

# DriveSafe

Bhuvaneswari Keerthivasan  
University of Washington  
bkeerthi@uw.edu

Poornima Dixith  
University of Washington  
pdixith@uw.edu

## ABSTRACT

Drowsy driving is one of the major causes behind fatal road accidents. This paper presents a real-time driver drowsiness detection system, DriveSafe, for driving safety. DriveSafe helps make roads safer by analyzing driving behavior and distracted driving patterns, detecting drivers who are sleeping while driving and enabling insurance companies to construct safety score for drivers.

## KEYWORDS

Drowsy driving, Raspberry pi, Grove pi, Sleep Detection, IBM Watson, Image Classifier, IoT, Internet of Things, Sensors, Accidents.

## 1 INTRODUCTION

Driving has become an integral part of our lives. We drive to work, to drop off, pickup kids, some of us even prefer to take a long drive for fun. Over the years the number of people who have started driving has increased substantially, which is obvious considering today's lifestyle. And when we don't drive, we depend on other means of transportation like taking a taxi or carpooling with others or taking the school bus where we entrust our lives with other drivers.

The number of people who walk or take public transportation to work has drastically decreased. People prefer to travel to and back from work according to their convenience. What more convenient way than to drive to work? One of the major problems with increased number of drivers is congestion which is one of the most prevalent transport problems in especially in urban area. On par with congestion people are spending an increasing amount of time commuting between their residence and workplace. Growing traffic in urban areas is linked with a growing number of accidents and fatalities, especially in developing countries. Accidents account for a significant share of recurring delays. As traffic increases, people feel less safe to use the streets.

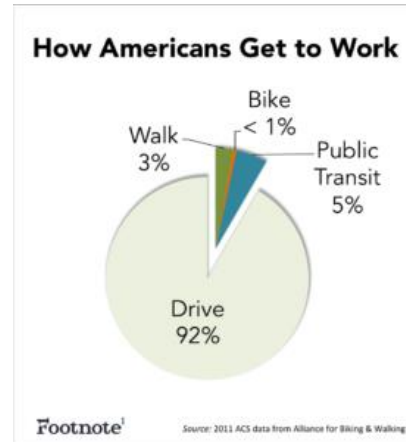


Figure 1: How Americans Get to Work

Approximately 50% of car accidents are due to distracted driving. Driving is a routine daily life activity for many people. Studies have shown that driver drowsiness is one of the main reasons for many major accidents which often result in physical injury or loss of life and loss of money. With the increasing urban population, distracted driving detection becomes increasingly useful to avoid or minimize loss of life on roads. According to a survey by the National Highway Traffic Safety Administration of the United States of America (USA), police studied more than hundred thousand crashes that occurred due to the driver distraction or drowsiness that led to major losses such as 71,000 wounds, \$12.5 billion budgetary mishap and over 1,550 deaths. Keeping track of driver capabilities can help alert drivers who are distracted or falling asleep while driving and enables insurance companies to detect distracted behaviors to reduce crashes and claims. This certainly highlights the fact that across the United States the total numbers of road traffic deaths are very high due to driver's drowsiness. Driver fatigue, drink-and-drive and carelessness are coming forward as major reasons behind such road accidents. Many lives and families are getting affected due to this across various countries. Our proposed

solution consists of a device that contains sensors and a camera to be used for detecting distracted driving behavior. The device will continuously capture images and uses sensor data to determine if a driver is distracted or falling asleep. The system will help insurance companies build distracted driving capabilities profile for drivers (or potential drivers who are likely to be distracted while driving) and notify them in case of distracted behavior detection. This will include the duration and the severity level of the pattern. In addition, the system will alert the driver when such patterns are discovered in an attempt to provide driving coaching and safety awareness while driving.

## **2 RELATED WORK**

### **2.1 Existing system**

The driver drowsiness detection is based on an algorithm, which begins recording the driver's steering behavior the moment the trip begins. It then recognizes changes over the course of long trips, and thus also the driver's level of fatigue. Typical signs of waning concentration are phases during which the driver is barely steering, combined with slight, yet quick and abrupt steering movements to keep the car on track. Based on the frequency of these movements and other parameters, among them the length of a trip, use of turn signals, and the time of day, the function calculates the driver's level of fatigue. If that level exceeds a certain value, an icon such as a coffee cup flashes on the instrument panel to warn drivers that they need a rest.

### **2.2 Limitations of Existing System**

Here is where our proposed solution stands out compared to the existing solutions with respect to the following:

1. Cost is comparatively much less than existing ones.
2. The device is hardware independent - can be adapted to any car (unlike existing ones which are often proprietary).
3. This solution can connect to insurance companies in a service-oriented approach and hence will support insurance companies get the data they need and provide them insights about driving patterns.
4. Existing solutions often connect to cloud to store data which is not feasible as we would like to build an edge-based device that can process data locally and alert drivers accordingly while minimizing network traffic and faster notifications.

