

# Smart Traffic Signals

By: Saro Karimi, Tirth Patel, Vatsal Patel  
Advisor: Dr. Hossam Gaber

# Introduction

- As we move forward in time, the cities grow bigger and get more populated.
- By population growth, we would have more cars in the streets which leads to more traffic.
- Managing traffic congestion and enhancing traffic flow are two of the main goals to accommodating and supporting urban expansion.
- If we don't improve the functionality of traffic signals, the traffic flow will be out of control.
- Since we have the problem of traffic to handle and the classic traffic signals are outdated, we have to come up with newer ways of controlling traffic flows.



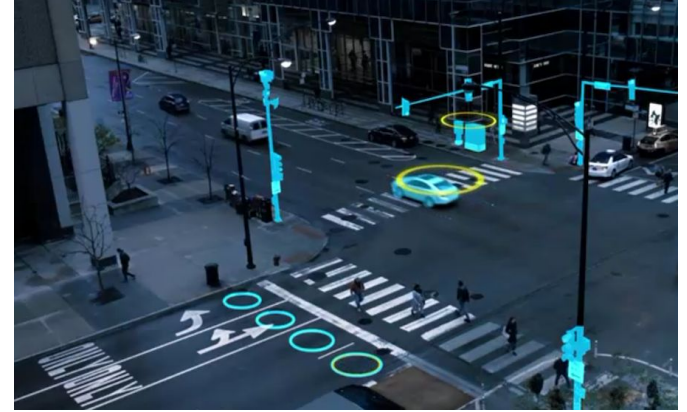
# Goals

- Our goal is to create and design a smart traffic system for replacing the original systems.
- This system will help to increase the traffic flow, decrease accidents caused on intersections, faster travel time, lower wait time, less consumption, and many other thing.
- The system will be following a procedure that has three stages for now. Each stage has a different plan to implement the device and when we get to the final stage the system will be fully operational.
- The STS includes many components and softwares. The sensors will be used, improved, or removed based on the use of them, but mainly the scope of the project will be creating an AI to control the traffic flow by analyzing the real-time data.
- AI will be used on a blockchain, which will be installed on the cars.

# Solutions

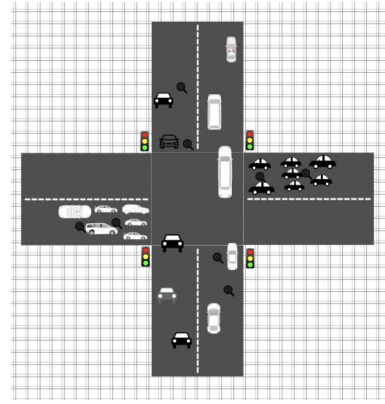
- First stage is using the basics of the program to improve and enhance the traffic signals we have now.
- Second stage is doing more changes by removing the old components and softwares and adding new modules and software programs to it.
- In the third stage, this system will be integrated in vehicles to operate without any hardwares. This stage is only achievable when more than 90% of the cars are highly computerized.

# Engineering Requirements



- The STS should provide efficient and synchronous signal timing.
- The STS shall provide visual indication of crossing/not crossing intervals.
- The STS shall reduce waiting time at the traffic lights.
- The STS shall adjust the timing based on information gathered by sensors in real-time.
- The STS shall include pedestrian and cars should be able to stop when the pedestrian is crossing.

# Concept Design I



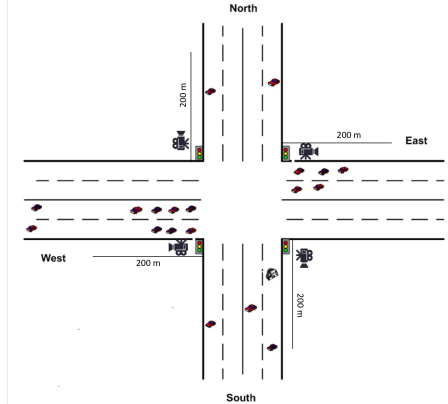
One of the concept design is about vehicle priority index. It will be new in smart traffic lights

