**Advanced Traffic Integration System Proposal**

**A close up of a sign

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**Abstract:**

We currently live in an era where science and technology run the world. Most of the common things around us are getting advanced, intelligent and smart. This doesn’t necessarily mean everything. One of the things that are getting better every day is transportation. Driving experience today has completely changed when compared to driving back in the 60s or 70s. Vehicles are now safer, advanced, intelligent and becoming eco-friendlier as we progress. Autonomous vehicles are getting more common as we move forward. One thing that has not changed since its introduction is the way traffic operates, roads and highways. As vehicles that drive on it get smarter, we find it necessary to make the functions of the traffic and roads advanced and intelligent. Hence, the proposal of ATIS (Advanced Traffic Integration System). One of the core ideas behind ATIS to create a smarter and safer way to deal with day to day traffic operations, the way cars drive on the roads, etc. It is a device that can connect the vehicles with its surrounding environment, including road signs, traffic lights, law enforcement, etcetera without using expensive and bulky hardware.

**Introduction:**

One of the main concepts behind the idea is to invent a device (ATIS), that can be equipped to vehicles, traffic signals, road signs etc. We currently have the technology where a vehicle can detect surrounding vehicles speed, collisions, pedestrians and other stuff using the conventional radar system and object recognition cameras. This is just one-way communication. Although some vehicle manufacturers like Tesla have bit advanced feature where there might be a limited intelligent communication between vehicles if there are from the same manufacturers. I plan to achieve a fully establish two-way intelligent communication between vehicles regardless of them being from different manufacturers using ATIS. ATIS will also be open source to some extend allowing vehicle manufacturers to customize and comply the device according to their requirements and business models.

**What does it do?**

1. **ATIS Functionality**

In general, ATIS processes necessary data like when a car is about to make a complete stop, drastic speed change, turn, incoming pedestrian, just like V2V but on the advanced side of ATIS, using machine learning it records, collects and analyzes driver’s driving habits, frequent mistakes, reactions and way of driving in different road and weather conditions, reactions & habits on long drives, congested roads, etc. After analyzing the data, it sends out data to other drivers in the surrounding on a need to know basis or just as a cautious and alert warning and in many cases to the traffic signals and road signs.

1. **An Example of ATIS Features**

An example of how ATIS works and is beneficial in the following case: The driver of Car B as shown figure 1 is a beginner driver and is prone to sudden braking or hard braking when he sees a car in front of him slowing down(Car A), regardless of the distance between the two cars. Car B’s sudden stop on a highspeed highway might be lethal to Car B and the car behind it, which is Car C, both cars most likely might collide. Given that all cars in our situation are equipped with ATIS devices, ATIS device installed in Car B is familiar with the Driver’s habits, it sends an alert to Car A’s ATIS about this particular habit in case Car A might slow down. When car A slows down or is about to slow down, Car A sends out an alert to the ATIS device of Car C to slow down and be cautious in case Car B might make use of hard breaks. Hence preventing a collision.

A picture containing screenshot

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Figure 1: Example of ATIS features

This is just one example of the feature of an ATIS device, with the help of machine learning, the more ATIS learns and analyses, the more intelligent it gets. Common mistakes of a driver that leads to an accident can be avoided if ATIS is installed in vehicles.

**How it works:**

I proposed multiple approaches to create the methodology for the system. One thing that I found necessary was the use of neural network for the system to find and solve multiple tasks with appropriate solutions.

