Be a Pirate Challenge

Team Spatium

SWIFT

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SUBMITTED BY

Allen Benny

Nithin Santhosh

Rueben Joseph Rex

Harshit Kumar Saini

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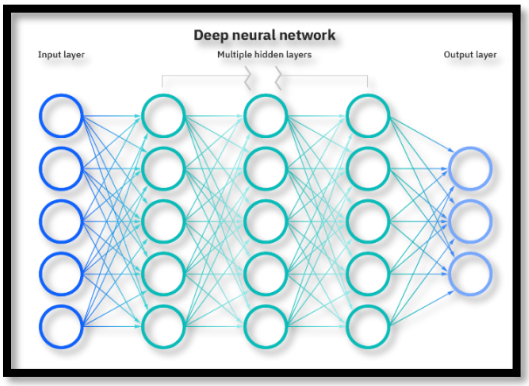
1. Consensus:

Idling cars cost you money and create pollution, leaving your car unattended for more than 10 seconds consumes more fuel, produces more CO2 emissions than a moving car and uses more fuel than stopping and restarting your engine. The more time you spend idling more carbon emissions is being released into the atmosphere. When you spend more time on a traffic signal people tend to get distracted or use their phones which decreases road safety. As a team, we aim to solve this by reducing the time spent by people at a junction using Ai image processing and Deep Neural Network.



2. Aim:

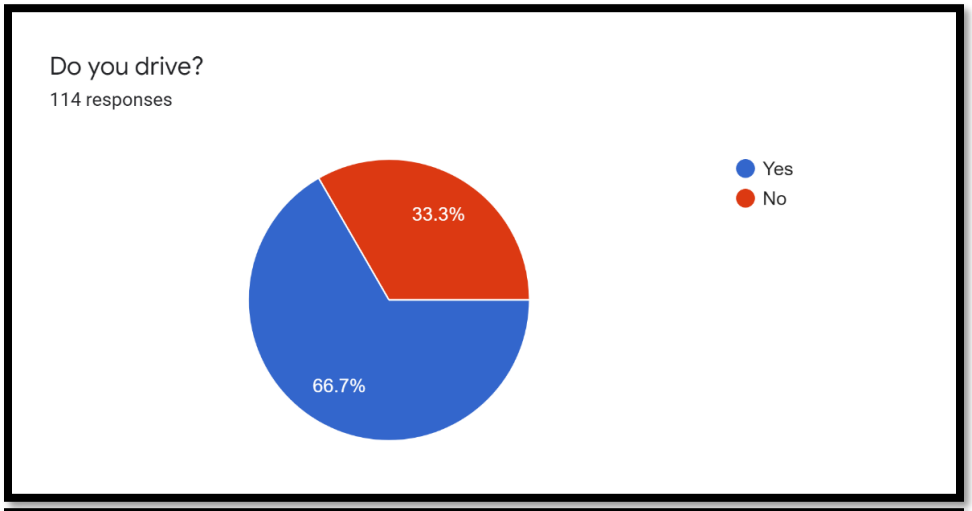
Reduce carbon emissions of idling cars by reducing traffic on the roads by introducing smart traffic management systems which are compatible with existing infrastructure with minimal need for additional equipment.