- Where although we have count which is there like we have count which is there like we have a sensor to count and statics all those are there, but what is not there is a priority index for each vehicle, so the signal will be able to include in addition to the account and waiting time the priority index of each vehicle.
- It is automatically calculated, we will have an algorithm to calculate but we will not depend on the people.
- Only thing the people keep is just information which is validated information like who they are, where they are going, where they are going to drop.
- So that the typical information fit to the system will calculate the priority endings in real time and that will be used with this system

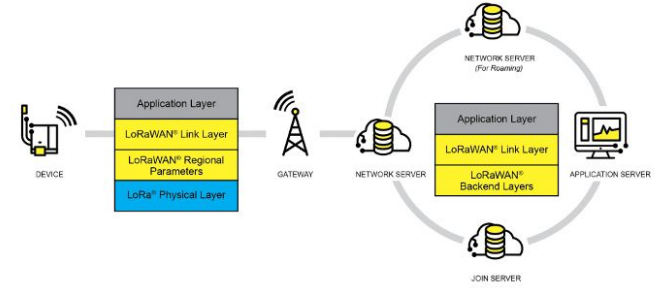
# Concept Design II

Concept Design 2 is built upon the idea of using video processing.

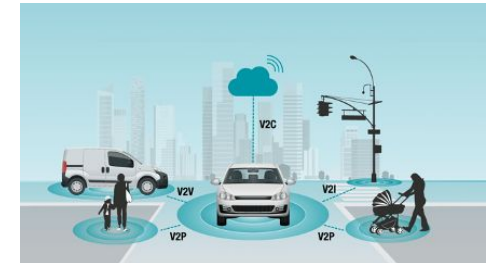
- The design is made up of a number of autonomous cameras, one for each lane being handled.
- Each camera includes a density checker to determine the number of cars traveling along its designated lanes and can detect vehicles within 200 meters of traffic light.
- The algorithm for timing the traffic lights depends on the input density for each lane is likewise executed by each camera
- The timing algorithms for traffic lights determines what color signal should be shown by a traffic light for how long.



# Concept Design III

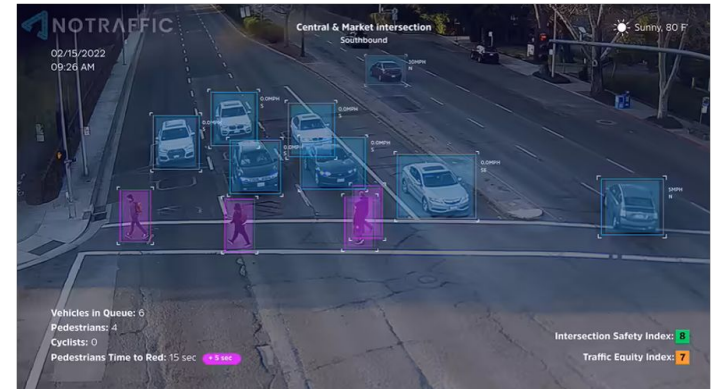


- A blockchain is a decentralized ledger of a peer-to-peer network that consists of multiple data sets.
- LoRaWAN is a low-power wide-area end-to-end network architecture. This system is used to connect nodes and devices in regional, national, or even global network.
- The main aim of this design is to connect all possible nodes via the blockchain. We need to create a system that supports V2I, V2V, V2P, AND V2X.
- The vehicle must connect to everything that is using the traffic signal and the signal as well.
- By using the blockchain methods and LoRaWAN system, we can make this connection happen.





# Concept Design IV



- Machine learning is a subcategory of Artificial Intelligence (AI), that is used in computers and systems to give the ability to learn in the system without any need for developing the systems furthermore.
- By applying machine learning to image detection, we can use a method called image processing to detect and process images faster and with less processing time.
- Creating these systems has helped to achieve autonomous driving, traffic safety, lane recognition for lane keeping.
- By adding more value to cameras and image processing, we can use them to control traffic flows and detect them and keep the interactions organized.
- Image processing is one of the methods of machine learning used in our design.
- Image processing is used to gather the data and process and analyze some data gathered from the cameras like detecting crashes and accidents and warning the drivers and pedestrians.



