Road Companion-Vehicle Collision Predication System

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Abstract

Nowadays, the numbers of road accidents are taking place in all countries. The main reason for road accidents are: Physiological and psychological limitations of drivers, limited performance of vehicles, improper road alignment, as well as harsh weather caused risks. Here, data mining can play an important role. With machine learning a driver can identify the accident-prone area or could get knowledge of the heavy traffic and road conditions. Based on that, the driver can take an alternative route. For constructing such kind of model, this paper has implemented a new framework of Chain of Road Traffic Incident (CRTI). This paper has implemented two steps for implementing CRTI 1) a support vector machine is utilized to classify leaving lane scene versus remaining in lane scene and 2) Gaussian-mixture-based hidden Markov models are developed to recognize accident versus non-accident pattern CRTI given the classified scene. Thus, this paper has implemented a framework for vehicle collision prediction and prevention is presented based on machine learning and pattern recognition technique.

Keywords: Chain of Road Traffic Incident (CRTI), collisionprediction, HMM, SVM, vehicle safety.

Introduction

Background and Basics

Nowadays Due to traffic and collision, fatalities and injuries remain high. There are main four factors that cause roadway accidents such as driver, vehicle, roadway and environment. Physiological and psychological limitations of drivers, limited performance of vehicles, improper road alignment, as well as harsh weather caused risks (such as poor visibility and slippery road) may altogether lead to a roadway accident. To improve roadway safety, earlier works mainly focused on "passive" safety measures (to reduce injury or property damage) by improving the performance of vehicles; whereas recent works conducted more research on "active" safety strategies (to realize collision avoidance, such as pre-crash and auto-brake systems) by actively identifying drivers' behaviours as well as risk prediction for a future time is still kinematics and dynamics-based, where much interaction information may not be captured in more complex situations such as when the driver conducts a switching lane maneuver or other complicated handling maneuvers. Thus practical applications of such models are limited.

This paper presents a framework of accident prediction with a new perspective. First, the new framework of Chain of Road Traffic Incident (CRTI) is proposed, in which the observed vehicle movement features are viewed as road traffic system's external "performance" that, in essence, reflect the internal "health states" (safety states) of the system at a specific time. A two-stage modeling procedure of CRTI is then proposed using scenario-based strategy: 1) a support vector
machine is utilized to classify leaving lane scene versus remaining in lane scene and 2) Gaussian-mixture-based hidden Markov models are developed to recognize accident versus non-accident pattern CRTI given the classified scene.

Problem Definition

Driver, vehicle, roadway and environment are the main factors that increase roadside accidents. Physiological and psychological limitations of drivers, limited performance of vehicles, improper road alignment, as well as harsh weather caused risks (such as poor visibility and slippery road) may altogether lead to a roadway accident.so there was needed to implement a system which will analyze the area and give alternate route to diver to avoid accident based on the traffic analysis and environmental conditions.

Scope Statement

This project is useful in vehicular applications in order to avoid traffic congestion and road accidents. Traffic congestion causes air pollution and wastage of fuel. Thus using the proposed system we can avoid these issues. By avoiding accidents, human life can be saved and also fatal injuries can be avoided.

System design:

DFD0 Diagram

Fig: DFD0 Diagram

DFD1 Diagram

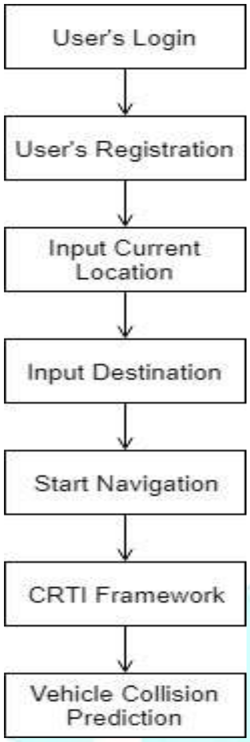


Fig: DFD1 Diagra

Use-Case Diagram

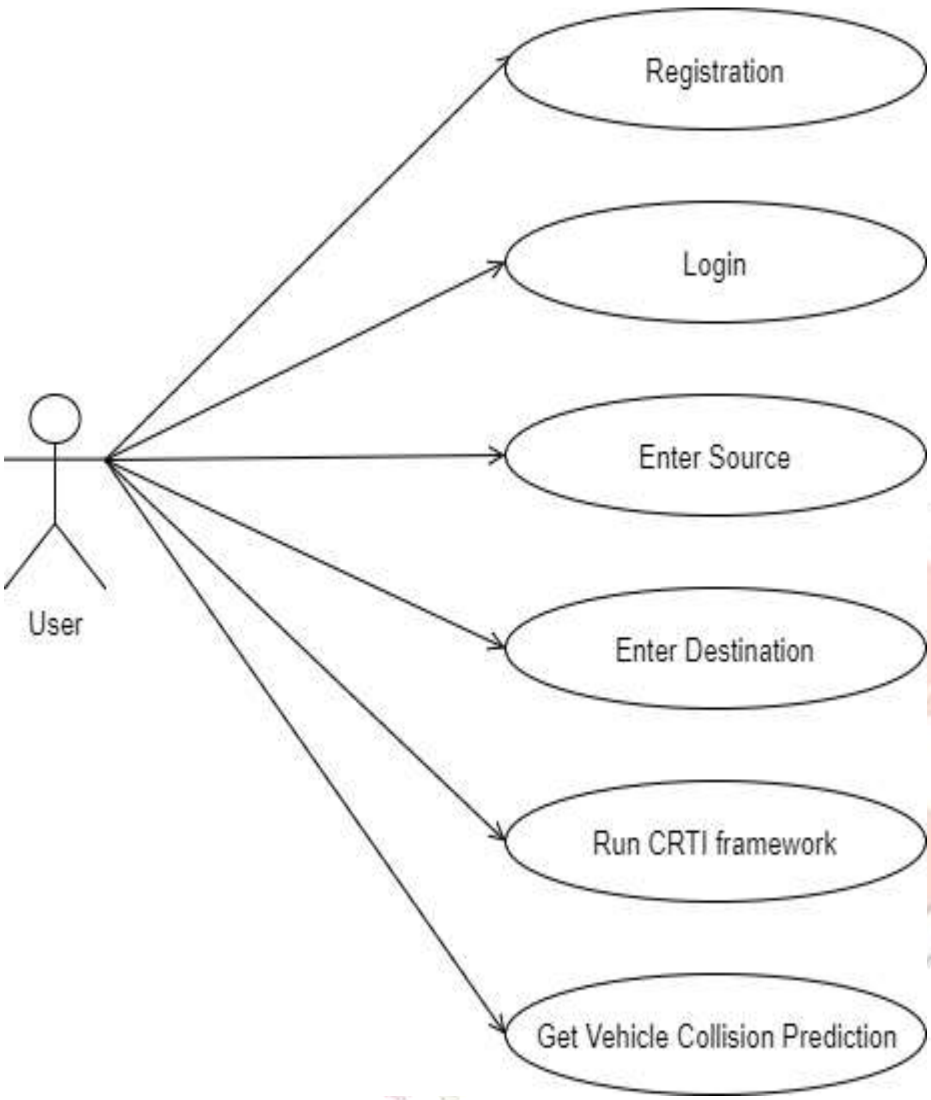


Fig: Use case Diagram

Activity Diagram

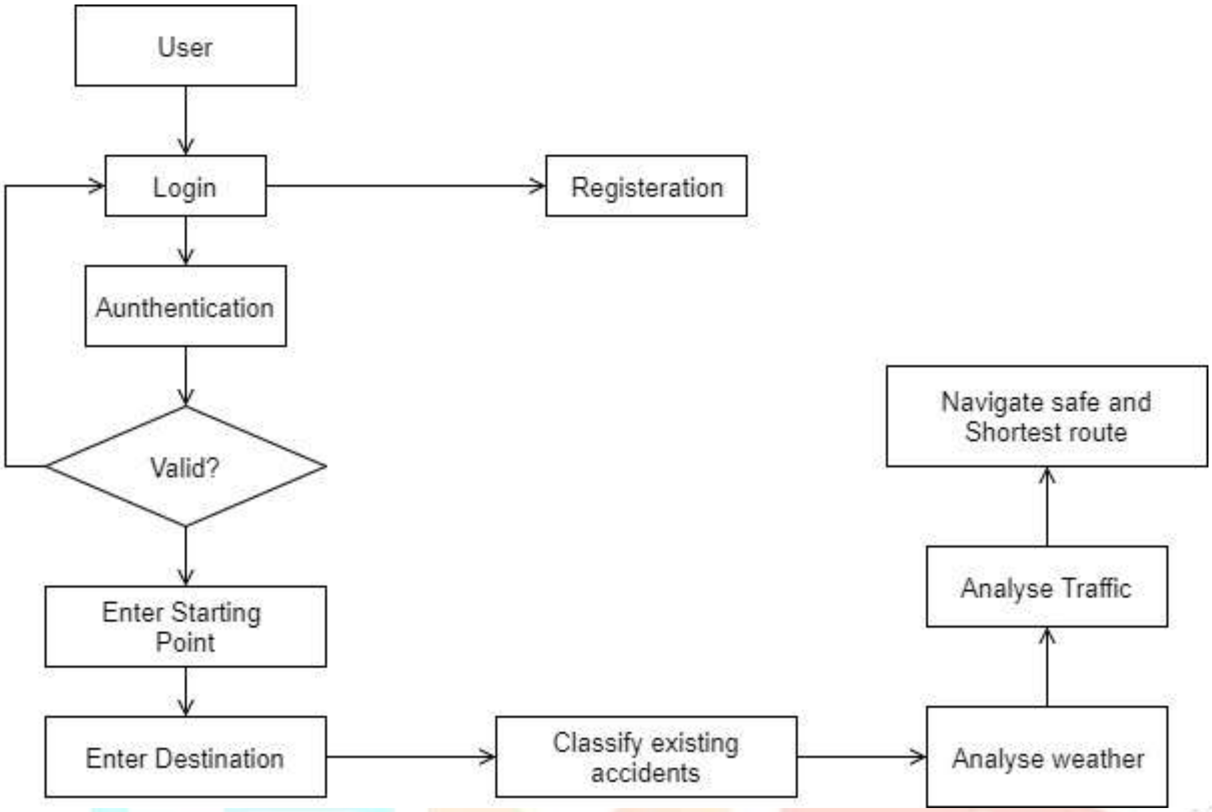


Fig : Activity Diagram

Architecture Diagram

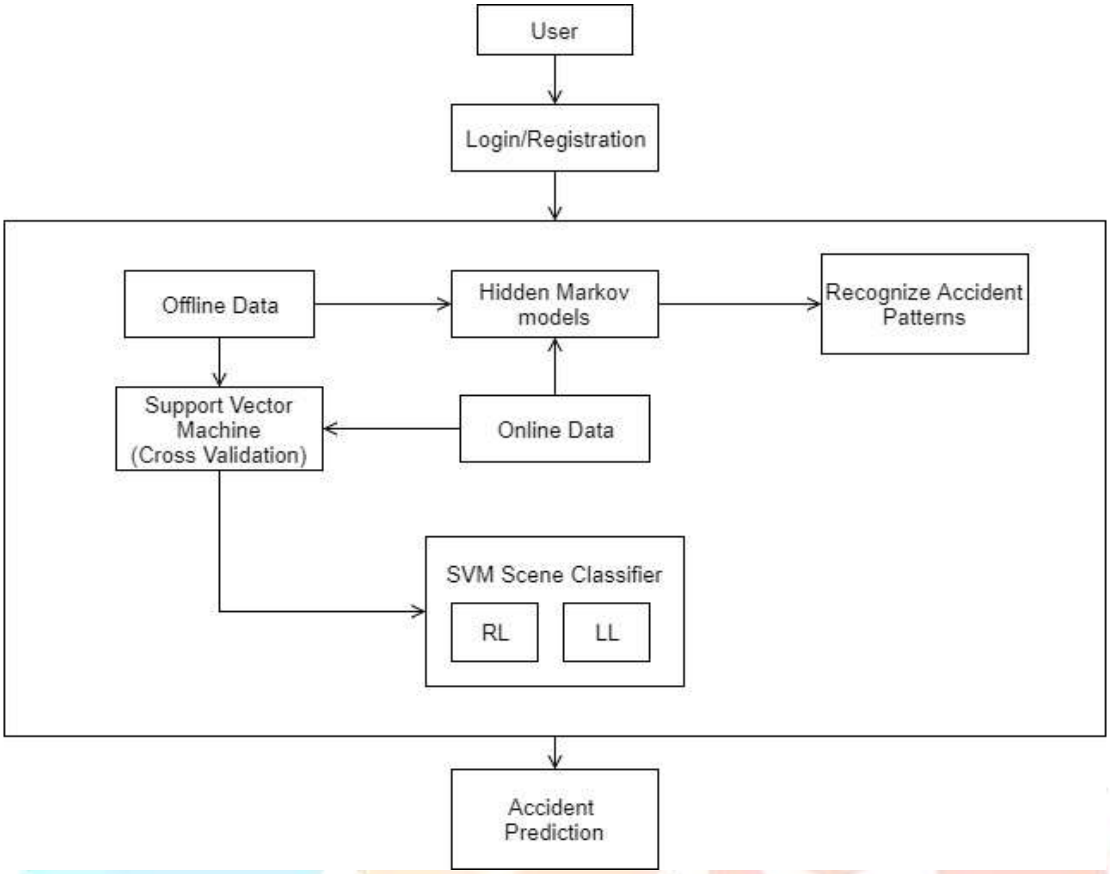


Fig : Architecture Diagram

Class Diagrams

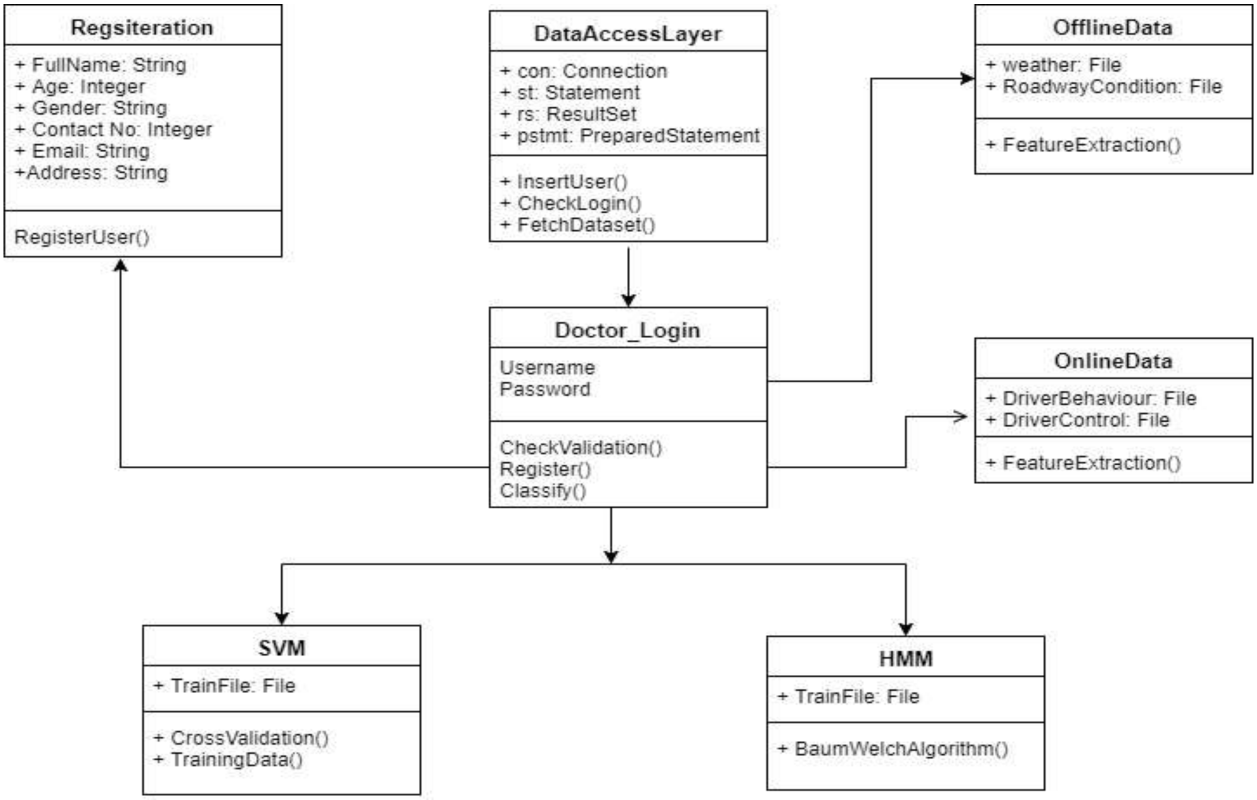


Fig Class Diagram

ERDiagrams

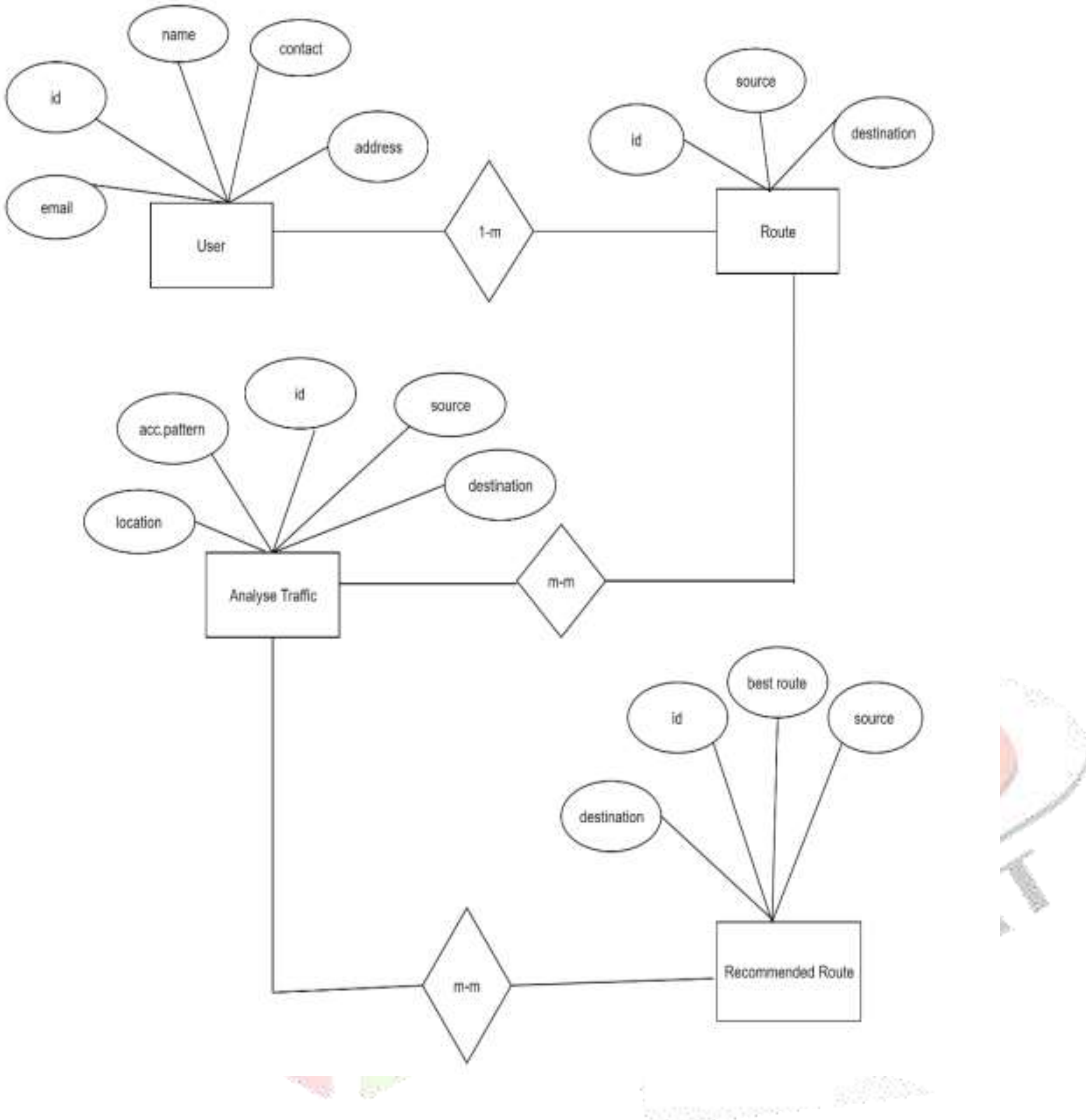