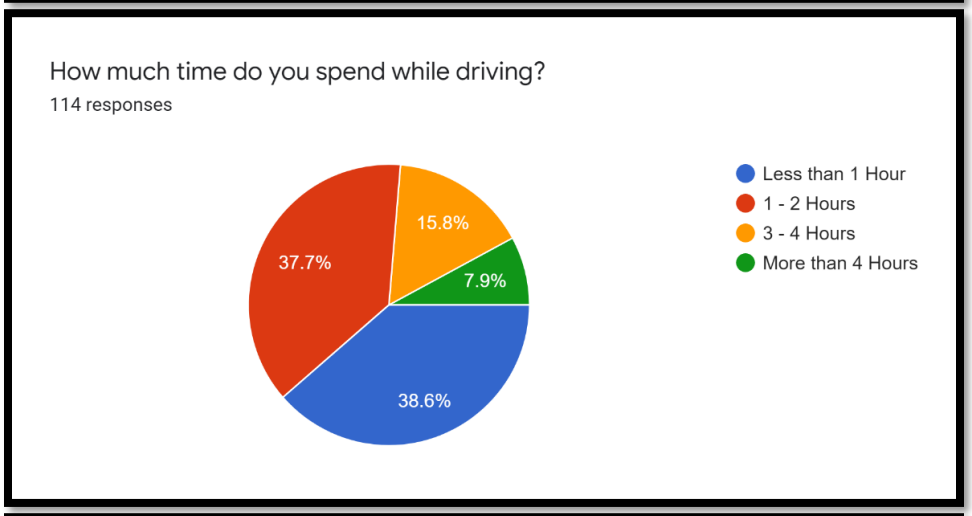
3. Survey:

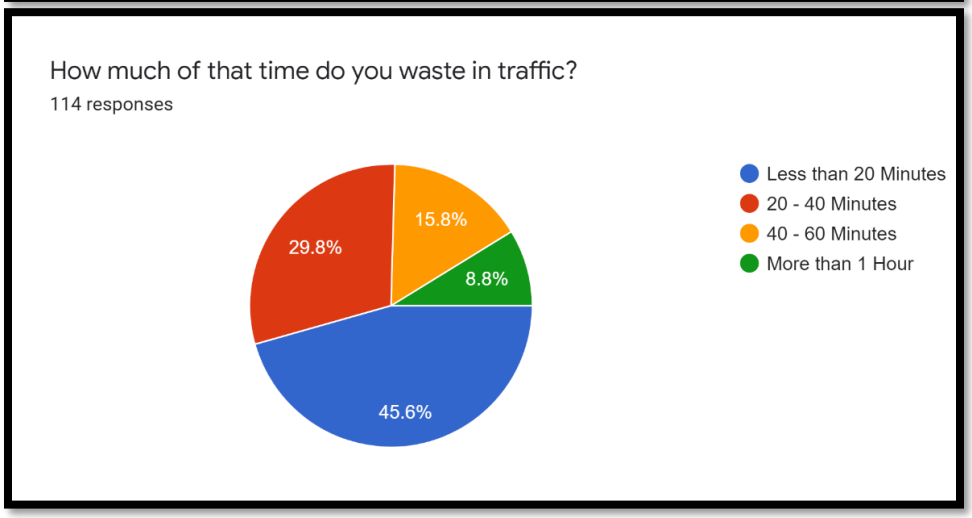
A survey was published by us in order to identify if there is a significant demand for our solution and to confirm whether traffic was as big a problem as we had thought it was. From 114 responses to our survey, we identified several problems and came to several conclusions. We identified that more than 50% of people spend more than 1 hour driving. Thus, people spend a considerable amount of time on the road driving their respective vehicles.

Out of these people, more than half of them spend more than 20 minutes stuck in traffic. These may be on highways, towns, near corporate establishments and schools etc. About half of these people reported that they would stop at traffic more than 2 times during their

drive. Additionally, a staggering 79.8% of people reported that waiting in traffic has taken a toll on their mental health.
As a result, 93% of people surveyed would like to have a solution to the current traffic problem. Thus, Swift has been developed to cater to these needs.

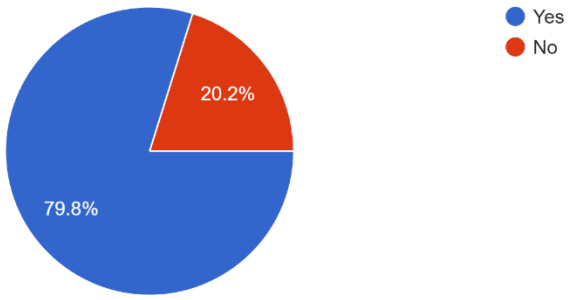






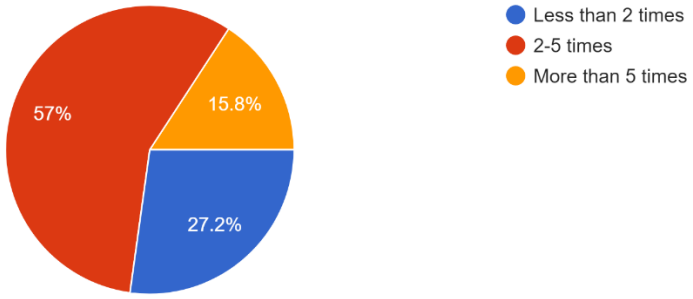
Do you think waiting for a long time in traffic has an impact on your mental health?