DEMOS









```
1 import cv2
2 import dlib
3
4 cap = cv2.VideoCapture('test5.mp4')
5
6
7 def findCenter(x, y, w, h):
8     cx = int((x + w) / 2)
9     cy = int((y + h) / 2)
10    return cx, cy
11
12
13 def pointInRect(x, y, w, h, cx, cy):
14     x1, y1 = cx, cy
15     if (x < x1 and x1 < x + w):
16         if (y < y1 and y1 < y + h):
17             return True
18     else:
19         return False
20
21
22 def main():
23     fgbg = cv2.bgsegm.createBackgroundSubtractorMOG()
24     count = 0
25     SKIP_FRAMES = 10
26     trackers = []
27     cars_in = 0
28     # cars_out = 0
29     Font = cv2.FONT_HERSHEY_COMPLEX_SMALL
30     while True:
```

# Conclusion & Future Goals, way to improve

- The smart traffic system is important because it reduces the accidents, reduces waste as there will be few stop-wait conditions and reduce waiting time.
- Creating a live camera feed and get the cars amount with a faster processing time.
- Make a better simulation with CARLA.
- Add the blockchain features to the cars so they can communicate with each other.
- Try to make a real life demo with simple cars to show that the project works.

# Acknowledgement

We want to appreciate and sincerely thanks our advisor Dr. Hossam Gaber for making this work possible. His guidance accompanies us through every phase of this project. We also want to express our gratitude to our coordinator Dr. Vijay Sood for providing us with some inputs regarding the reports and the overall project. This project would not have been possible without your guidance and encouragement.



# References

- [1] M. Nofer, P. Gomber, O. Hinz, and D. Schiereck, <http://cs.unibo.it/~danilo.montesi/CBD/Articoli/2017Blockchain.pdf>, Mar. 2017.
- [2] “Home: Helium documentation,” *home | Helium Documentation*, 2018. [Online]. Available: <https://docs.helium.com/>.
- [3] “Lorawan for developers,” *LoRa Alliance®*, 29-Sep-2021. [Online]. Available: <https://loro-alliance.org/lorawan-for-developers/>.
- [4] “What is lorawan® specification,” *LoRa Alliance®*, 25-Jun-2022. [Online]. Available: <https://loro-alliance.org/about-lorawan/>.
- [5] *Qorvo*, 31-Oct-2018. [Online]. Available: <https://www.qorvo.com/design-hub/blog/v2x-in-the-connected-car-of-the-future>.
- [6] S. Brown, *Machine learning, explained*, Apr. 2021.
- [7] N. Maan, “Vision and image processing in automotive Adas/AD Development,” *LinkedIn*, 23-May-2021. [Online]. Available: <https://www.linkedin.com/pulse/vision-image-processing-automotive-adasad-development-nakul-maan/>.
- [8] J. Singh, “JITENDRASB24/car-detection-opencv: Detection of cars from video, photo and Real Time,” *GitHub*, 06-Aug-2021. [Online]. Available: <https://github.com/jitendrasb24/Car-Detection-OpenCV>.
- [9] P. Dharshini, *Must-Know Statistical Data Analysis Techniques in Machine Learning!*, Jun. 2021.
- [10] M. Paterson, “Machine learning gives Santa Cruz traffic the Green Light,” *Cloud Brigade*, 24-Jan-2022. [Online]. Available: <https://www.cloudbrigade.com/smart-traffic-using-machine-learning/>.
- [11] City of Toronto, “Types of traffic signal systems,” *City of Toronto*, 29-Aug-2022. [Online]. Available: <https://www.toronto.ca/services-payments/streets-parking-transportation/traffic-management/traffic-signals-street-signs/traffic-signals-in-toronto/types-of-traffic-signal-systems/>.
- [12] M. Yakub, “How connected vehicles and Smart Traffic Infrastructure offer a roadmap to make cities safer,” *Electric Autonomy Canada*, Sep-2022.



The END Thank You for Listening!  
Any Questions?