ARTIFICIAL INTELLIGENCE TRAFFIC CONTROL

FINAL PROJECT PROPOSAL
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1. INTRODUCTION

I am pleasant to submit this innovative project proposal to International College of Business and Technology. In order to complete my final year project I have decided to come up with a unique solution of a major problem in Sri Lanka. Therefore I named this project as Artificial Intelligence Traffic Control.

Most of the roads in our country are crowded due to traffic congestion and Sri Lanka police unit has been appointed many traffic polices to control the vehicle jam in particular times. But they even don't know the upcoming traffic situation on many roads.

Here the solution we bring is to make the traffic signal lights to artificial intelligence based and also there is an opportunity to record the data of each roads and store them to the database which we will be needed to make machine learning model to predict the traffic status of future and let our AI act more accurate. I am only covering AI based traffic signal application here based on the object detection system but also this idea can be extended into many deep learning models to solve the problem 95% such as feeding the model to predict future traffic situation, connecting all the traffic signals to let them take decision by communications between the signals. I totally mean the object detection system to detect the vehicle, take decision and implement through signals.

This project proposal is comprised of all the necessary information regarding the complete predicted process of the implementation of the proposed system such as what are the technologies we are going to use, feasibility of this project and the final outcomes etc.

2. PROBLEM IDENTIFICATION

Traffic control systems are very important systems when the traffic police unit cannot control the amount of vehicle entering in to the city. I am focusing the existing problem in Sri Lanka at this time. There are plenty of traffic signal lights in all the roads which are controlling vehicles right now, as I know all the traffic signals that we have today are not artificial intelligence but automated.

These signals work based on the timing they programmed to the microcontrollers and loop the round again and again. For an example that signals were only programed to change the lights like red to green or green to red once every 5 minutes. If the signal light has been changed, it doesn't mean the particular signal knows that there are many vehicles waiting.

This workflow may lead to major traffic jams on several times, as a good example that I came across sometimes we may want to stop the vehicle in a signal light even the road is totally empty like a playground also the other hand side in some junctions the way which has more vehicles is stopped less times but the other way which has less vehicles is stopped more times by signals. Which is obviously useless.

Another main problem is controlling the traffic jam by police men even the signal lights are there. It also make more headcounts on road to solve the problem even some situations the police men don't know what is the traffic situation of the next way. In some cities they use CCTV cameras and take decision.

3. PROPOSED SOLUTION

Changing the traffic signals intelligence and make them to take decisions themselves to reduce the traffic jam in cites. I propose a traffic control system which will work as a human brain.

In order to solve the problem which I mentioned in section 2, we want to make the system artificial intelligence. Without a single police man the system should be able to take decision whether stop the vehicle or allow them according to the traffic situation in the city even in any time either night or day even it's so crowded.

More than a human the systems can understand the situation of entire city in a few seconds and change the all the traffic signals according to that circumstance unlike acting time based ruled signals as I mentioned in previous section.

Here the solution that I will come up with is to make single signal light artificial intelligence, which I let the signals know about the amount of vehicle in front of it and let it to take decision. But also in future we can store those information which is collected by the cameras such as number of vehicle, the day, time, whether and road status etc. to make machine learning models to predict the future traffic situation on the same road or city. If we can collect those information and make a model I do believe definitely the entire city will be controlled based on artificial intelligence models.

4. LITERATURE REVIEW

There are many countries today facing issues on handing huge traffic jams manually, as I researched in many sources I have found that there are several peoples already tried to give solutions for this issue using different kind of technologies. One of a good researches I found which was published in International Journal of Scientific and Research Publications, IJSRP, Volume 8, Issue 2, February 2018 Edition [ISSN 2250-3153]. Here the research paper was aimed to solve traffic congestion in India. The major findings that they referred here are reducing the time of waiting in traffic jams and avoid to wait at no traffic roads.

Every vehicle has a RFID enabled device that stores a vehicle identification number (VIN). VIN number that provides the information regarding the priority of the vehicle and type of the vehicle. Readers collects the information regarding the vehicles approaching towards the junctions. The Central processing unit calculates the volume and speed of vehicles on each road according to information collected by readers. (Ragha, 2018). The team tried to achieve this problem using Radio Frequency Identification Devices (RFID) technology. Also they calculate the number of vehicle using the RFID reader when the vehicle moves near the reader. Our system we are going to include object based detection systems to easily identify the vehicle through the surveillance cameras which fixed on the particular traffic signal. I hope this method will not require to embed any devices in to the vehicles, it just get the vehicles' object fallen in to the real camera's video and process it to get the number of vehicle and waiting time they spent. As I mention about the RFID the research team tried to fix RFID devices in each vehicle to get read by the readers also many RFID readers should be placed in each roads which is really very difficult. Our system will capture the traffic situation using cameras even human can easily understand if the system does not take decision well.

