whether it is tourists, drivers, roads, or the environment as a whole) in relation to injuries. College students utilize a variety of data mining techniques in the study to ensure the safety of attendees at the information mining technology event. Organizational data mining is often used to examine the causal aspects that contribute to visitor harm. The hidden network inside the risk data is revealed by using strict rules of communication. They may be attracted by arranging the foundations so that they can live the worth and quality of the foundations with a twofold standard of support and confidence.

Because of the staggering number—over three thousand per day—of individuals who are killed in traffic accidents, "road safety becomes a huge public health problem in today's society." The global economy suffers damages from road accidents as well. Costs associated with this for developing countries When doing research into the identification of crucial components for a better understanding of the sequence of events and the use of linked data in key target placements, the road information unit is essential. When it comes to transferring Brobdingnagian data, there are a number of locally accessible (information | information) mining techniques that may be had for very little money. Finding organizational law typically makes use of algorithmic law and current fads. This serves as a general caution that it is not uncommon for connections between data to include useful insights. in advance, foresightful Common mining approaches used by the regional unit included apriori and FP-growth algorithmic rule, and their outputs aided in identifying the most salient or typically continuous patterns.

The crash was only recorded by authorities in one Asian country. Since the channel is dedicated to covering accident cases, the approach taken when aggregating, compiling, and recording accident data has a long list of improvements they'd like to see made; currently, analysts use only the most fundamental information and report no success when trying to draw conclusions from it; numerous data mining tools exist, but it's challenging to find useful information; and there is no publicly available database of road accidents. There is data on car crashes, and the risk entry includes 16 characteristics and 2634 pieces of data. Researchers employ a wide variety of information mining techniques. Predictable information may be mined from massive knowledge bases via data mining, and the resulting summaries of the data are often presented in a style that is easy to use. Data processing methods aid in recognizing the most consequential, or persistent, trends.

1.1 PROJECT DESCRIPTION

PROBLEM STATEMENT

Accident prevention strategies in modern societies have a number of drawbacks. The database we'll be utilizing may be accessed freely via many academic and government portals. The collected data will be analyzed, integrated, and sorted in line with predetermined parameters using the best available algorithm.

In order to reduce the shocking number of traffic accidents that plague a city, a comprehensive analysis is required. This study will be conducted more completely to determine the severity of the traffic events using supervised learning methods like Deep Learning Neural Network and AdaBoost. The accidents will be ranked according to their severity: fatal, serious, minor, and vehicle-related. Many groups, including governmental ones, are researching what factors contribute to roadway mishaps. Expansion of the barrier, slowing of accident speeds, and whatever else is being done. When all road users account for the many ways an accident might happen, it becomes a serious problem for organizations as Royal Mal (JKR), the road transport process, planning procedures, or in repair operations. The accident evaluation paradigm allows for a thorough investigation of all contributing elements. It is difficult for the developed model because of the very simple mathematical model.

1.2 OBJECTIVE OF STUDY

To better prepare for potential disasters, it would be helpful to review the region's documented events in the past. Use variables like device location and ID, speed, weather and pollution data, road geometry, and other environmental factors to produce predictions.

1.3 SCOPE OF THE PROJECT

Both RTO administrators and researchers may benefit from using this software. They can figure out where the most accidents will take place. What can be done to foresee and prevent mishaps?

1.4 METHODOLOGY USED

The purpose of this research is to identify the most influential factors in determining the severity of a roadside accident via the use of the Support Vector Machine (SVM) and random forest classification methods. The following steps were taken by us in order to accomplish our goals.
System's actions and their context are documented in the system's point of view. the connections and interactions between the system and its surroundings.

