Real Time Driver Somnolence Alert System Using Web Application

R. Lakshmi Devi, S. Vaishali, S. Vishalini

Abstract--- ***The number of accidents that has occurred in India due to driver fatigue has been alarmingly high due to continuous driving, throughout day and night. According to the statistical data of 2017, approximately 80,000 deaths are occurring each year and 1.47 lakhs of passengers with an accuracy of about 80% in a non- real time implementation and intrusive method based detection were found to be drowsy drivers. The aim of our project is to detect the driver's drowsiness with the help of Computer Vision based technology and to alert the driver through a stimulator and a voice playback system. This project describes an efficient method for drowsiness detection by three well defined phases. These three phases are facial features detection, the eye tracking and yawning detection. Once the face is detected, the system is made illumination invariant by segmenting the skin part alone and considering only the chromatic components to reject most of the non face image backgrounds based on skin colour. The tracking of eyes and yawning detection are done by correlation coefficient template matching and it is processed in the MATLAB using Support Vector Machine Algorithm and the Object Detection library to segregate face and non face regions and disintegration the left eye, right eye and mouth images from the face region to analyze the three different facial parameters separately. If the reference template matches with the current frame in real time then the speed of the engine is reduced automatically and the driver is alerted using the playback system and the vibrator under his seat. In addition to this, the driver's sleep status will be updated on the travel agent's personal login. The entire process such as detecting, processing, alerting takes place at the faster rate and the driver is alerted within a second. This method gives an accuracy of about 99% so that the driver fatigue is to be detected accurately. It can be translated into a mobile app to provide additional information to the passengers such as vehicle information, live vehicle tracking, driver details and the time of arrival to reach the destination.***

Keywords--- Computer vision, Support vector machine algorithm, Vibrator, Automatic speed control, Playback system, Linear regression, Ada Boosting algorithm, Facial Adaptive coding.

I. INTRODUCTION

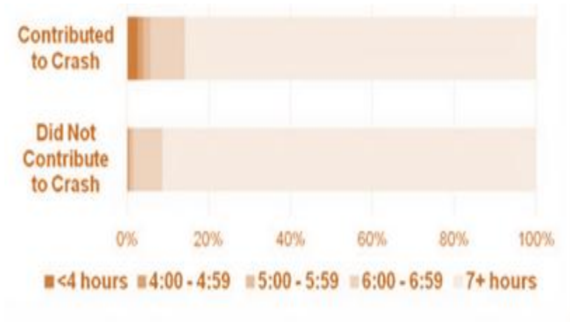
In this modern world, the number of vehicles and the accidents are increasing day by day. Generally the accidents that occur due to drivers falling asleep during driving as they are expected to work overtime without proper rest and sleep due to which they involuntarily dose off. This not only affects the driver but is also a threat to all the other riders which results in crashes within a second. It becomes a dangerous situation when drivers often lose control over a vehicle moving in a constant speed over a large distance. In India hundreds of people die in road accidents which take place between 2 A.M to 5 A.M.

According to the symptoms studied by the sleep foundation, these where the features commonly noted among drowsy drivers:-

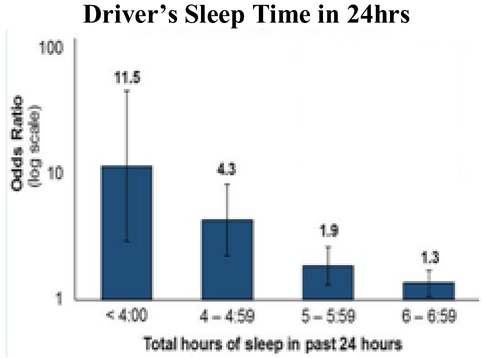
- Difficulty focusing, frequent blinking or heavy eyelids as they has a long attention lapse
- Yawning repeatedly
- Decrease in accuracy of response and slower response to stimuli

Effects of sleep deprivation and performance on attention and performance were greater during the early hours of morning has lead to the following:-

- 7 % of all the crashes where a vehicle was towed
- 13 % of all the crashes resulting in hospital admission
- 21 % of all fatal crashes



Driver's Sleep Time in 24hrs



Sleep VS Car Crash

II. EXISTING TECHNOLOGY

Initially the blink rate of the driver has been detecting by image processing technique to detect the drowsiness of the driver but it resulted in the accuracy of 85%.