114 responses



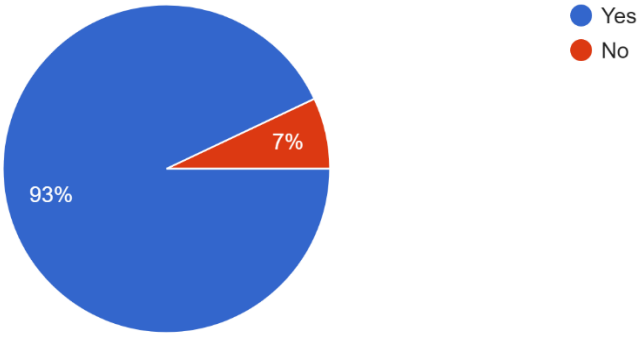
How many times do you have to stop at a signal during traffic on average?

114 responses



Would you like to get a solution for the current traffic problem?

114 responses



4. **Problems:**

An hour of automobile idling burns approximately one-fifth of a gallon of gas and releases nearly 4 pounds of CO2 into the air.

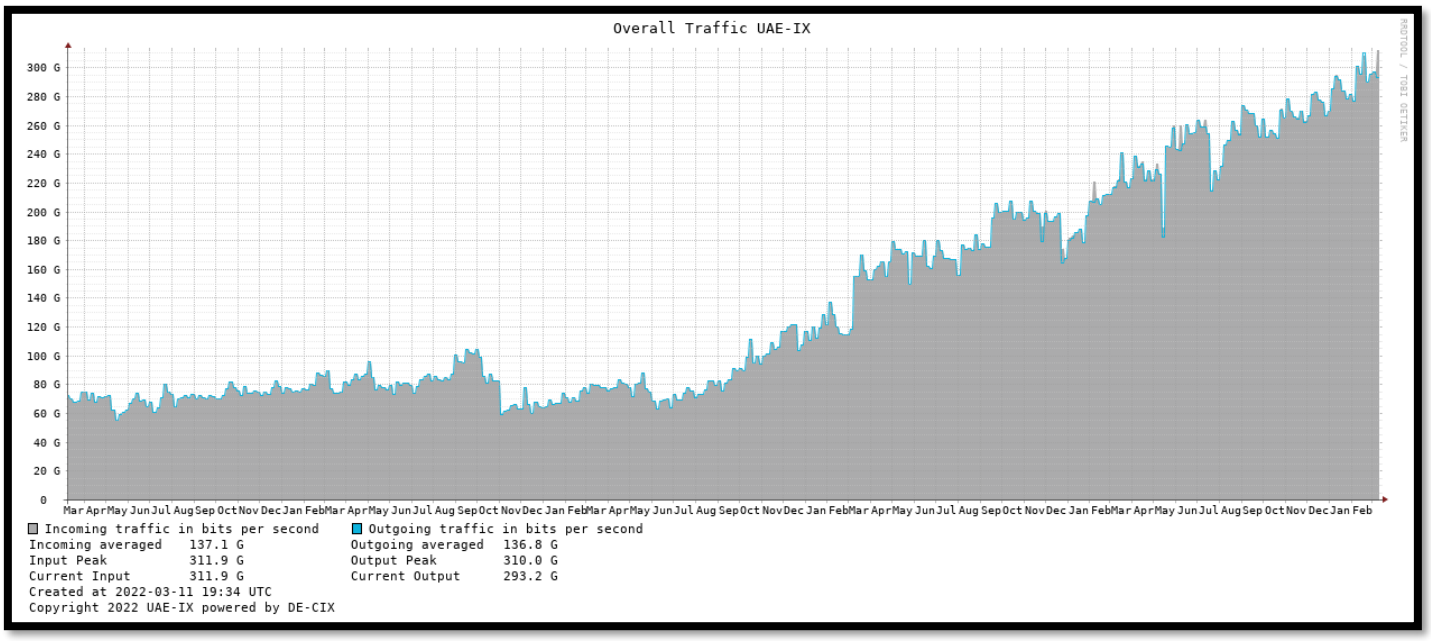
The estimated fuel consumption of an idling engine is 0.6 litres/hr per litre of engine displacement. This means that an idling 3.5-litre engine consumes more than 2 litres of gas per hour. Letting your engine idle 30 minutes a day for two winter months burns a full tank of gas without ever moving a kilometre! Transportation is still responsible for 24% of direct CO2 emissions from fuel combustion. CO2 equivalent gas emissions of vehicles are expected to increase in the coming years and, consequently, the contribution of the transport sector to climate change will also increase.