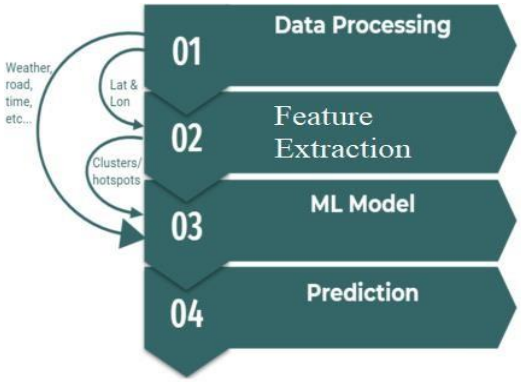

Figure 1: Architectural Design

There are two types of Support Vector Machines:

Linear SVM, often known as basic SVM, is used to categorize information along a linear axis. If a dataset can be partitioned into two categories using a straight line, we say that it is linearly separable, and we use the linear support vector machine (SVM) classifier to do it. It is often used for problems involving classification and linear regression.

Nonlinear support vector machines (SVMs), also known as Kernel SVMs, are used for datasets that cannot be linearly classified. The classifier used here is a nonlinear support vector machine (SVM) classifier called asto. It offers more leeway for nonlinear data since more features may be introduced to fit a hyperplane instead of a two-dimensional space.

II. LITERATURE SURVEY

1. Sachin Kumar et al. [3] employed data mining methods to locate places with a high incidence of road accidents, and then analyzed those locations to determine what causes such accidents. The k-means clustering technique, which uses traffic accident numbers, will initially be used to partition the accident site into k groups. Once the connection between the variables in the accident data set was established, the association rule mining method was used to determine the characteristics of the locations.

2. RndTree and C4.S, developed by S. Shanthi et al. [4] for data mining classification, achieve high precision by using the AdaBoost Meta classifier. Incorporating the training dataset and the Critical Analysis Reporting Environment (CARE) technologies from the Fatal Analysis Reporting System (FARS).

3. “Hossain, M. et.al. [5] remarked, "driving or being in a car is one of the principal harmful actions individuals in motorized civilizations conduct everyday. Researchers and road authorities are taking measures to ensure safe travel for road users as cutting-edge ITS-based systems become available. RTCPM is one of several game-changing initiatives that bridge the gap between early education and technology. When fully developed, it will be a crucial component of the $64,000 Time Proactive Road Safety Management System. By the time a security breach occurs, you will have detected it and taken appropriate action to restore regular flow. Here and nowThere is still just one strategy that allows for accident evaluation in real time. Incapable of handling expansion. The research analyzed previous research in the field. The most recent research in the field of real-time crash prediction models (RTCPM) has focused on synthesizing and harmonizing preexisting notions and identifying the essential contours of style lines. The seasonal risk assessment is positive and significant. Improvements have been made in the ways in which we produce content and its usability and performance.

4. Annie Racheal Rajkumar et.al. [6] This research offers a framework for examining the impact of traffic collisions and the variables that contribute to their occurrence. It has been noted that external elements, such as illumination, may play a crucial role in determining the severity of an accident. With better street illumination and improved road conditions, the cost of automobile accidents should go down. For further exploration to provide important insights and contribute to road safety, a database comprising various data, such as three classes information about the severity of the accident (minor, severe, and deadly), and the mild condition and police officers, is provided. While it is impossible to prevent all accidents, this data may help governments and individuals plan for and respond to them more effectively.

5. According to Labib, M. F. et al. [7], For a developing country like ours, the damage caused by traffic accidents is terrible on many levels. Therefore, it is crucial to control and manage traffic utilizing cutting-edge techniques in order to reduce the number of traffic accidents in our country. Traffic accidents may be avoided with the use of simple measures based on predicted forecasts or warning systems. Furthermore, many people are killed in road accidents daily, and since this number is growing, it has become a need in our country [6]. At the end of the analytical phase, using the information gathered through situation management, it is recommended to make an educated decision and reduce the number of traffic police in order to avoid accidents. Since the proposed methods for using machine learning have a history of success and high accuracy for assessing the seriousness of traffic events, we may choose to implement them here. [6].

III. TOOLS AND TECHNOLOGIES USED

PYCHARM, PYTHON 3.7

Python stands out from other scripting languages because it is interpreted, object-oriented, and interactive. Python was designed to be easily understandable.

The Interpretation of Python Python code is processed in real time by the interpreter. Your code may be executed directly without being compiled. Similar to PHP and PERL in this respect.

Python is interactive, so you may write programs by interacting with the interpreter at the Python prompt.