Fig : ER Diagram

Sequence Diagram

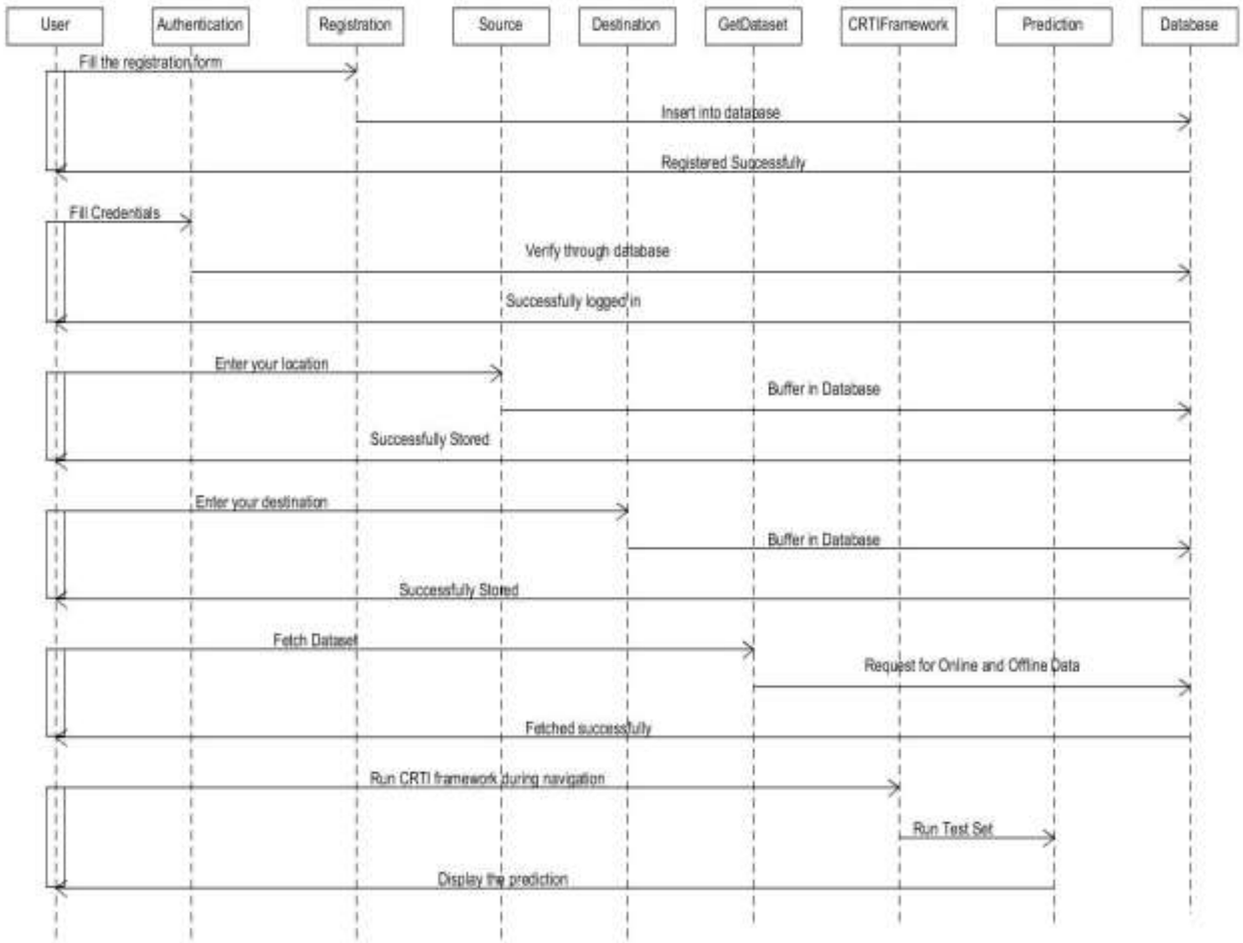


Fig : Sequence Diagram

State Transition Diagrams

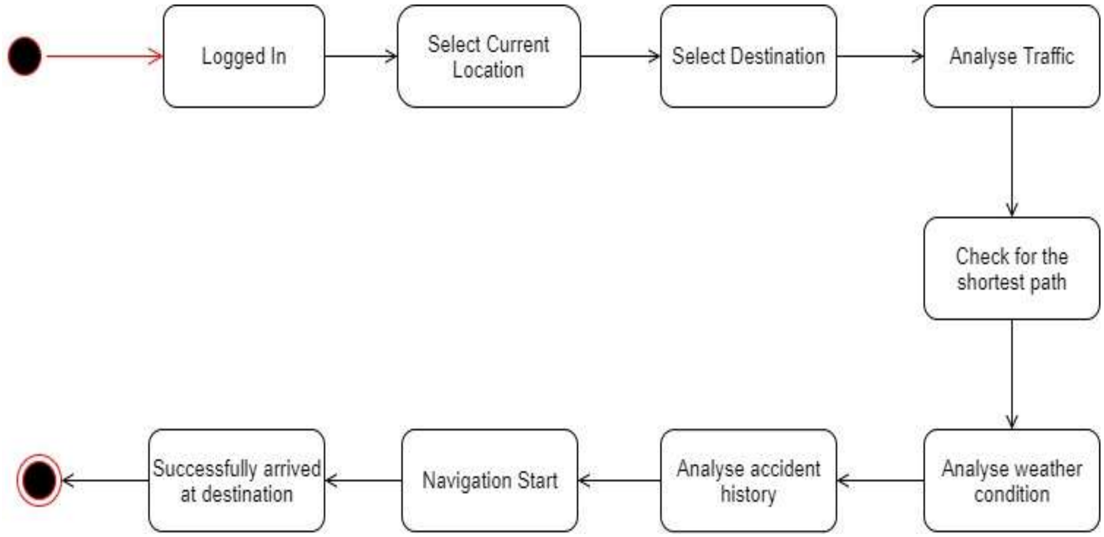


Fig: State Diagram

Deployment Diagrams

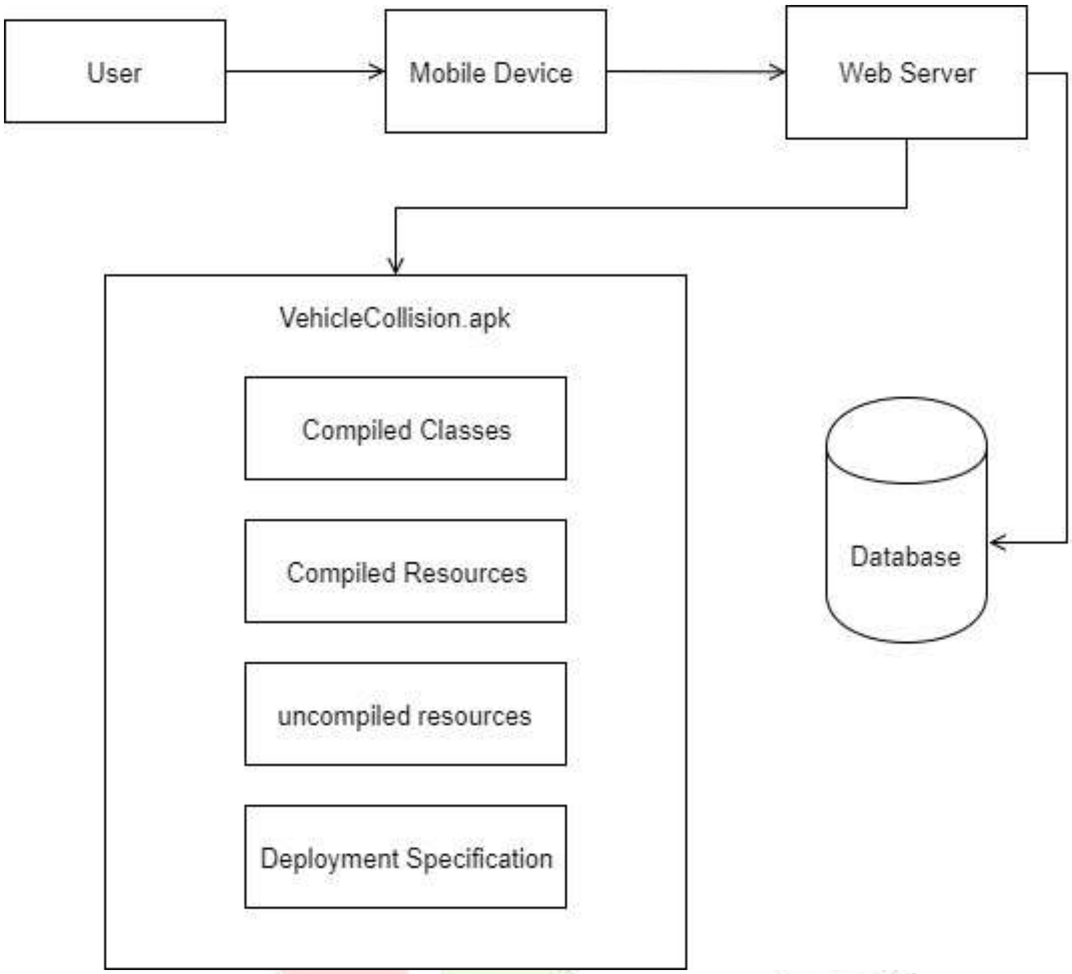
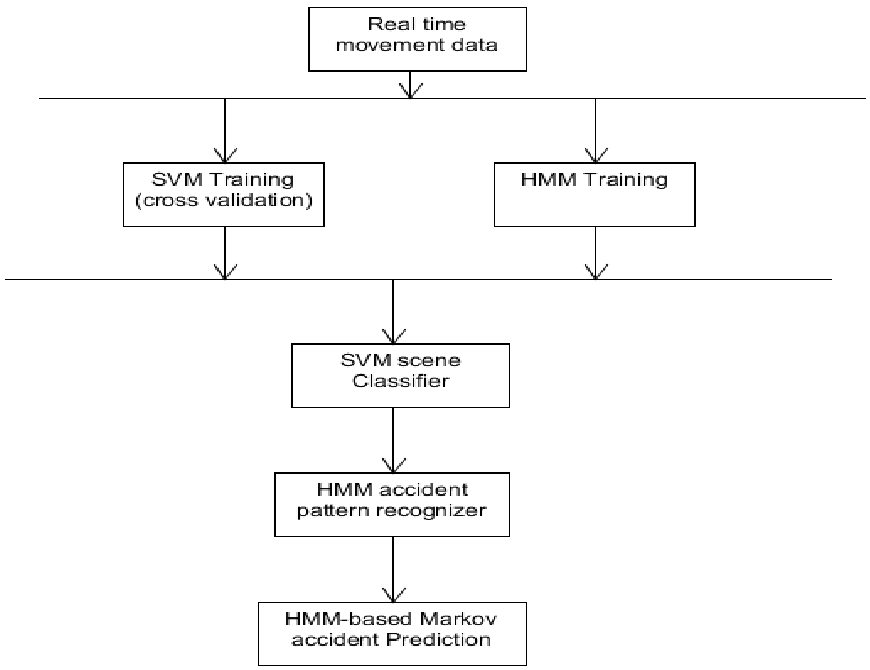


Fig : Deployment Diagram

SYSTEM ARCHITECTURE



This system contains the following steps:

1. Firstly, we need to feed the data to the system. We need to access the GPS of user's phone and plot the data point as to where the vehicle is moving the geographical map. This will be generated dynamically.
2. Our second step would be training the data by combining two classifiers called Support Vector Machine (SVM) and Hidden Markov Model (HMM).
3. Next step of the system is to train the movement of other vehicles in that area to catch the traffic analysis of the system using SVM scene classifier.
4. Also, we need to also detect the accident-prone area in the upcoming route of the vehicle using HMM accident pattern recognizer.
5. Lastly, the system will predict the accident-prone route and will suggest for another route to the user.

Related Works

Proposed *Chain of Road Traffic Incident* system. Before road traffic accident occurs ,it generates a seriesof incidents happened which together evolved into the final accident stage.it helps to identify and recognize accident at an early stage. CRTI incidents may include driver's manipulation of vehicles such as acceleration, deceleration, and lane changing; as well as real-time inputs from roadway and environment. Such incidents could either result in a crash or a non-crash (i.e., an accident CRTI vs. a non-accident CRTI) scenario with different underlying evolving paths. In the regime of vehicle-to-vehicle collision, a typical CRTI incident could be described using a collection of driver, vehicle, roadway and environment "behaviours" at a specific time.