The major cause of idling of cars on the road is due to traffic caused by the cars waiting at the signal. Traffic signals mostly have fixed timing without regard to the immediate traffic at that location. This may lead to more cars waiting at signals for long times.

What do countries around the world recommend as idling turn-off times for their engines? In Europe, the recommended guidelines for turning engines off are 10 seconds in Italy and France, 20 seconds in Austria, 40 seconds in Germany, and 60 seconds in the Netherlands. In the United States, the Environmental Protection Agency's Smartway and DriveWise programs recommend turning the engine off if you're stopped for more than 30 seconds.

However, in recent years, indeed, automakers have significantly reduced the CAC emissions from new vehicles. In fact, as a result of automakers' compliance with government regulations and the introduction of cleaner fuel standards, today's vehicles emit about 99 per cent less CAC emissions than vehicles built in the 1970s. But one component in tailpipe emissions is directly impacted by the type and amount of fuel your vehicle uses – carbon dioxide (CO2). This is the principal greenhouse gas linked to climate change. Every litre of gasoline that is burned produces about 2.3 kg of CO2. The bottom line: the more fuel you use, the more CO2 you produce. And one easy way to cut fuel consumption is to avoid unnecessary idling. After all,, it gets you nowhere.

The idling of cars not only damages the environment but also damages an individual's vehicle. Idling isn't good for your vehicle. Here's why: an idling engine is not operating at its optimum temperature, which means fuel combustion is incomplete. Idling leaves fuel residues that can condense on cylinder walls, where they contaminate oil and damage engine components such as spark plugs.



5. Causes of Traffic:

There are several reasons why traffic seems to increase in several parts of the world. After in-depth research we have found that the following are the reasons:

1- Too many cars for the roadway due to inadequate mass transit options or other reasons.

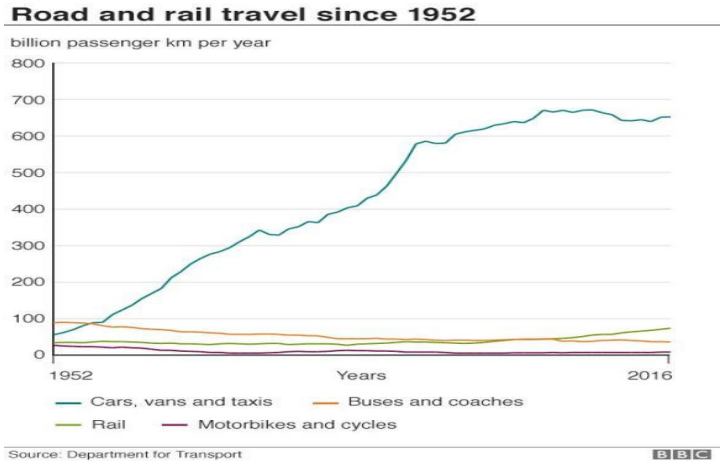
2- Traffic signals are out of sync many times due to changes in traffic behaviour or occasionally when the computers are malfunctioning.