Characteristics of Python

1. In addition to object-oriented programming, it also accommodates functional and structured approaches.
2. It allows for dynamic type verification and offers extremely high-level dynamic data types.
3. Garbage collection is fully automated.

Here we are used 3 library

- Pandas
- Numpy
- Matplotlib

HARDWARE AND SOFTWARE REQUIREMENTS

HARDWARE REQUIREMENTS:

Table1: Hardware requirements

Processor	Intel Core I5 and above
Processor Speed	1.0GHZ or above
RAM	4 GB RAM or above
Hard Disk	500 GB hard disk or above

SOFTWARE REQUIREMENTS:

Table2: Software requirements

Operating System	Windows 10/11 or above
Front End	**PYTHON**
Back End	**SQLITE3**

SOFTWARE REQUIREMENT SPECIFICATION

USERS

Despite the efforts of automobile industry researchers and engineers to create safer cars, traffic accidents will continue to occur. Accident trends may be found if a prediction model is developed to automatically classify the severity of injuries sustained in different types of traffic accidents. prediction of traffic accidents by using a decision tree, support vector machine, and random forest techniques. Read dataset, preprocessing, classification, and prediction are the four pillars upon which this project stands. This program is useful for researchers and RTO managers alike. They can predict which places would have more accidents. How to foresee potential mishaps and prevent them.

Module Description

Dataset Collection In machine learning,

Simply described, a dataset is a collection of data points that can be processed and forecasted by a computer. Data collecting has to be standardized so that it may be comprehended by computers whose perceptions differ from those of humans. Data collection is just the first step, however; the data must also be cleansed, finished, and tagged with relevant tags that a computer can understand.

Data Preprocessing

Data preparation is a method used in information mining that processes raw data into a usable and efficient shape. It's a vital step in developing a model for gaining knowledge from a system. Creating a system mastery goal doesn't necessarily provide clean, well-organized data. Each statistical procedure also has to be streamlined and organized beforehand. As a result, we use a statistics-based job for this purpose.

Dataset Splitting.

The reason for this is because after the dataset is split into train and test sets, the training dataset will no longer include enough information for the model to analyze a robust mapping between inputs and outputs. In addition, the check set won't have enough data for an accurate comparison of the versions' overall performance. The partition is completed by designating 80% as the training set and 20% as the test set. Toy train: The data needed to feed the model would be included in the train set. To put it simply, our implementation would derive conclusions from this data. For instance, the data above may be used by a regression model to find gradients that would allow them to lower the value characteristic. Next, we'll use these gradients to effectively reduce value and lower expectations around information.

Test set:

The test set is where the trained and validated model is put to the test. It shows us how probable it is that our regular version will forecast anything that makes us feel bad about ourselves or the environment. To evaluate how well our model performs, we may use any number of measures.

Data Visualization

The term "data visualization" refers to the practice of displaying information visually. It simplifies the communication of information and ensures its accuracy by summarizing and presenting a vast amount of data in a simple and smooth-to-recognize manner. Records visualization use statistical graphics, graphs, information pictures, and other methods to convey data in an open and effective manner. Dots, trails, and bars may all be used to graphically convey numerical information.

IV. ANALYSIS AND DESIGN (HIGH LEVEL OR ARCHITECTURAL DESIGN)

CONTEXT DAIGRAM

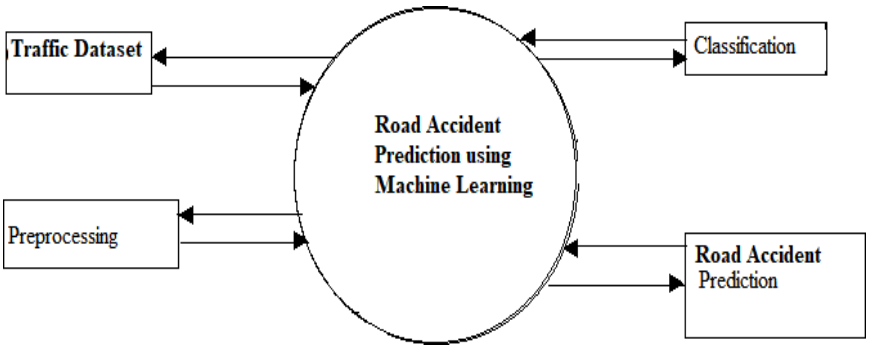

Figure 2: Context diagram

As can be seen in the diagram above, suggested methods first gather the data and then preprocess it by excluding any blanks. Then, use a classifier, such SVM or Random forest. The road accident may be predicted when categorization is used.

