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**Subject : IOT**

**Traffic management system**

Abstract

In todays world or at least in my country of Nepal one of the main problems during traveling from one place to another is traffic . Whether your on a private vehicle or on a public transportation system the main problem is that due to the high density population and lack of management of poor management skills , traveling from point A to point B, if it should take only 15 minutes , then it takes the entire population 35-40 minutes to travel and one another problem is that some people are in such a rush that they are over speeding and being a safety risk to them selves and as well as other that are on the road . With everyone being in a rush and not abiding by the traffic laws and now to help manage the crowd of people in hurry, it delays the arrival time to the destination even more. So in this essay today I will be explaining in proper detail as to how we can use upcoming innovative technology to over come these problems in our society.

To make this concept of idea into a reality we would need the help of multiple sensors , communication system, computers to process and analyze and manage according to the data received ,input and use of AI to some extent, a application to show the current level or amount of traffic on the particular road that the person is trying to drive down and traffic signals . And also use computer integrated with cameras and radar sensors to capture people who are unlawfully speeding .

**Concept idea**

The concept is that through out the main streets and roads of the city , there will be infrared sensor, radar detectors and cameras to track the movements . The sensors will pick up data such as density of the vehicles on the road, the speed at which they are travelling down the road and their speed as well . All of these data will be then transmitted to the main computer or control device over either WIFI or Bluetooth . The computer will then read through all of this data and search for pattern of people driving. Then after the acquisition of data , with the help of artificial intelligence , we derive or create multiple algorithms and then choose one most suitable to allow a reasonable continuous flow of vehicles down the road with out delay for people and without having the line of waiting vehicles stretch far. And for those who are speeding , the camera capture an image of the vehicle and then with the help of AI we scan the number plate of the vehicle. The computer then goes into the national data base of vehicle registration, and it finds out who owns the car and immediately contacts them via sms claiming they are unlawfully speeding and fines them a certain amount and also adds this record to the police database.

Once the most suitable algorithm has been decided , the computer controls the traffic lights and carefully coordinates each lane of traffic allowing for smooth flow and saving peoples time and keeping everyone on the road safe and happy .

**Data Acquisition**

To acquire the data we use sensors such as infrared sensors, ultrasonic sensors, radar sensors and cameras . One example is

**PIR sensors** ,

PIR sensors and how they function is that they are able to recognize changes of infrared radiation caused by movement of some object or some sort of entity .They themselves do not use or apply infrared to the surroundings but rather absorb and gather data from those that are already present there due to natural causes .

Another example is

**LIDAR sensors .**

LIDAR sensors gather information by emitting laser beams to their surroundings and then measuring the exact amount of time that it took the beam to reflect off the objects in its surroundings . With the help of LIDAR sensors we can use it to measure the speed of an entity traveling down the road .

And one final example for the method of data acquisition is

**Camera systems with Computer Vision.**

How camera systems with computer vision work is that the cameras are actually high speed, meaning they are very quickly able to capture the image of the object in front of them and when they are integrated with computer vision , it is able to calculate the speed of objects . By computer vision it refers to things such as image processing, object recognition , patter recognition and machine learning.

**DATA TRANSMISSION**

So once all the data has been collected with the help of the sensors , the next step is to transmit all that data to the main computer or cloud server . To transfer or transmit the data to the head quarters we can use several methods, some which are a bit newer some which are a bit older. To begin with , we can use the most modern method of data transmission which comes down to using WI-FI signal to transmit real time data the main computing unit .

Another method of transmitting data is Bluetooth . We can use Bluetooth to transmit data , covering a smaller area than you would with wifi. Its benefits are that it can be used to cover a smaller are and it consumes less power, the disadvantage is that well, it has a limited range as compared to other options

A slight different method than that would be to use satellite communication in areas where perhaps the use of Bluetooth or WI-FI is not available or the most optimal solution. Now it is suitable for a larger scale coverage but it can be costly and also consume a lot of power .

Now, the final option is rather not much practiced these days as it is slightly old school and tough to maintain. That would be to manually connect the sensors that gather the data to the computer or cloud servers through ethernet cable or fiber optics. Now yes while fiber optic cables can be super fast we also have to realize how delicate they are and how securely we have to maintain them , the labor required to install the fiber optic cables from the sources to the destination , extra power dependency etc.