Even though the research aims to make traffic signals to intelligent based, but the readers and signals are placed individually here, there is no communication would happen between one signal to another also the fact we already referred in our previous sections that the traffic signals are able to communicate between one and other in order to make proper decisions either allowing the vehicles or stopping them.

Conventional traffic signals

These traffic signals have been programmed with a fixed timer. They do not consider the volume of the traffic on the street before taking a decision of green or red light. Hence if the volume of traffic is large, it may result in accumulation of traffic on the street and the junctions. This is the traffic signals which the research team wants to change, we also decided to give a proper solution of this problem using object detection models and AI based decision makings by considering the situational facts.
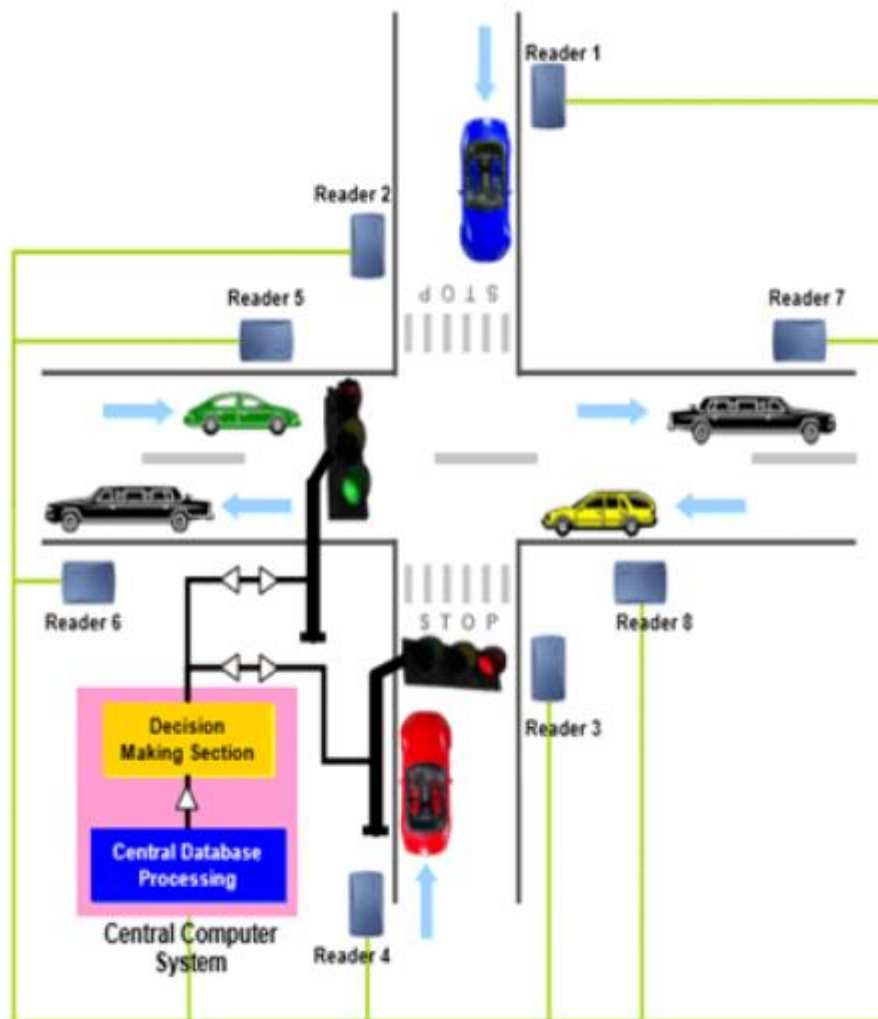

Figure 1: RFID based traffic control

5. METHODOLOGY

Since our project scope is so huge we want to build it section by section additionally testing them which would help to get some improvements to include in the next release. So here the very important part is giving more satisfaction to the client. Once the system is implemented, sometimes that may require changes or development depend on the new experiences. At this point the entire development team has to work on the system to fill the flaw which was discovered in the previous release. The very two important parses that we analyzed from this scenario are more customer satisfaction and iterative development according to the present and future requirements. These requirements can be built through spiral model in software development which has more approaches to solve our issue.