ACTIVITY DIAGRAM

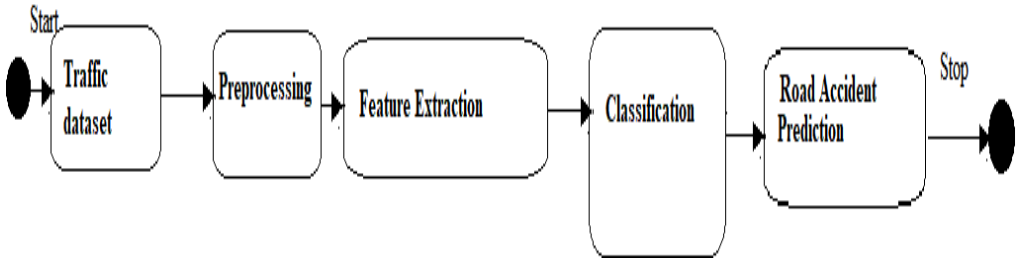

Figure 3: Activity diagram

From inception to completion, this diagram depicts the project's workflow and the procedures required to get the desired outcome..

SCREEN SHOTS

Main

Figure 4: Main

This window shows the predicted number of traffic accidents in the specified location..

Load dataset

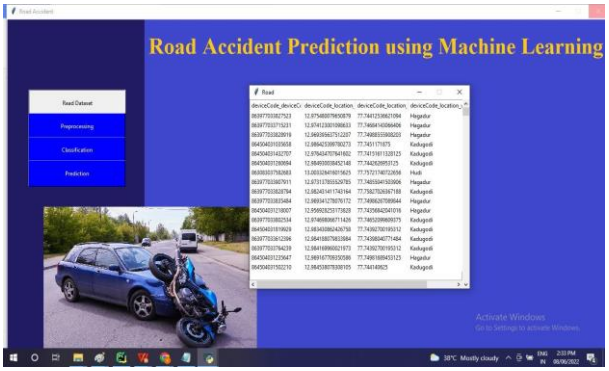

Figure 5: Load dataset

In the above figure if we click on the first model among the four modules. We can see data set of Bangalore cas dataset. It includes 7 columns and 207617 rows (records). Those 7 columns are deviceCode_deviceCode, deviceCode_location_latitude, deviceCode_location_longitude, deviceCode_location_wardname, deviceCode__alarmType, deviceCode_speed, deviceCode_time.

Preprocessing

```
[1 rows x 7 columns]
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 415234 entries, 0 to 415233
Data columns (total 7 columns):
 #   Column                          Non-Null Count   Dtype
---  ------                          --------------   -----
 0   deviceCode_deviceCode           207617 non-null  float64
 1   deviceCode_location_latitude    207617 non-null  float64
 2   deviceCode_location_longitude   207617 non-null  float64
 3   deviceCode_location_wardName    207617 non-null  object
 4   deviceCode_pyld_alarmType       207617 non-null  object
 5   deviceCode_pyld_speed           207617 non-null  float64
 6   deviceCode_time_recordedTime_$date  207617 non-null  object
dtypes: float64(4), object(3)
memory usage: 22.2+ MB
None
```

Figure 6: Preprocessing

The aforementioned picture is a rough draft. In preprocessing, we eliminate gaps in the information and reveal the whole picture. Here, we started with 415234 records, and after some preliminary cleaning, we were left with 207617 records.

Here we also using total 7 columns such as deviceCode_deviceCode, deviceCode_location_latitude, deviceCode_location_longitude, deviceCode_location_wardname, deviceCode__alarmType, deviceCode_speed, deviceCode_time.