HYPOTHESES

1- System helps to identify and recognize accident at early stage.
2- User will select source and destination location as aninput. System will predict traffic weather and collision and will suggest the best route.
3- Two algorithms i.e. Support Vector Machine and Hidden Markov Model are proposed to predict traffic.Weather and collision and suggest the best route.

DESIGN OF THE STUDY

Implementation phase focus over system design objectives. Software implementation is the process of designing, writing, testing, debugging / troubleshooting, and maintaining the source code of computer programs.

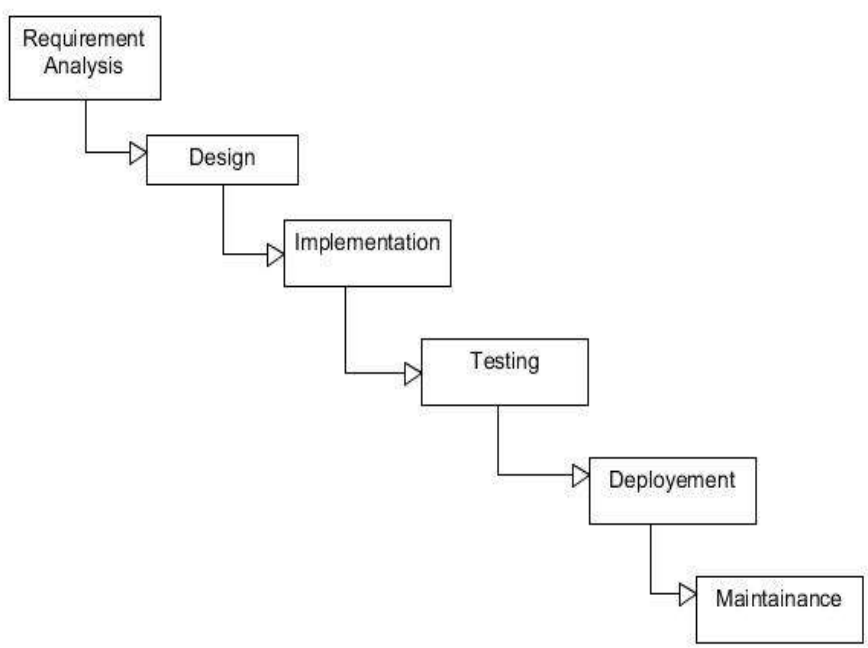


Fig : Software Development Process

Implementation of system is divided into 7 main modules.With the help of Register and Login module user will register and login into the system.User will select source and destination location as an input. System will predict traffic weather and collision and will suggest the best route for that system uses weather, collision and traffic modules. Fore predication system uses Support Vector Machine and Hidden Markov Model.

SAMPLE OF THE STUDY

This paper has implemented a new framework of Chain of Road Traffic Incident (CRTI). This paper has implemented two steps for implementing CRTI 1) a support vector machine is utilized to classify leaving lane scene versus remaining in lane scene and 2) Gaussian-mixture-based hidden Markov models are developed to recognize accident versus non-accident pattern CRTI given the classified scene. Thus, this paper has implemented a framework for vehicle collision prediction and prevention is presented based on machine learning and pattern recognition technique.

TOOLS UDED

S/W System Configuration: -

- Software Requirements
  1. Eclipse.
  2. SQLite.
  3. GPS Sensors.
- **Hardware Requirements**
  1. Laptop/PC with minimum 4 GB RAM.
  2. Mobile.
- **Languages used**

Front End – Android Java

Back End – SQLite

STATISTICAL TECHNIQUE USED

We have developed Login and Registration which manages the user profiles. User has to enter the source and destination address after login into the system. Then system will recommend the best route and predict the weather and collision. System uses two algorithms for predication these are Support Vector Machine and Hidden Markov Model (HMM).

Algorithms

Algorithm 1: Support Vector Machine (SVM)

Step 1: Input data is taken for training purpose.

Step 2: Training is done using Support Vector Machine (SVM) algorithm.

Step 3: Whereas the SVM helps to train the movement of other vehicles in that area

To catch the traffic analysis of the system using SVM scene classifier.

$$f(y) = \text{sgn}[\sum_{i=1}^{N} a_i l_i K\left(y_i, y\right) + b]$$

Notation	Meaning
LL	Leaving Lane
RL	Remaining in Lane
(y_i, l_i), i = 1, 2,. . . , N	instance-label pairs (N is the number of instances)
y_i	Vehicle movement data
$l_i \in \{-1, +1\}$	Represent their scene
$K(y_i, y)$	solution to the optimization
b	bias term
$f(y)$	$f(y)$=+: vehicle LL Scene , $f(y)$= - : vehicle RL Scene

Step 4: End of this algorithm and next HMM algorithm is used for further process.

Algorithm 2: Hidden Markov Model (HMM).

Step 1: System analyses need of detecting accident-prone regions.

Step 2: So, the system detects the accident-prone area in the upcoming route of the vehicle using HMM accident pattern recognizer.

Step 3: Set of states are taken under consideration as followsλ = {_, A, c, μ, U}, I = {0,1} : To identify an accident CRTI vs. a non-accident CRTI (Chain of Road Traffic Incident).

Notation	Meaning
A	State transition matrix
c	Driver State
μ	mean of observations
U	Dimension of categorical observations.
i	Instance

Step 4: Accident-prone ranges are detected

OUR APPROACH

Chain of Road Traffic Incident (CRTI)

We have proposed a *Chain of Road Traffic Incident* (CRTI) concept . The concept of CRTI originates from Heinrich causal chain theory.