3- Inadequate green time

4- Too many pedestrians crossing not permitting cars to turn

5- Too many trucks on the road due to inadequate rail freight opportunities

6- Overdevelopment in areas where the mass transit system is already overcrowded and the road system is inadequate.



6. **Solution:**

Traffic management can often be challenging. But some of the ways to minimize traffic include optimizing traffic light duration, using surveillance systems to monitor road traffic, while also road traffic laws could be enforced to a greater extent by the government of the country. We aim to combine the first two solutions to improve the efficiency of traffic management.

Swift is a traffic management and monitoring system that makes use of Artificial intelligence, Deep neural network and Algorithms to improve and suggest changes in traffic management and trends. It works on the fundamental principle of Ai image tracking by using OpenCV to track cars in real-time.

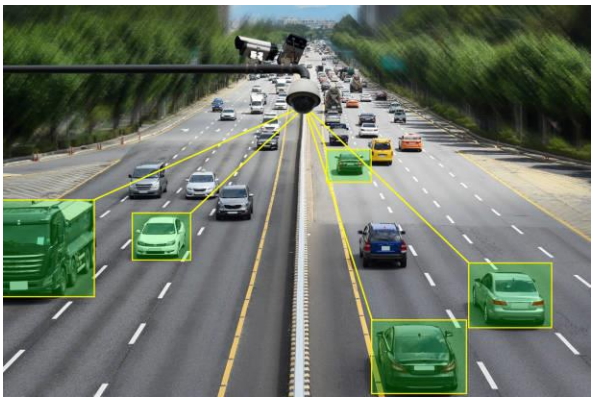
It is a device that can be attached to present traffic signals enabling the smooth transition into a smarter monitoring system whilst contributing to lesser emissions since a lesser number of stationary vehicles will be waiting for their turn in an intersection regulated by traffic signals.

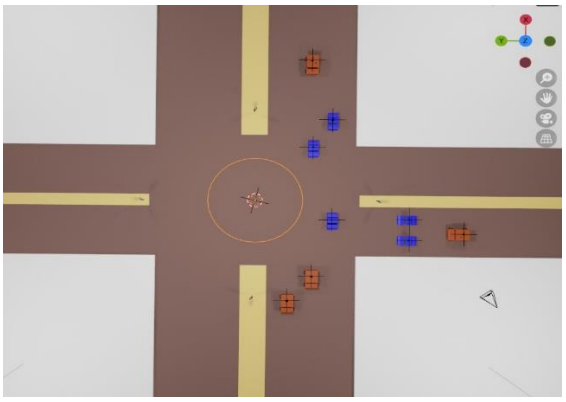
Usually, a traffic signal operates by assigning a fixed amount of time to each lane in an intersection. Swift is an additional device in the form of a sensor and cameras within a dark sphere on top of traffic signals so that the sensors are as discreet as possible thereby not causing a distraction to the drivers on the roads.

After the time allotted to a particular traffic signal is nearing its end, Swift activates for the traffic signal whose turn it is next to turn to green. The system captures an image before 2 seconds of the traffic signal turning green. A predefined program calculates the number of vehicles in the frame captured of the road. The amount of green light time depends on the number of vehicles present on the road. The system follows the following algorithm. The program calculates the number of vehicles on the particular part of the intersection. A fixed time of 2.5 seconds is assigned to each vehicle. Thus, the time for which the signal will turn green will be determined by [number of cars in the road x 2.5/ The number of lanes in that part of the intersection]. An additional 2.5 seconds will be added to the above time to account for human latency as the signal turns green.

The system also activates when there are emergency vehicles and public transport in a particular section of the intersection. Thus, promoting the use of public transport and helping people that need emergency assistance reach necessary institutions and hospitals faster.

Additionally, Swift will also be accompanied by a mini-LED display attached to it displaying the approximate time left for the signal to turn green thus encouraging the drivers to put their vehicles in standby mode in order to reduce emissions from idling cars.