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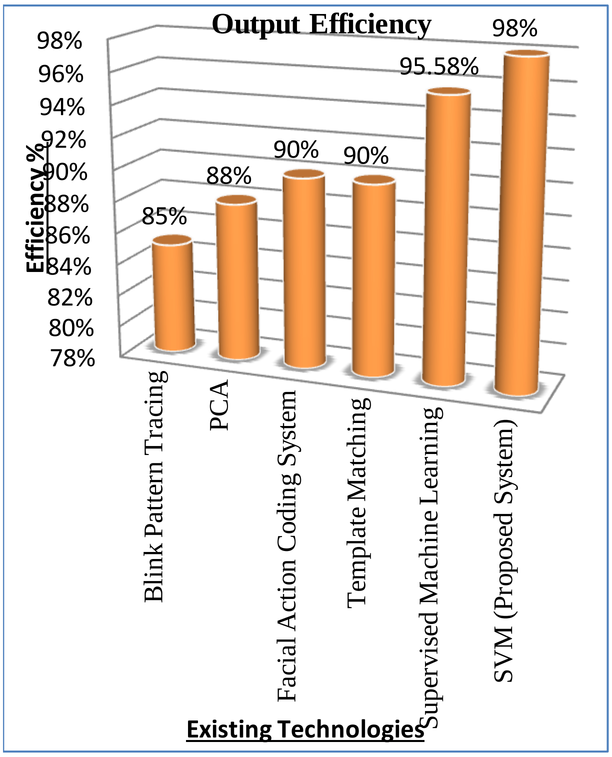
In the existing systems noticeable weakness of these systems is that they don't respond in real time to the environmental changes. Another method to check the driver fatigue is monitoring the physical condition and facial expressions of the drivers, which wireless sensor networks are unable to process and transmit these information with adequate precision and a good recall. The popularity of HOG SVM lies with object detection and not with the eye blink detection. Another method has a smart watch and a headband containing sensors to identify the drowsiness. But this is limited by the choice of the driver who might wear it. After which a system was developed to measure EEG, ECG and EOG with the help of electrodes to detect the drowsiness but the driver has to wear a device. Its disadvantage is that it an it is an intrusive method. At recent times, the driver drowsiness was detected using open CV method with the 90% accuracy. The main aim of our project is to detect the drowsiness of the driver by using Computer Vision technology through which the facial features were captured and the support vector machine was trained using linear regression and Ada boosting them before comparing the detected frames with those of the captured frames. The machine gets trained to the driver's face automatically and the speed of the engine is controlled automatically by slowing down the vehicle speed into three different intermediate speed levels giving an accuracy of 98% of our proposed system.



Efficiency of comparison between existing technologies

III. COMPUTER VISION TECHNOLOGY

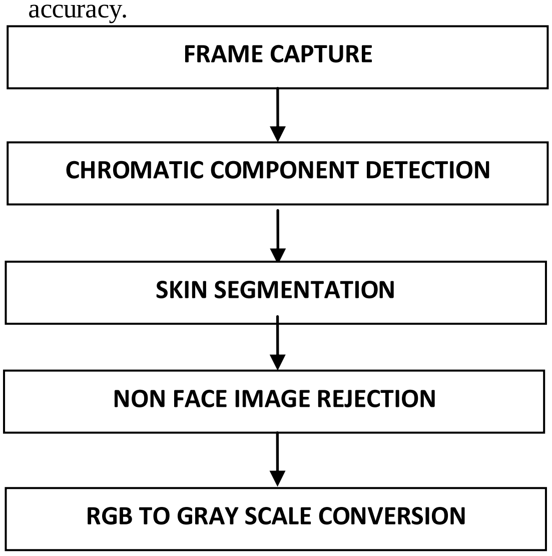
The Computer Vision technology is a part of image processing. In image processing method the input and the output are images. The image processing includes analysing and manipulating the digital image to improve the quality. The machine uses several algorithms to process the image. But the computer vision technology uses image processing algorithms to process the image like humans and categorises what it sees It also detects analyses and process the digital image and so that it can be used in the real world environment to detect the human faces.