The proposed solution is intended to reduce driving accidents in urban cities to a very low rate to avoid significant accidents and reduces driving behavior which often leads to these accidents. By keeping track of driving patterns, insurance companies can also attain a lower insurance claims by a much lower number than current ones. In addition, helping reduce car accidents will improve urban transportation and enable people to have safer commutes without delay to a great extent. Furthermore, it will help police and emergency response personnel to use their resources (e.g. police officers) in other tasks than writing police accident reports. sample distances, obtaining the same results with different operating conditions.

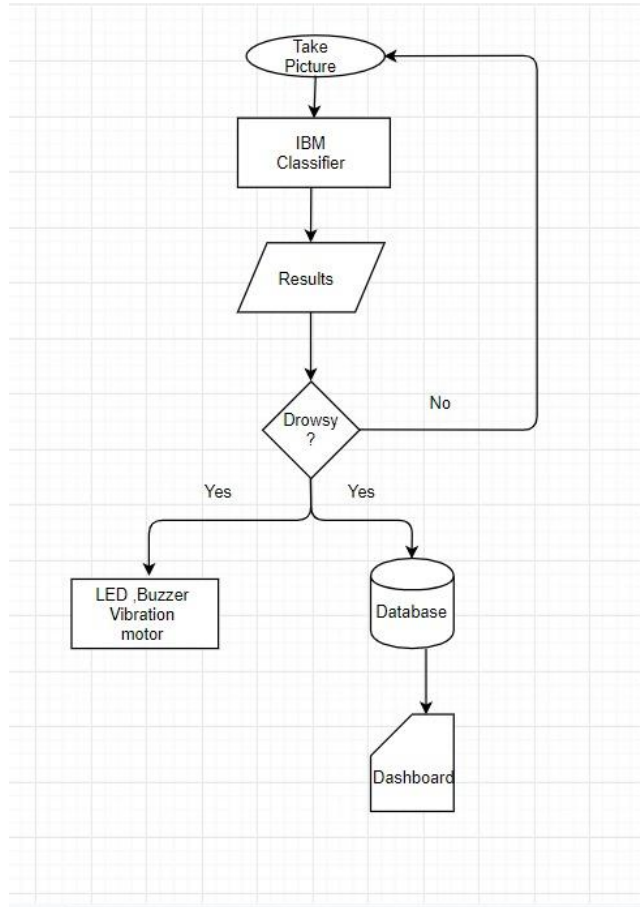
## **3 SYSTEM ARCHITECTURE AND DESIGN**

### **3.1 Purpose and Requirements**

- Purpose: The purpose of Drive Safe is to detect the driver when he is drowsy and to alert and wake up the driver.
- Behavior: The prototype detects the drowsy driver and wakes up the driver by turning on the buzzer, LED and vibration motor that is used as a wristband
- Data Analysis: The prototype also collects the drowsing history of the driver and stored in SQLite database that is further used for analysis.

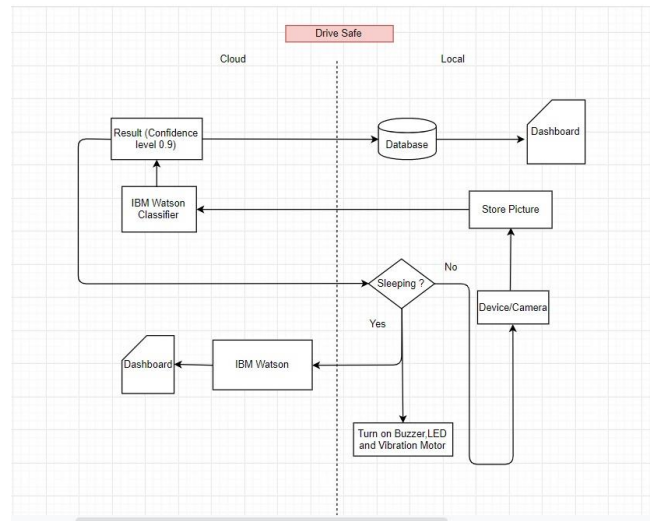
### **3.2 Process Specification**

A high-level specification of the prototype represents the Raspberry Pi camera takes picture of the driver and sends the picture in buffered mode to IBM classifier model. The IBM classifier model outputs the appropriate result based on the model trained and if the driver is detected drowsy the result is saved on the local SQLite database and the LED, Buzzer and Vibrations motor are turned on to wake up the driver.