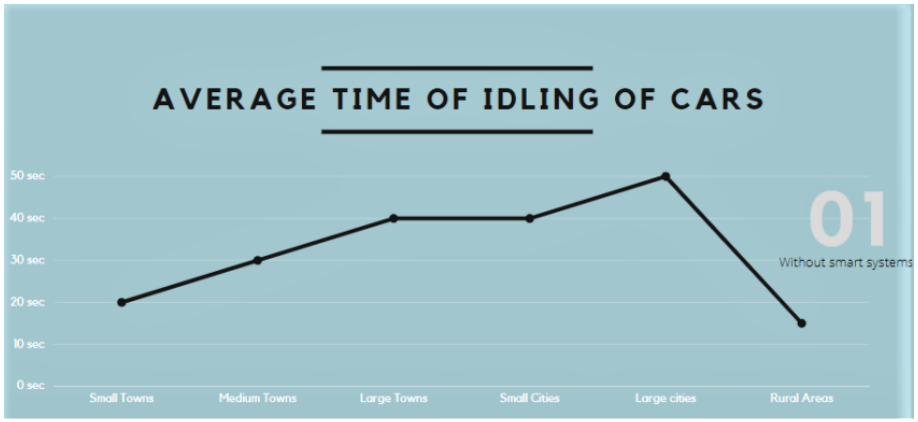


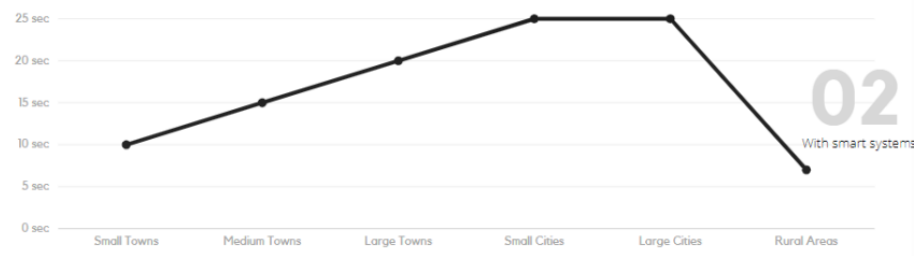
7. **Advantages:**

This project has additional applications beyond the smart management of traffic. At the end of the day, the information regarding the number of times the system was activated in a particular part of the intersection will be uploaded to a cloud-based storage database. This will be analyzed by a computer program that would suggest changes like the need for increasing the number of lanes or adding other modifications to the road. Additionally, it could also suggest the addition of shops or advertisement billboards in these particular sections of intersection to generate more revenue for the country.

Over a long period of time, this project could contribute to the autonomous development of the country without the need for human intervention to find out a particular problem like modifications to the road system or commercial aspects like deciding where to advertise a company's products thus generating maximum consumer interaction with one's products. This would attract companies to the country where this system is being implemented thus promoting the economic base of the country.

Swift will consist of a normal ultrawide long-range camera of a minimum of 32MP used on roads along with an infrared camera in order to detect the vehicles on the road at night. The entire package will comfortably fit on top of present-day traffic signals operating on current roads. The camera will be fitted with a program to perform the necessary functions.





8. Methodology:

The details regarding the vehicle detection program, Information Database, Analysis and prediction/suggestion methodology are given below:

1. Vehicle Detection Program(VDP):

```
import cv2
import numpy as np

class VehicleDetector:

    def __init__(self):
        net = cv2.dnn.readNet("dnn_model/yolov4-tiny.weights", "dnn_model/yolov4-tiny.cfg")
        self.model = cv2.dnn_DetectionModel(net)
        self.model.setInputParams(size=(832,832), scale=1/255)

        self.classes_allowed=[2,3,5,7]

    def detect_vehicles(self, img):

        vehicles_boxes = []
        class_ids, scores, boxes = self.model.detect(img, nmsThreshold=0.4)
        for class_id, score, box in zip(class_ids, scores, boxes):
            if score <0.5:
                continue
            if class_id in self.classes_allowed:
                vehicles_boxes.append(box)

        return vehicles_boxes
```

The program for tracking the number of vehicles present in a frame was created using Python.