General Statistics

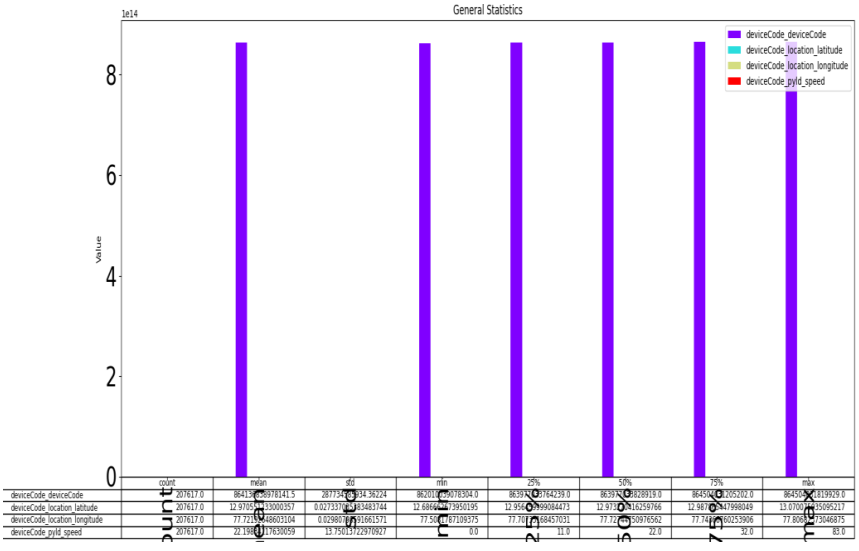

Figure 7: General statistics

The following diagram is a statistical plot of data set properties.

City map

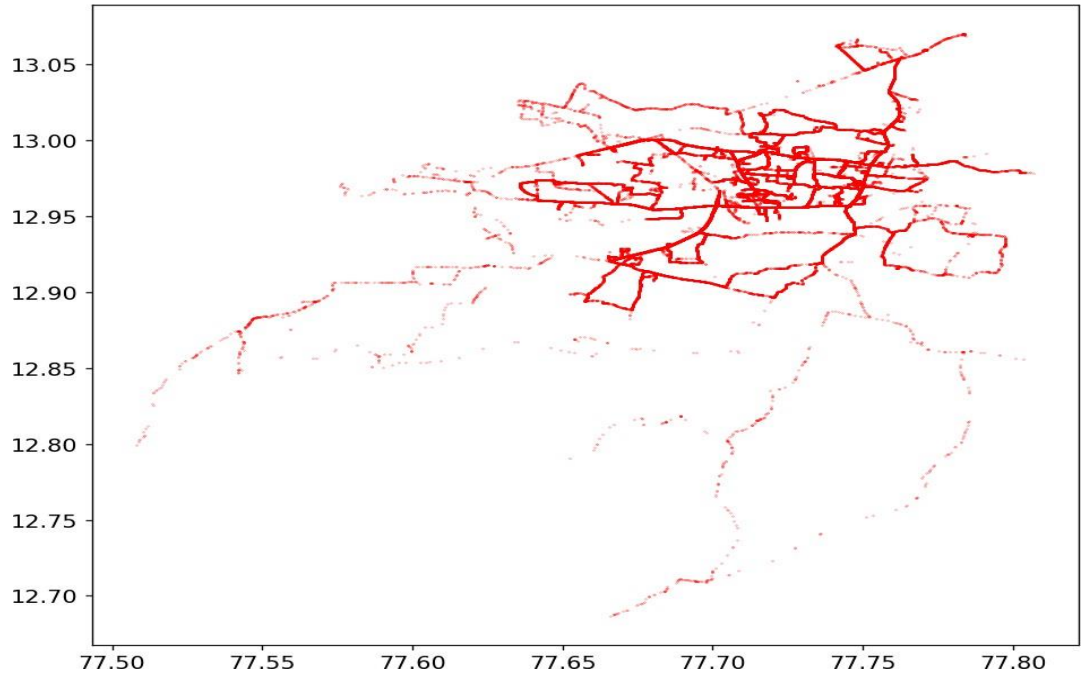

Figure 8: city map

The above figure shows the city map of Bangalore.