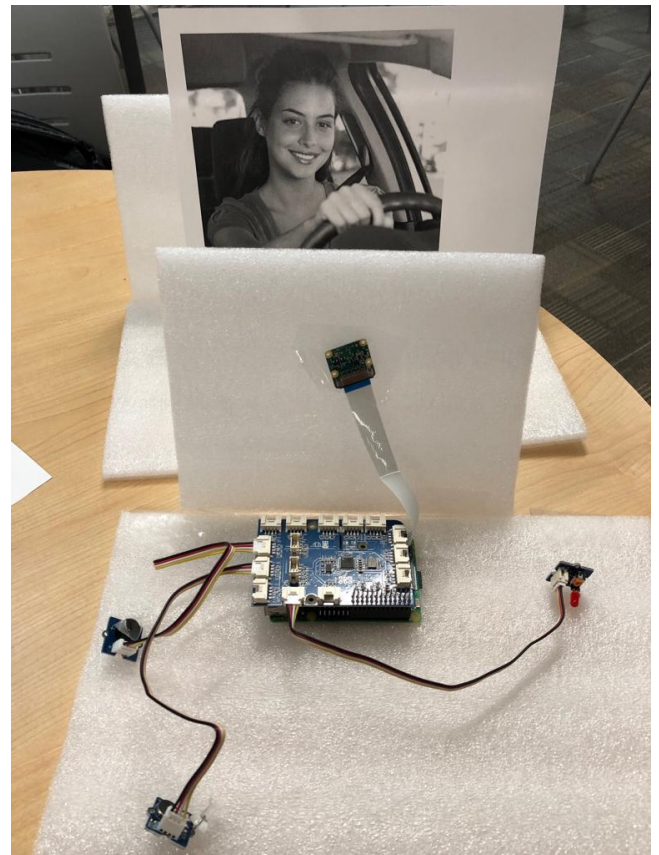


### 3.3 IoT Level Specification

The IoT Diagram represents the prototype where the Raspberry Pi camera takes picture of the driver and stores the picture locally and sends the picture in buffered mode to IBM classifier model. The IBM classifier model outputs the appropriate result based on the model trained and if the driver is detected drowsy the result is saved on the local SQLite database and the LED, Buzzer and Vibrations motor are turned on to wake up the driver. The status of LED, Buzzer, Vibration motor are displayed on the IBM Watson Dashboard along with gender of the Driver and the awake/drowsy status of the driver Simultaneously on the local dashboard.



### 3.4 Device & Component Integration





roads in urban cities and making them safer for pedestrians, other drivers, etc.

**Insurance Companies:** Insurance companies will have information about distracted driving behavior and hence can reduce number of car accident claims and ensure a certain level of driving standards.

**Governments:** Local governments can then enforce a minimum level for driving and offer penalties to those who have distracted driving patterns.

#### **Hardware:**

We used Raspberry Pi, Grove Pi and connected sensor-Camera, actuators – Buzzer, LED and Vibration motor to GrovePi. We used node-red-grovepi-nodes to wire these devices into our application. We also used SQLite provided by node red to store the data.

#### **Software:**

We create a custom model in IBM Watson with two classifiers using IBM Watson's Visual Recognition tool. We train this model with set of images of drivers sleeping and awake drivers. We then test the model with a set of images to infer the confidence level. We retrained the model with more images to increase the confidence level. We also created an IBM Internet Of Things project and launched it. This was used to create dashboard and charts to display our data analytics.

#### **Node Red Nodes:**

We used camera node available to capture driver's face and send it to IBM Watson to get the result back.

We used node-red-contrib-moment module to convert timestamp in epoch format to human readable format and store this in our database. We used node-red-node-Watson module (Visual Recognition node) to wire custom visual recognition model into our application. This node returns a classifier if the driver is sleeping or not. We used node-red-node-sqlite module to store data and run queries against local SQL database. Stored data is used to run analytics. In future enhancements, we can move this database to host it on cloud. The buzzer, LED and Vibration motor is turned on when a violation occurs and is intended to wake up the driver.

## **5 CONCLUSIONS**

Enabling police and insurance companies to track a safety score for potential drivers who are likely to be distracted or get drowsy while driving we believe is of tremendous value to help make roads safer. Through this system, insurance companies, for example, can infer about bad driving

behavior and potentially include other parameters that can contribute to his behavior such as day of the week, commuting distance, driver's speed, braking, among others. Having an individualized safety score will help make roads safer and will eventually force distracted drivers to be more committed as well help those that may have medical conditions or uncontrollable drowsiness to be alerted before danger or car accident can happen. Therefore, we believe that this system is innovative and will help make urban transportation safer, help save lives and reduce delays caused by the accidents on the roads. The proposed solution is intended to reduce driving accidents in urban cities to a very low rate to avoid significant accidents and reduces driving behavior which often leads to these accidents. By keeping track of driving patterns, insurance companies can also attain a lower insurance claims by a much lower number than current ones. In addition, helping reduce car accidents will improve urban transportation and enable people to have safer commutes without delay to a great extent. Furthermore, it will help police and emergency response personnel to use their resources (e.g. police officers) in other tasks than writing police accident reports.

## **6 FUTURE WORK**

- We would like to extend this system to multiple cars and test in real time.
- We would like to adapt other algorithms to make the accuracy of the prototype even more reliable.
- We intend to use steering angle sensor to improve the accuracy by adding another feature in predicting.
- Analytics can be extended to use the data and utilize its full efficiency.
- We would like to integrate the existing system to insurance and police system thereby utilizing the data for betterment of people.
- A facial recognition layer that processes images locally to determine if driver is distracted or has drowsiness while driving,
- A notification layer that that uses Alexa for triggering commands and connecting to vibration motors or buzzers that alerts drivers when a distraction or sleeping pattern is detected, and
- Cloud-based dashboard for real-time analytics using either Microsoft Azure IoT Hub or AWS IoT



## 7 ACKNOWLEDGEMENTS:

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