Before road traffic accident occurs, a series of incidents happened which together evolved into the final accident stage (i.e., the chain of road traffic incidents leading to traffic accident.

CRTI helps to identify and recognize the accident at an early stage .it helps to avoid accidents by giving early warning or intervention to the driver.

Specifically, CRTI incidents may include driver's manipulation of vehicles such as acceleration, deceleration, and lane changing; as well as real-time inputs from roadway and environment. Such incidents could either result in a crash or a non-crash (i.e., an accident CRTI vs. a non-accident CRTI) scenario with different underlying evolving paths. In the regime of vehicle-to-vehicle collision, a typical CRTI incident could be described using a collection of driver, vehicle, roadway and environment "behaviours" at a specific time. The occurrence of CRTI incidents would lead to different safety states of the system (hidden states that cannot be directly observed), while each state is characterized by a set of vehicles movement features like two adjacent vehicles' relative velocity, relative heading angle, and relative position (observed features). Compared with the complexity and uncertainty in identifying incidents from respects of human behaviours and environment variations, vehicle movement features are more easily retrievable and accurate in essence. Thus, in the paper, the evolving process of CRTI is studied through its external movement feature observations instead of incidents themselves.

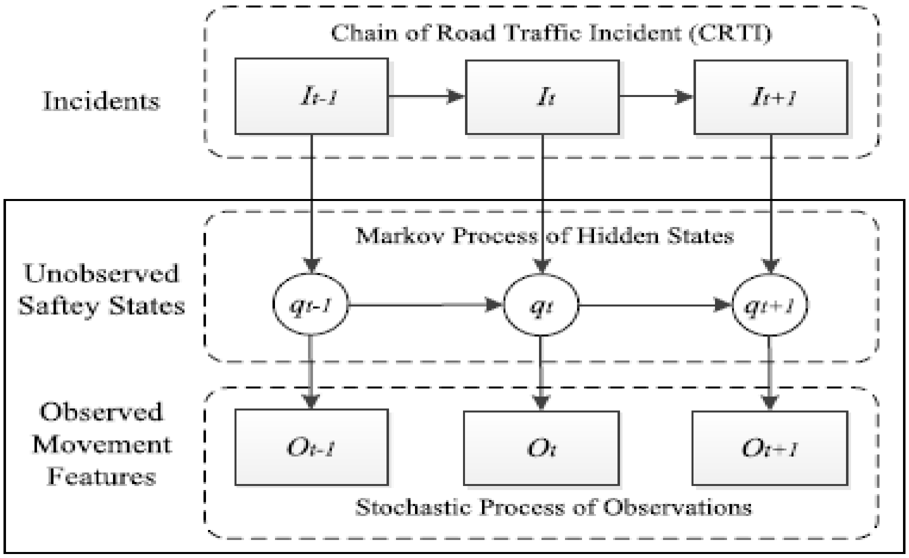


Fig: Chain of Road Traffic Incident (CRTI)

Experiment Result:

Results demonstrate that a proposed technique is able to predict the collision, weather and the route accurately, proposed algorithmsoutperform in terms of effectiveness and efficiency.

The proposed concept *Chain of Road Traffic Incident* (CRTI) provides a framework for accident predication.

Proposed system is implemented using two algorithms , these are SVM and HMM .The concept makes use of assumptions in thetheory of HMM, where observed vehicle movement featuresare viewed as road traffic system's external "performance"at a specific time, which in essence reflect the internal"health states" (safety states) of the system.

A scenario-basedtwo-stage modeling procedure of CRTI is constructed, including1) *the 1st stage scene classification:* SVM is utilizedto classify Leaving Lane (LL) scene versus Remaining inLane (RL) scene; and 2) *the 2nd stage accident patternrecognition:* Gaussian-mixture based HMMs are developed torecognize accident vs. non-accident pattern CRTI given theclassified scene.

Compared with existing collision prediction methods,the CRTI framework could account for more complex and unrecognized traffic factors by modeling accident vs. nonaccidentpatterns based on machine learning, which enables theutilization of the uncovered driver-vehicle-road-environmentinteraction pattern (instead of mere motion trends of surroundingvehicles) for future risk prediction. Also, the CRTI frameworkis scenario-based and applicable to different accidentscenarios. Moreover, a recognized accident pattern CRTI couldprovide a new foundation for investigating strategies of earlywarning/intervention in driver assistance systems.

Future scope:

Compared with existing collision prediction methods, the CRTI framework could account for more complex and unrecognized traffic factors by modeling accident vs. nonaccident patterns based on machine learning, which enables the utilization of the uncovered driver-vehicle-road-environment interaction pattern (instead of mere motion trends of surrounding vehicles) for future risk prediction. Also, the CRTI framework is scenario-based and applicable to different accident scenarios. Moreover, a recognized accident pattern CRTI could provide a new foundation for investigating strategies of early warning/intervention in driver assistance systems.

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Priyanka Potabatti

Kshitija Khandagale

Akshay Kolhe

Abhishek Jadhav

Conclusion:

This paper has proposed a framework called *Chain of Road Traffic Incident* (CRTI) where observed vehicle movement features are viewed as road traffic system's external "performance" at a specific time, which in essence reflect the internal "health states" (safety states) of the system. A scenario-based two-stage modelling procedure of CRTI is constructed, including 1) *the 1st stage scene classification:* SVM is utilized to classify Leaving Lane (LL) scene versus Remaining in Lane (RL) scene; and 2) *the 2nd stage accident pattern recognition:* Gaussian-mixture based HMMs are developed to recognize accident vs. non-accident pattern CRTI given the classified scene.

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