Light Illumination

- When the natural light focuses on the driver's face, the light is partially absorbed and partially reflected from his face during drowsiness detection. The webcam senses a part of the light inside the vehicle when the reflected light from the drivers face passes through the web camera. The lens refracts the light to the sensors that transform the sensed visible light into an electrical voltage form. The CMOS array based webcam has a group of sensors having an array size of 1280 x 720 pixels. The intensity of the light from the output determines the strength of the voltage.

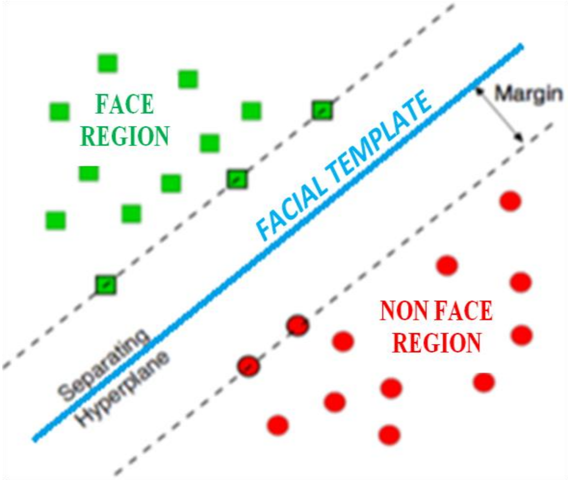
Skin Detection Algorithm

- The system is made illumination invariant by segmenting the skin part alone and considering only the chromatic components to reject most of the non face image backgrounds based on skin colour. This helps to eliminate the non- face region from the face region. Drowsiness was detected using a camera near the dashboard. The proposed algorithm detects the driver's face in the image and estimates the landmarks in the face region. In order to detect the face, the proposed algorithm uses an Ada Boost classifier based on the Modified Census Transform features and adaptive facial coding scheme by regressing Local Binary Features for face landmark detection. Eye states (closed, open) are determined by the value of Eye Aspect Ratio which is easily calculated by the landmarks in eye region and can run on the embedded device. We obtain the datasets using video records from the infrared camera which is used the real-field. The proposed algorithm tested in the target board (i.mx6q). The results show that the proposed algorithm outperformed in the speed and accuracy.

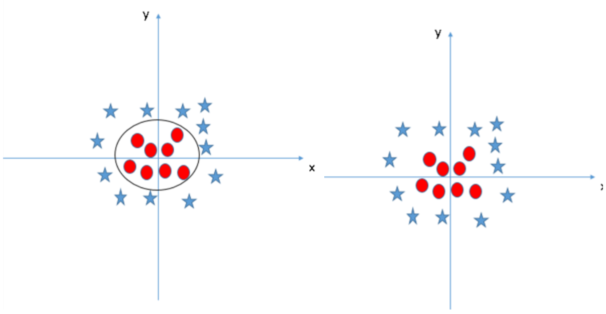


IV. MACHINE LEARNING

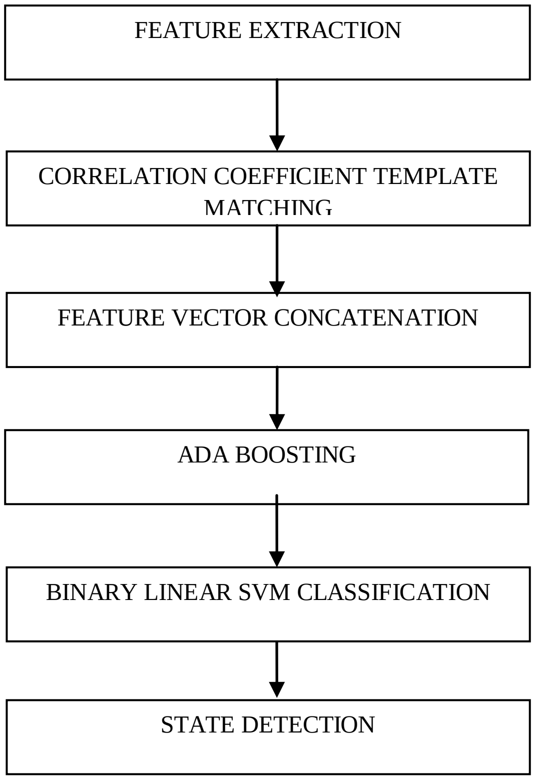
Supervision machine learning algorithms such as SVM and Linear regression is applied on the three extracted feature. The tracking of eyes and yawning detection are done by correlation coefficient template matching. Support Vector Machine algorithm is a type of supervised machine learning algorithm. The machine learning algorithms in general used by the computer to interpret like human. The two types of machine learning algorithm are supervised machine learning algorithm and non- supervised machine learning algorithm. In supervised machine learning algorithm, the machine is given a set of data which are labelled so that the machine gives the correct output with reference to the label.