The spiral model combines the idea of iterative development with the systematic, controlled aspects of the waterfall model. This Spiral model is a combination of iterative development process model and sequential linear development model i.e. the waterfall model with a very high emphasis on risk analysis. It allows incremental releases of the product or incremental refinement through each iteration around the spiral. (tutorialspoint, 2018)

Spiral Model - Design
The spiral model has four phases. A software project repeatedly passes through these phases in iterations called Spirals.

1. Identification

2. Design

3. Build

4. Evaluation and Testing

The following pointers explain the typical uses of a Spiral Model.

- When there is a budget constraint and risk evaluation is important.

- Long-term project commitment because of potential changes to economic priorities as the requirements change with time.

- Requirements are complex and need evaluation to get clarity.

- Significant changes are expected in the product during the development cycle.

The advantages of choosing this model to our project

- Changing requirements can be accommodated.

- Requirements can be captured more accurately.

- Development can be divided into smaller parts and the risky parts can be developed earlier which helps in better risk management.

The project requirements are so complex and those can be changed whenever some additional issues jump in to the planning circle while the project development in action so this project should be flexible enough to go back to the previous stage to solve that and come again to build or testing. The development process of traffic control system using object detection can be changed time to time depends on the requirements or released product also this process is repetitive.

6. FEASIBILITY

6.1 Financial Feasibility

One of the major component that I want to suggest here is high level servers to handle all the cameras machine learning models and train them, it can be obtainable by Sri Lankan government due to this project may be proposed to them on final stage.

6.2 Technical Feasibility

Technical feasibility mainly focuses on resources that are required for the project both Human and material. It portrays the technical requirement of the proposed project. The requirements are then compared with the resources that we have and resources that can be acquired in order to determine the feasibility. Here we must also consider upgrading and refurbishing the existing resources to get the full potential out of the resources that we are provided with.

For traffic control system we can use the existing traffic signals and the proper network cameras should be placed in each signal areas in order to detect the vehicles according to the connected server. The server should be able to handle all the data coming from every cameras even we can have more servers to reduce the load. No person required to maintain the system daily basis but some professional can be assigned if there is any technical or whether issues.

6.3 Legal Feasibility

According to Sri Lankan law this system can be built but if it should be implemented to solve the real problem, the government should approve to move ahead on the implementation and testing. Other than that everything is going with Sri Lankan law and rights.

7. PROJECT DESCRIPTION

In order to replace the automated traffic control system to artificial intelligence traffic control system, initially I make machine learning model and train the model with bunch of sample images of each vehicles in the city. Once the object detection model is trained we can implement that into real cameras to detect the vehicles appear and get information such as number of vehicle, waiting time also the next traffic signal status. In the future this system also can be extendable to take decision by the stored data, for an example if 100 vehicle entered into Peliyagoda road, the Dehiwala road will be delayed 30 minutes than usual. So the system can take decision itself on such a situation in order to reduce the traffic jam among the city.