Speed map

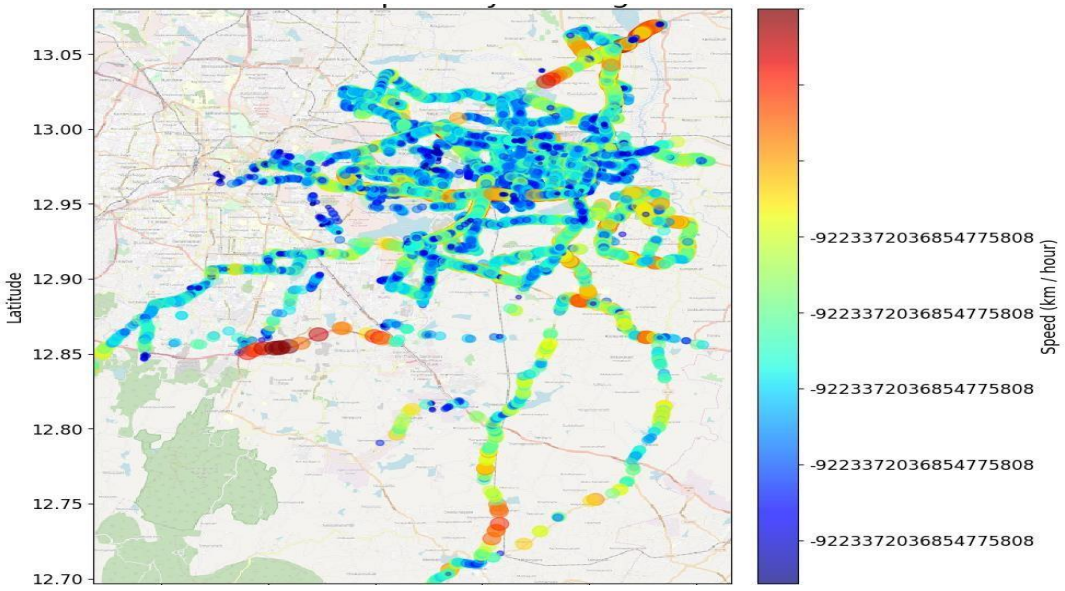

Figure 9: speed map

This diagram depicts a speed map, with different colors representing different speeds, locations, and longitudes of cars. If we use yellow as an example, we can observe that its 92 km/h speed corresponds to a latitude of 12.85 degrees. The orange zone represents the greatest speed allowed before becoming the accident zone.

Using the vehicle's latitude and the colors of its speeds, we can tell where it is and how fast it is moving.

% of Alarm Types

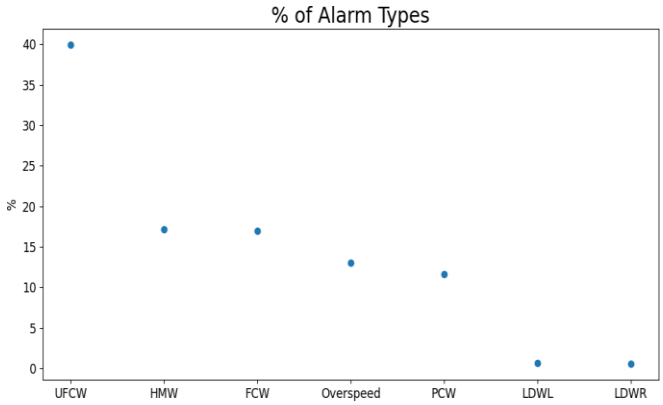

Figure 10: % of Alarm Types

Based on the data, we can see that UFCW has issued the greatest alarm alert, at 40%, while LDWR has issued the lowest alarm alert, at 0%, in the graph depicting the percentage of alarm kinds.