For example dark regions in face are labelled as eyes and brighter regions in face are labelled as cheeks. If the image is given, the machine would be able to identify the eye region correctly. In non-supervised machine learning algorithm, the set of data are not labelled and the information is grouped by their similarities, patterns, etc. In the support vector machine algorithm, each data is plotted as points in n-dimensional space. The data are classified into two classes with the help of a hyperplane. Choosing the right hyperplane is another problem but there are two thumb rules for choosing a hyperplane. The first rule is that the hyperplane should clearly separate the two classes. The second rule is that the margin between the two classes should always be the maximum.



Suppose if the hyperplane cannot be drawn between the two classes, then a kernel function is used to separate the two classes. The kernel is a mathematical function used to transform two-dimensional points into n-dimensional space so that the hyperplane can be built. Here, we take kernel function as x2+y2=z2, a circle equation to build the hyperplane a circle.



V. PROCESS

In the proposed system, the computer is trained in the real time using computer vision technology. By using this technology, this system can be brought into a real time application with low cost and effort.

The system is made illumination invariant by segmenting the skin part alone and considering only the chromatic components to reject most of the non face image backgrounds based on the skin colour.

This system is highly efficient in alerting and detecting the driver drowsiness.

This system does not require any wearable devices and sensors and also works well under illumination conditions. The driver's face is continuously monitored using the webcam which is fixed in front of the driver. The captured video is converted into frames.

The webcam captures 32 frames per second and nearly 10 to 15 frames are used to detect the drowsy state of the driver.

Before this process, the database is created to store the mouth, eye opening, and eye closing features. The generated frame is compared with the features in the database. SVM classifier descriptor is compared the dataset of open and close position of eye and mouth with the test set to give the condition of person. If the features are matched, the driver s in the drowsy state and is alerted by controlling the speed of the vehicle, by turning ON the talkback system and also by turning on the vibration motor. The entire process is done in the MATLAB.

The libraries are included in MATLAB to compare the facial template and database is also created to store the left eye, right eye and mouth features.