In the initial stage the system will detect the vehicles and waiting time through network cameras, then the data will be passed to the appropriate server and receive the response to control the particular traffic signal point.
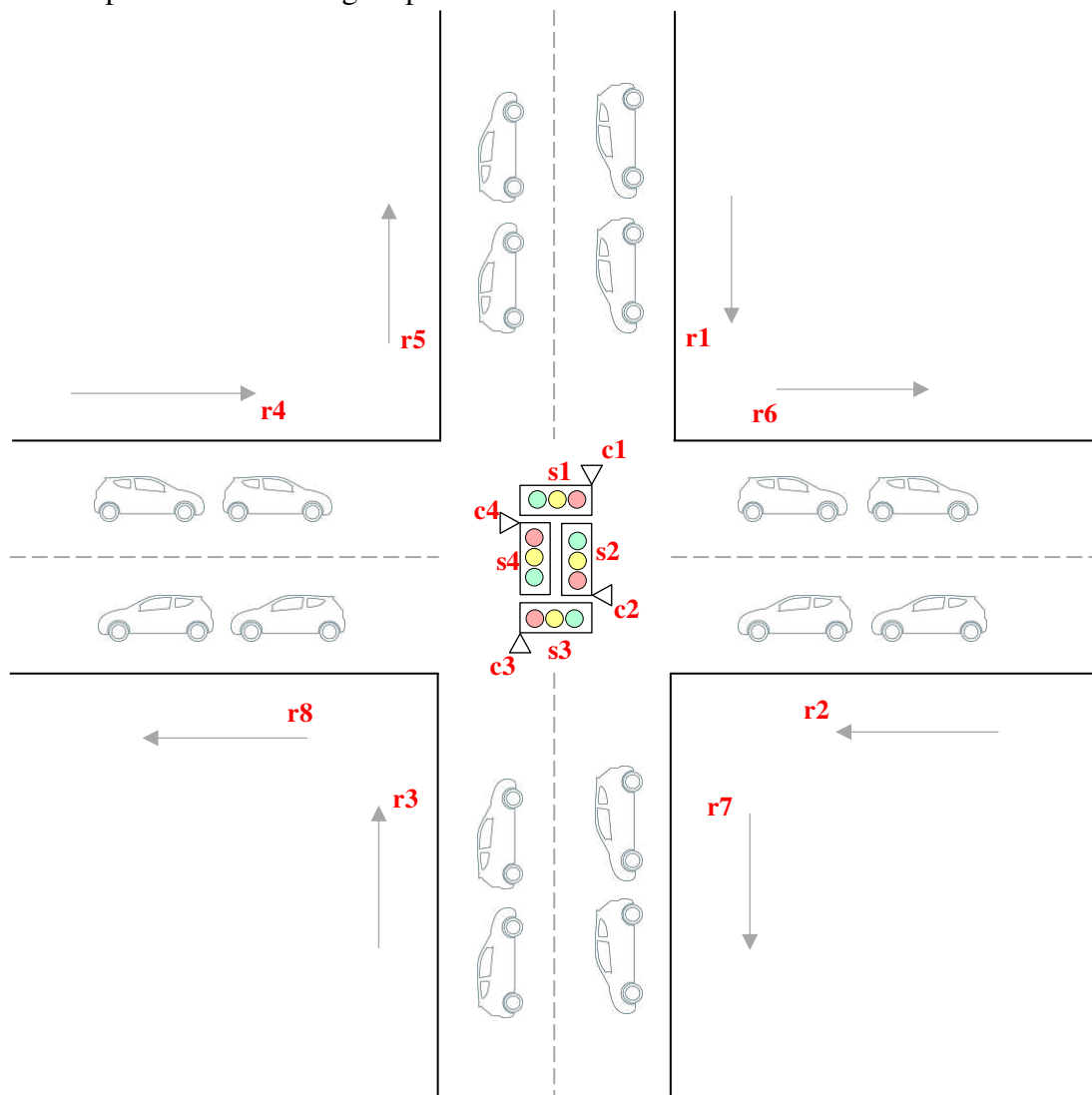
7.1 Variables

r = road

c = camera

s = signal

i = inactive state all

a = active state

t = waiting time

7.3 Vehicle tracking roads

r1, r2, r3, r4

7.3 Camera and signal of the road

Road	Camera	Signal
r1	c1	s1
r2	c2	s2
r3	c3	s3
r4	c4	s4

7.4 Active states

s1 & s3

s2 & s4

s1 != s4

s3 != s2

7.5 Training Dataset

active	r1	r1t	r2	r2t	r3	r3t	r4	r4t	active-signal	active-time
i	0	0	0	0	0	0	0	0	i	0
i	1	5	0	0	0	0	0	0	s1	5
s1	5	5	0	0	0	0	0	0	s1	10
i	5	5	0	0	10	10	0	0	s1,s3	10, 20
s3	0	0	0	0	5	0	0	0	s3	5
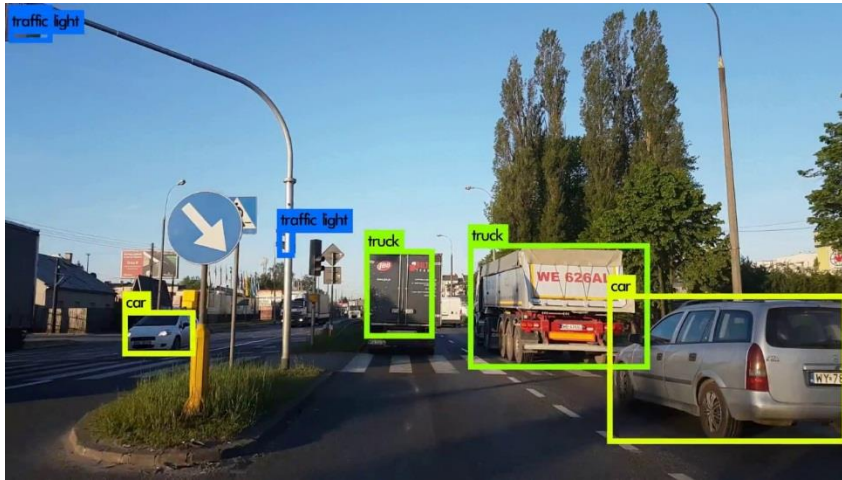
Figure 3: Vehicle detection