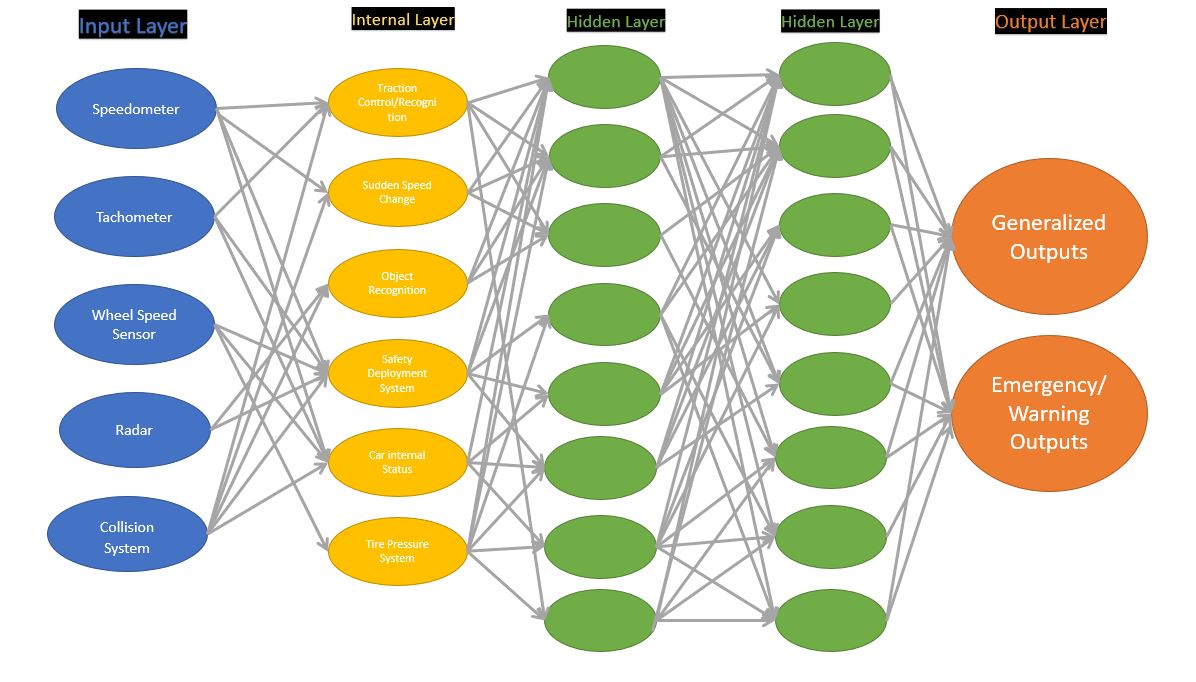


Figure 2 : Basic Neural Network

A neural network similar to the one shown in figure 2 is what the I am targeting to create. This neural network is layer based, the first layer (colored in blue) is a layer which recognizes the inputs using the sensors and equipment that are readily available in most modern vehicles including but not limited to built-in radar, camera, proximity sensor, etc. The internal layers of the neural network further simplify the data, combines it and finds the appropriate solutions to give a final result or solution through the final output layer.

A global pointing system (GPS) will be equipped in the system or pre-installed. The GPS plays a crucial role to recognize the virtual grid system which will be created specifically for the ATIS system to point the coordinates of a vehicle equipped with the ATIS device. It will also help for updating real time vehicle location that can be useful in many directions for emergency and law enforcement services.

The ATIS system uses machine learning to give an accurate solution or an output to a given input. There is no specific method or an algorithm to determine the amount of data needed to give an accurate output nor is there a way to determine the number of layers to be required by a neural network to produce an output. Due to this reason, the I had to determine the amount of data needed for a machine to analyze to produce an accurate output manually using the trial and error method. Accurate data is very crucial for the system to work successfully.

**Data Collection on Training the System:**

As a proof of concept, I initiated an experiment to determine the amount of data required in general to give an accurate result by using a machine learning hardware created by Nvidia. The device is known as Nvidia Jetson Nano.

The goal of the experiment was to determine the amount of training time and data needed for the computer to successfully recognize if a human hand is closed or open. At first, the machine was given limited amount of data, in this case pictures of a closed and open hand. The machine was also given limited amount of training time.

A screenshot of a social media post

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Figure 3: Example of the Test

As shown in figure 3, with limited amount of data given, the system was only 34% confident the hand is closed. It was clear that the more data and training time given to the machine the more accurate the results are.

A screenshot of a social media post

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Figure 4: Example of the Test

After multiple steps, trial & error and increased amount of data and training time given to the machine, it was able to accurately recognize if the hand is closed or not with a confidence of 99%.

![A screenshot of a cell phone

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generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAkACQAAD/4RDyRXhpZgAATU0AKgAAAAgABAE7AAIAAAANAAAISodpAAQAAAABAAAIWJydAAEAAAAaAAAQ0OocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAEFiZHVsIEhhc2VlYgAAAAWQAwACAAAAFAAAEKaQBAACAAAAFAAAELqSkQACAAAAAzk4AACSkgACAAAAAzk4AADqHAAHAAAIDAAACJoAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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Graph 1 : Object Detection & Recognition Accuracy

As shown in graph 1, the more training time and data given the more accurate the machine is.

**Test Conclusion:**

In conclusion, the more data ATIS gets on multiple things like driver’s driving behavior, the more outputs it will be able to give overtime.

**Survey:**

After understanding the test results, one of the most important things was to find out people’s opinion, research habits and impact. I created a survey online on Google forms asking people wide variety of questions based on their driving history, age and opinion on smart driving. The results of the survey were very interesting, gave us a better understanding on where people stand and how its going to affect the device sales are going to be affected when it finally releases. The survey gave me some insights on two different topics. One of the things I was targeting was to find out opinions based on age and history specifically. In the survey, I asked questions if they were any major or minor car accidents, another question I asked was how much they would trust their car safety system and how much would they trust a fully autonomous car. The answers were the complete opposite than I expected. I expected people who were involved in an accident would be less confident to sit in a self-driving car but surprisingly it was the opposite.

Graph 2 (X-Axis represents the age and the Y-Axis represents the trust rating (0-5))

As expected, the trust level of riding in an autonomous car is low are the age category expected but what I did not expect was that people did not loose confidence or trust while riding a self-driving car even though they where involved in a major car accident. I personally reached out to some of those people and many gave a common explanation. They said that the accident they where involved could have been avoided if not for human error. Hence, they trust computer more than humans itself. This was a very interesting observation.

Another observation I made, that was very crucial and directly related to ATIS was comparing the answers to the two questions in the survey. The questions were “How much do you trust your car's safety features like reverse camera, automatic braking systems, front radar, Blind spot warning, etc...” and “Opinion: Roads and Highways need a significant safety upgrade”.

Graph 3

While this is a one-sided opinion, the side that disagreed that “Roads and Highways need a significant safety upgrade” also gave a 5/5 rating on their car safety system. My understanding is that those individuals believe that car safety is not related to road safety or that as long as the car is safe the road safety doesn’t play a major role.

The responses of this survey were very fruitful. I know have a better understanding on how people feel about smart roads and cars. This will also help me significantly to see where can I advertise this device if I am using targeted advertising.

**Conclusion:**

With the boom of technology, IoTs and the world getting closer to making a complete smart city, ATIS is a necessary addition. With the good possibly of driverless cars to be common on the road within a decade or two, The ATIS device should a mandatory addon on every vehicle on the road. ATIS is customizable to the point that its features can be added as it advances giving the developers limitless options and opportunity to take advantage of using machine learning and Artificial Intelligence.

Based on the survey I can also confidently say that, if this device is rolled out in the market, it could be a hit among the millennials. The survey also proved that over 93 percent of the people agree that the roads and highways need a significant safety upgrade. I strongly believe ATIS is an answer to this!

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