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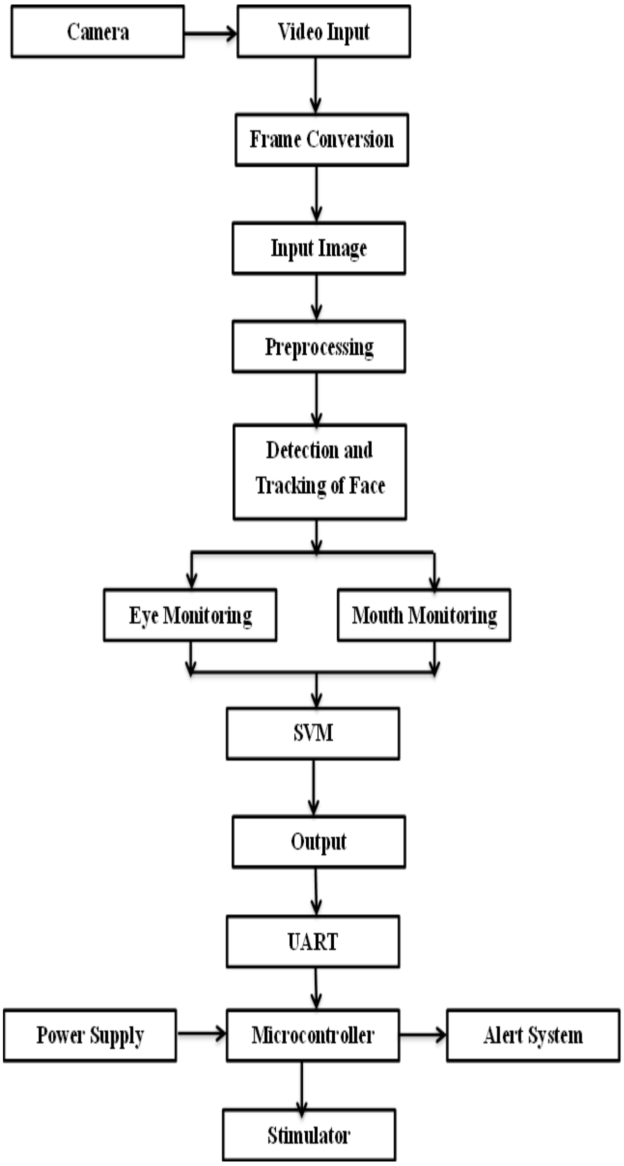
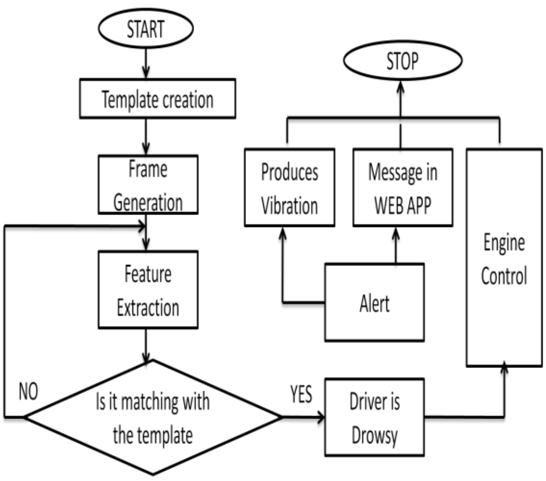
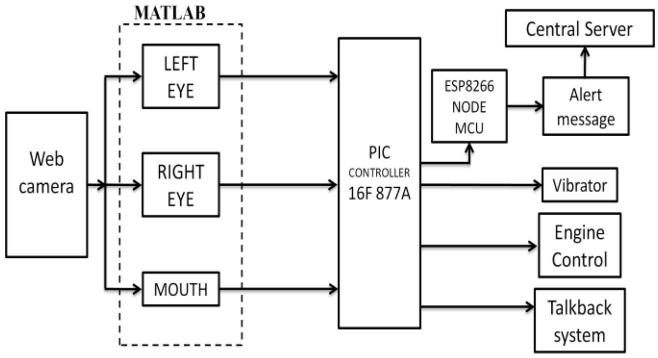
Process Flow