8. DELIVERABLES

This application will save many people's time from waiting on a road long time with the poor traffic control systems which is working loop basis. As I mentioned in the previous sections here our goal is to make AI based traffic control system to solve the real problem in cities.

I believe this system will control the traffic signals in a better manner than human using many data and machine learning models. The public is a part of them who can get benefits from this as well as the police department can easily manage everything through the system, sometimes they even can have entire cities' traffic situation and take some additional decision on that or predict the vehicle situation on a particular day with figures.

Here I would deliver a well-trained vehicle detection model according to Sri Lanka roads to implement in network cameras. That will take decision in one or two signals but it can be extendable for further modifications such as connecting all the cameras in city or store data to predictions.

9. RESOURCES REQUIRED

1. IP Cameras or Web Cameras (Basic Usage)

2. Good Servers with high level CPU or GPU

3. Traffic signal lights

4. Software tools to make machine learning models.

10. EXPECTED OUTPUT AND OUTCOME

The system should be able to understand the vehicle information in front of the camera according to the written logic and make decision to switch the signal lights to green or red. Also the system can communicate between other traffic controls to know about all the traffic situation in roads, but it's an additional thing that I propose in this documentation.

If there is no people in traffic jam, more people or night time the system should be able to take the proper decision on every situation.

11. TIME PLAN FOR IMPLEMENTATION

	ACTIVITY	START	FINISH	DAYS
1	Project Proposal	22-Jun-18	24-Jun-18	3
2	System analysis & Requirements gathering	25-Jun-18	1-Jul-18	7
3	Preliminary investigation	2-Jul-18	8-Jul-18	7
4	Build a machine learning model using Tensorflow	9-Jul-18	22-Jul-18	14
5	Train the model	23-Jul-18	1-Aug-18	10
6	Implement the trained model with cameras	2-Aug-18	6-Aug-18	5
7	System testing and quality assurance	7-Aug-18	11-Aug-18	5
8	Prepare the final documentation	12-Aug-18	21-Aug-18	10

12. LIMITATIONS

The following limitations may be the most the most obvious to occur, although some may not occur at all if avoided beforehand. General Limitations that may occur the project in general may conjure many new constraints. The project will last up to the given time and within this time period many limitations can occur.

- Time constraints - Time is the most important part of any project. Time has to be managed well in order to meet the required deadlines. Due to the reason that out program has very little time remaining the time remaining to complete this project is less and therefore this is a major limitation.

- Maintaining project scope – The main aim of the project is to implement an artificial intelligence traffic control system. Although the initial scope has been realized, changing the scope may occur during the project, which have to be strictly avoided.

- Lack of massive datasets – The datasets we will use will be relatively large, but they may not be larger than required. This needs to be understood as a limitation because measures need to be taken in order to maintain the efficiency of the system. All the dataset in internet is based on different countries so we want to make own dataset for Sri Lanka.

- Consistently maintaining a single methodology – Any particular project would consist of one methodology, for example the waterfall model. While this is the norm in any software project, it can be considered as a limitation. This is because of the reason that if any changes need to occur in the project after the planning phase, and the planning has not been properly conducted, it will not be possible to change the methodology without causing major problems to the core of the project.

- Lack of financial support – A certain limitation in the project is that I will not receive any financial aid and will not be able to use any financial capital in the project. This would mean that any additional implementation would require investments from my side.

- Changes in client's thought - People can change their minds quickly based on temporary distractions. This factor, even though it seems unlikely, may affect the project negatively as a limitation.

13. ACKNOWLEDGEMENT

I would like to declare my honest sense of gratitude to our institution – International College of Business and Technology (Associate College of Cardiff Metropolitan University) (ICBT).

14. REFERENCES

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