**DATA PROCESSING AND MANAGEMENT**

To process and manage and analyze the data we would require a central server or a cloud platform where all of this massive amounts of data from all over the city would be stored. Now of-course simple raw data can be confusing , have errors and miscalculations so first thing to do after collecting the data is to pre process it. And what that means is that we have to filter and clear out miscalculations ,errors, etcetera. Now the device used to do all these specific tasks could be an Arduino uno , or an Arduino mega . For those who don’t know, an Arduino is a microcontroller that is open source electronic platform that includes both hardware and software functionalities . To the best of my knowledge Arduinos are manufactured in Italy . An Arduino has multiple pins for connection on it . An Arduino is able to receive analog data signals. It is also able to do the same with digital signals and how it recognizes signal is in the form of electric impulses in highs and lows . It also has the ability to provide or send digital signals through its pins.

Arduino itself is a company and the controller that they make are of several varieties, some examples are Arduino uno , another is Arduino mega , and also Arduino nano . The main component in an Arduino uno is the Integrated circuit (IC) chip , that is ATMEGA328P. The AT MEGA 328p is a 8 bit micro controller which is based on the AVR RISC architecture . This chip consumes very little power and is yet still able to provide a performance that is very high performance and more than enough for such projects . The pin has 28 legs , each with its own capabilities .

In some cases if a micro controller like an Arduino lacks some capabilities or isn’t enough to conduct this , then we can also use a more powerful micro controller like a raspberry-pi . which is kind of like a very small computer, but its capabilities exceed that of ana Arduino . The main chip of a raspberry-pi is its micro controller chip RP2040.

For further information I will provide a link that contains information to learn on Arduinos and its main IC the AT MEGA 328P and also what a raspberry pi is and its main IC the RP2040

**Data analyzing and visualization**

After the processing of the data it can be analyzed through machine learning , AI pattern recognition and algorithm generator . Based on the vast amount of data collected , with the help of AI we conduct a statistical analysis for traffic jams , and what area people try to travel the most too and at what time of day is the road most filled with traffic . We can also try to teach the AI to capture images and know what an accident looks like and if anyone that was speeding has been caught in an accident .

And all of this can be visualized by developing a user interface application that has the routes and roads maps of the entire city. The application would be constantly connected to the main server located at the traffic control headquarters and would constantly update the drivers or travelers with real time update about the traffic jam conditions on the all the roads and also inform emergency medical personnel and the proper authorities about any and all accidents that have occurred on the road and what would the best way to reach the incident site and also inform the regular citizens what would be the best way to go around that traffic. In addition to the use of the application the computer will also control the traffic lights and signals to quickly dissipate the traffic and keep a continuous flow of vehicles on the street with out much of a delay .

Also for those drivers who have been caught speeding down the road illegally , the computer will capture the image of the vehicle , read the license plate number, scan through the data base of vehicle registration and send them an SMS that they have been caught speeding and they have a fine to pay. To send this SMS , we can use a GSM SIM 900 Arduino uno shield which is an add on component to the Arduino in which you can install a sim card and program it to either send or receive text messages and in some case even automated calls .

**CONCLUSION**

To wrap up and summarize this document , the traffic management project is a moderately simple project in which there will be sensors and camera such as PIR sensors , Infrared Sensor and Infrared Cameras , deployed through out the streets of the city. These sensors will be constantly updating the main data base with raw information .

Over there the data will be processed and be organized into proper information through the help of machine learning and AI . Then the computer or AI will scour through all of the data and it will try to look for or recognize the driving pattern through out the city .

All of these tasks such as gathering data from sensor , then processing it and analyzing it will be done with the help of an Arduino or a raspberry-pi. The program will then constantly update an application connected to the database server showing the traffic conditions and the best route possible.

The computer will also with the help of the data that it has gathered control the traffic signals and control the flow of traffic and help prevent a long line of vehicles waiting for their turn . It will only keep the people waiting for some amount of time while the computer calculates the best method of traffic flow.

**Reference Links**

Below I have provided links to information about micro controllers , sensors and other stuff which have helped in this topic and also for the learning of anyone who wishes to learn more about these device mentioned .

**PIR SENSORS :**

<https://learn.adafruit.com/pir-passive-infrared-proximity-motion-sensor/overview>

**Infrared Sensors :**

[**https://www.fierceelectronics.com/sensors/what-ir-sensor**](https://www.fierceelectronics.com/sensors/what-ir-sensor)

**Arduinos :**

[**https://www.arduino.cc/en/Guide/Introduction**](https://www.arduino.cc/en/Guide/Introduction)

**GSM SIM 900 :**

[**https://lastminuteengineers.com/sim900-gsm-shield-arduino-tutorial/**](https://lastminuteengineers.com/sim900-gsm-shield-arduino-tutorial/)

**ATMEGA 328P:**

[**https://components101.com/microcontrollers/atmega328p-pinout-features-datasheet**](https://components101.com/microcontrollers/atmega328p-pinout-features-datasheet)

**Raspberry-PI:**

[**https://opensource.com/resources/raspberry-pi**](https://opensource.com/resources/raspberry-pi)