Firstly, modules of computer vision and NumPy (Numeric Python) were imported to the Python editor. Then we defined a class known as 'VehicleDetector'. A function was defined within which we used the 'net' variable to read the dnn(Deep Neural Network) from the cv2 module. Additionally, another variable 'self.model' was defined to detect any object in the frame. Then we defined parameters for the vehicles in the frame. Finally, we defined the classes which we want to detect in the frame.
In the second part of the code, we defined a function 'detect_vehicles' to detect the vehicles in the image. Under this function, we get variables such as class ids, scores and boxes. Class id checks which class the detected object belongs to and the scores check by how much percentage the detected object belongs to the defined class.

We then used a 'for' function to iterate through the detected objects. Furthermore, we used an 'if' function to continue with the detected object only if it passes the 50% probability/accuracy of being in the aforementioned class. Then the code only proceeds if the object detected is present in one of the allowed classes. It then returns the detected vehicles.

2. Vehicle Counting Program(VCP):

```
import cv2
from vehicle_detector import VehicleDetector


vd = VehicleDetector()

img = cv2.imread("images/g.jpg")

vehicle_boxes = vd.detect_vehicles(img)
vehicle_count = len(vehicle_boxes)
for box in vehicle_boxes:
    x, y, w, h= box

    cv2.rectangle(img, (x, y), (x + w, y + h), (25, 0, 180), 3)
    cv2.putText(img, "Vehicles:" +str(vehicle_count), (20, 50), 0, 2, (100,200))


cv2.imshow("Cars", img)
cv2.waitKey(0)
```

The program for counting the number of detected vehicles was created using python.

Firstly, the modules computer vision and the vehicle detector were imported into the python editor. Variable(vd) was defined as the function VehicleDetector() (created previously).
Then we defined a variable(img) to read the image using computer vision from the folder where the images are stored. Another variable(vehicle_boxes) was defined to detect vehicles in the image using the function vehicle detector and finally, the last variable(vehicle_count) counts the number of boxes.

Furthermore, we defined a ‘for’ loop to show the detected vehicles in a box and to display the total number of detected cars on the top left of the screen.

The final part of the code shows the image with the detected vehicles in a new window along with the total number of vehicles that were detected.

3. Information Database:

The information for each days’ tracking is sent to a secure cloud database such as Amazon DynamoDB that offers 256-bit AES encryption on the information stored in the cloud database thus preventing the misuse of such data by malicious individuals. This information will be analyzed by our artificial intelligence program that uses machine learning that suggests changes in development and advertising opportunities as mentioned above.

4. AI analysis:

Our AI technology analyzes in which way the Swift program was activated in a particular part of an intersection to find out if an expansion of road infrastructure is necessary or not and to best suggest a location for advertisement potential due to large consumer concentration in that area by the assistance of machine learning. The machine learning part of the program will train itself by analyzing repeated amounts of such frames to perfect the Artificial Intelligence’s suggestions and judgements. The AI analysis could also help by giving suggestions to divert traffic through other existing roads and highways if there is a recurring traffic problem in a particular area without changing existing road infrastructure. It could also point out the intersections where most accidents and mishaps take place and could alert the drivers accordingly so that they could be more conscious and careful while driving in such areas. (To clarify this step would be done separately and not by the device in real-time).

9. Conclusion:

To conclude, Swift can efficiently and effectively help to reduce carbon emissions of the surrounding with great ease whilst supporting compatibility with present systems. It also helps in the physical and economic development of the country by providing key insights in several fields, as mentioned in the report above.

Swift can also be beneficial for improving road infrastructure before the situation worsens, thus contributing to a positive impact on the environment.

Looking into further aspects, Swift may also have positive impacts on the mental health of drivers driving the vehicles on the roads as they wouldn't have to wait for long times for traffic signals,

especially during busy days. This could contribute to them being more productive during their employment hours, thus contributing to a more productive workforce and increased development of the country through different aspects.

Thus, Swift has the potential to and can surely revolutionize several aspects of the life of a resident living in the country.