Distribution of speed

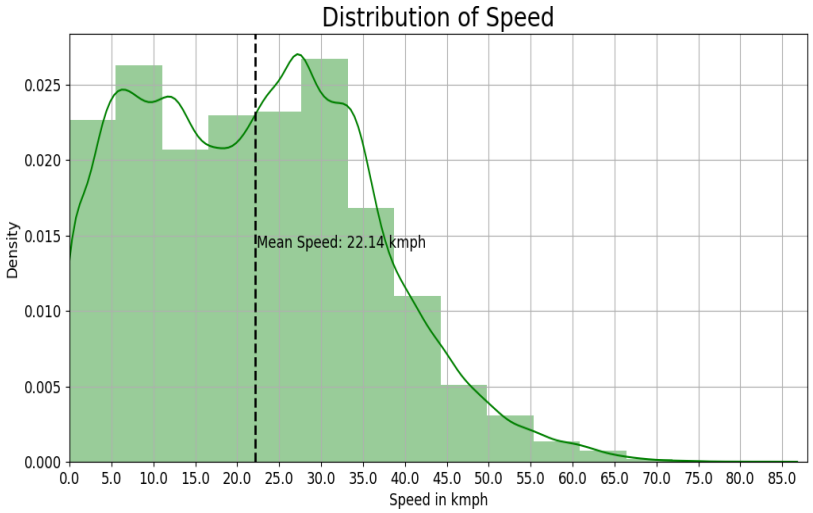

Figure 11: Distribution of speed

The following chart displays the speed in kilometers per hour using data from Bangalore, where the average speed is 22.14 kilometers per hour. Here, we see the density-dependent velocity distribution.

Accuracy

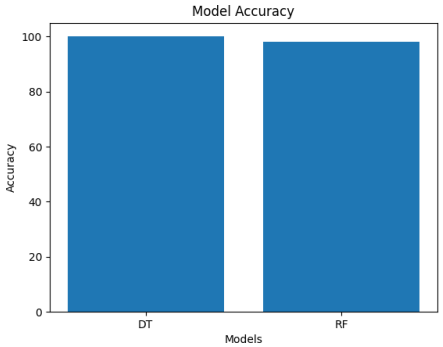

Figure 12: Accuracy

This chart is a module of accuracy; I used two classification algorithms—a decision tree and a random forest—to represent the number of accidents in Bangalore; the DT achieved a perfect 100% accuracy, while the RF achieved a respectable 98% accuracy.

V.TESTING

Testing software entails repeatedly running it while intentionally introducing new bugs. It may also mean making sure a product or piece of software is up to snuff from a technical and practical standpoint. Requirements, response to any input type, timely function execution, adequate use, portability across environments, and successful outcomes are all part of software testing. It also details the repercussions of software implementation concerns. It aids in confirming that a software product is fit for its intended use by continuously identifying flaws in the program. There are several approaches to testing, and selecting one that is workable given the constraints of time and money requires some degree of educated guesswork. Black box testing, white box testing, static testing, and dynamic testing are some of the most prevalent approaches, and typical testing levels include software testing, unit testing, component interface testing, and system testing. This section describes some of the tests that can be run and at what levels.

LEVELS

System testing is a methodical approach to software testing that involves checking out the whole thing at once. It checks to see whether they are adequate. Here, we'll break down the many phases of system testing, from integration to unit to system to acceptance.

Unit testing

The functional level of code that is being tested is defined and verified through unit testing. Developers create it because they need to manually type the codes to test whether the function works as intended. There might be several tests for a single function to accommodate the various edge and branching scenarios. The software's functionality is not tested, just whether or not the other programs are functioning properly. Detection tactics and a synchronized application form part of the software development process that aims to cut down on costs, risks, and development time. During the software development lifecycle, this task is carried out by an engineer or developer. Metrics analysis, data flow analysis, peer code reviews, static code analysis, code coverage analysis, and other approaches for verifying software quality are all part of it.

White Box testing

White box testing, also known as structural testing, clear box testing, and transparent testing, is a software testing methodology that exposes its inner workings to the outside world. Here, coders create test cases to ensure correct functionality. The developers choose their own inputs to test the code and figure out what the expected results should be. The software testing process often employs it at the unit level, but it may also be utilized at the integration and system levels. Although it can fix a wide variety of issues, it cannot identify loss conditions. At the system level, it may test the integration and subsystem path. Included are methods like "fault injection," "API testing," "mutation testing," "code coverage," and "criteria of code coverage," all of which are expressed as percentages for things like "decision coverage" (reports whether the test is true or false), "statement coverage" (shows reports on the executed number of lines to finish the test), and "function coverage" (reports on executed functions).