Flowchart



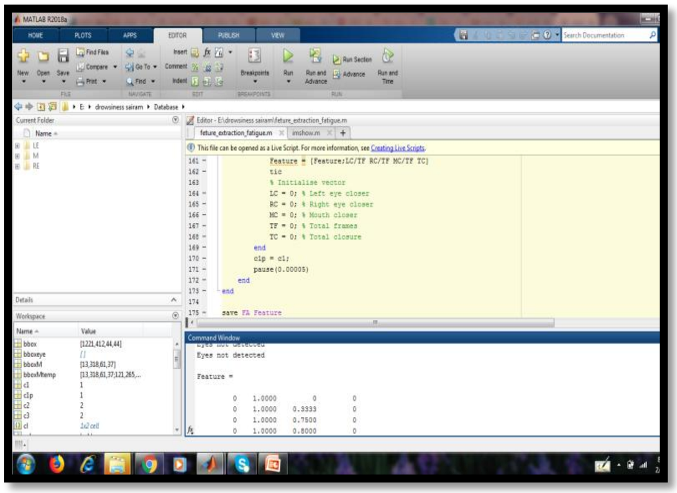
Block Diagram



VI. EXPERIMENTAL ANALYSIS AND RESULTS

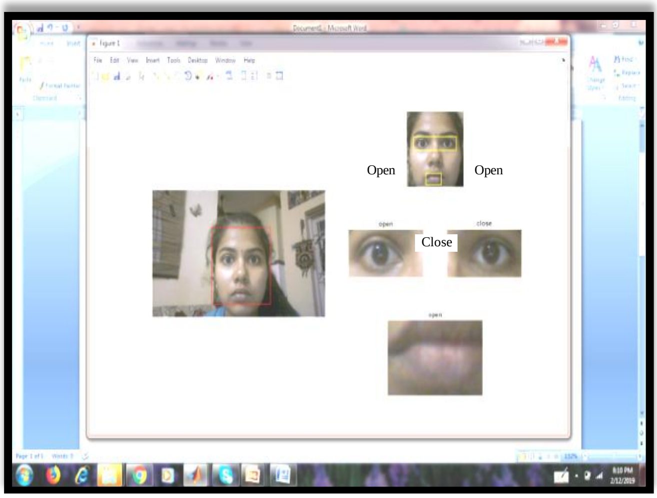
The entire process is carried out in MATLAB tool. The libraries are included to detect the eye region and mouth region. The frames that are captured are stored in the database. The features that are exacted within the bounded boxes are obtained as output.

Output for Correlation Coefficient Template Matching



Output for Computer Vision Based Feature Detection

Output for condition



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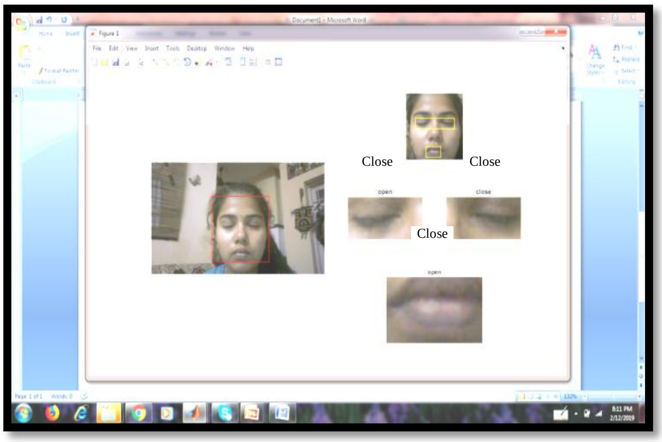
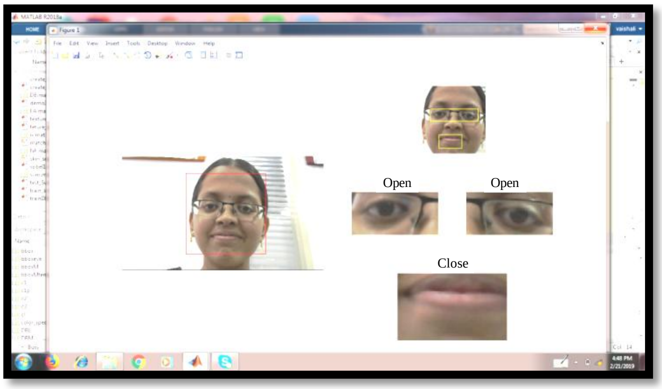
Output for Closed condition

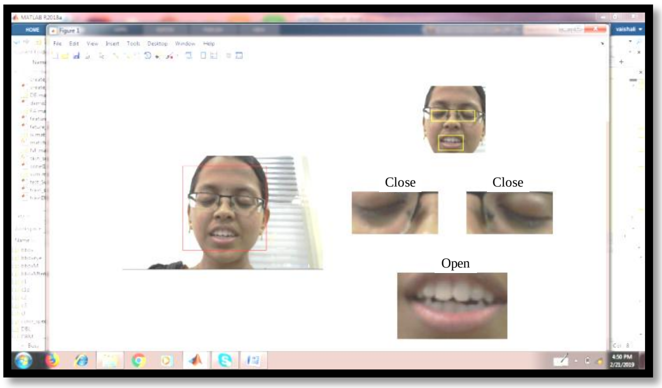


Output for Driver Wearing Glasses

Output for Open condition



Output for Closed condition



VII. CONCLUSION AND FUTURE WORK

This system can be implemented in all the vehicles such as car, buses, trucks, etc. This system gives an accuracy of 95% in real time .The time required to alert the driver also takes place within a second since it does not require large number of frames to detect the drowsy state and the webcam used to detect the face has high resolution such that the facial features can be obtained efficiently. The state of the driver is known by the passengers so that they may be alerted and necessary remedies are taken for their safe journey. The accidents that occur due to driver's drowsiness are completely eliminated. The advancements can be made that this system can also be developed in such a way that the state of the driver in the nearby vehicles are also known so that the collision of vehicles can be avoided. In the future, the system could also integrate driver details, vehicle tracking and time of arrival at the destination.

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