Black Box testing

The program is treated as a black box during black box testing. It ensures that internal functionality is being tested without the need to read or examine the source code. It will be clear to testers why this software exists. Boundary value analysis, state transition tables, testing based on specifications, testing based on models, equivalence partitioning, testing of use cases, all-pairs testing, fuzz testing, testing based on decisions, and exploratory testing are all included. The tester ensures accuracy by manipulating inputs and observing the resulting behavior. Specification-based testing ensures that the program works as expected under certain conditions. The test cases must be presented to the tester in their entirety. During black box testing, test scenarios are constructed according to predefined criteria. Included are plans, prerequisites, and specifications that drive test cases through an external software representation. It might be non-functional, but in most cases it would serve a purpose. It's crucial for smooth operation. It is not capable of handling complicated or high-risk problems. Black box testing has the benefit of requiring little to no expertise from the tester. The exam is quite easy. It is applicable to any and all phases of testing software.

Static and dynamic testing

Both static and dynamic testing are used, with the former including research and reviews and the latter involving the actual execution of the code with test cases. The compilers, source code structure, and data flow are all examined during static testing. The application is executed automatically to verify its dynamic behavior. In order to examine some of the crucial parts and applied modules, it is feasible to start before the program is fully finished. Validation is a part of both static and dynamic testing. The quality of software may benefit from both static and dynamic testing.

Test Cases

A test case is exactly what it sounds like: a hypothetical scenario used to verify the expected results of a set of actions or conditions. Test case management tools may be used with any application, whether testing is performed manually or automatically.

Ideally, each test case would verify some basic variable or action, such whether or not a given coupon code is properly applied to the intended product on an e-commerce site. As a result, a software tester may choose how to test code and features with more flexibility.

The data at hand must be sufficient to do the test. As much as possible, we want unit testing of the most essential part of our product to be painless. It might suffice to just represent the data by creating a string or object variable. You may use a dummy framework for testing if a real one is unavailable or you need it to be in a certain condition.

There are several possible outcomes that might indicate whether or not the system's criteria have been met. There are two types of test cases.

1. Positive Test Case
2. Negative Test Case

Positive Test Case: Positive test case becomes positive if that the row data is convert into a useful and efficient format.

Negative Test Case: Negative test case becomes Negative if that the row data is not converted into a useful and efficient format.

TEST CASE

Table 3: Test Case

TEST NUMBER	DESCRIPTION	EXPECTED RESULT	ACTUAL RESULT	RESULT
1	Read dataset	Read the data	Displayed data	TRUE
2	Preprocessing	Clean data from the dataset	Removed null data	TRUE
3	Classification	Perform classification based on	Performed classifications	TRUE
4	prediction	Predict accident	Predicted accident	TRUE

VI. CONCLUSION

Accidents on the road might have several origins. Using machine learning methods like decision trees, Random forests, and support vector machines, we offer a model for predicting the occurrence of traffic accidents. From this we may infer that parameters such as vehicle type, device code, device location, location latitude and longitude, speed, date, and time, and so on have a significant role in the occurrence of road accidents. The Kaggle dataset of traffic accidents was used. Our methods for predicting where accidents would occur most often were successful in 98 percent of cases. This estimate will help in analyzing and determining the flow and reasons of the accidents. Roads and bridges will be built according to its specifications so that problems of the past are avoided. The ability to predict future events will be very useful in planning how to address these challenges.

VII. FUTURE ENHANCEMENT.

This kind of quantitative research may help shed light on the causes of severe traffic collisions. There was complete consensus that changes like better lighting might make roads safer, which in turn could reduce the number of traffic collisions. Large amounts of data, such as those describing three types of accidents and weight loss circumstances and police activity at the site, might be studied in depth to provide insights that improve road safety. The occurrence of linked criteria is beyond of anyone's control, but an examination of this data will convince the government and its citizens that they need to take precautions to keep themselves safe.

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