RMIT UNIVERSITY

Assessment 2: Our IT World

Project: Traffic Control System with AI

COSC2083 – Introduction to IT

Group 7

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We declare that in submitting all work for this assessment, we have read, understood, and agreed to the content and expectations of the Assessment Declaration.

A. Team Profile

Team name: Group 7.

Member's information:

Pham Phuoc Sang (s3975979@rmit.edu.vn):

Skills: Problem-solving, Time management, Competent in data structures and algorithms, Good at solving linear algebra. Have a basic understanding of machine learning & neural network and deep learning, Proficient in Python.

Hobbies: I spend most of my free time learning about AI, machine learning, and deep learning by reading books and discussing them at some forums. I also work on my algorithmic thinking and coding skills while learning about data structures and algorithms.

IT interset, experience: I have been interested in AI since I was in secondary school, and I spent a lot of time learning about AI applications, how AI works, and the algorithms behind it. Also, i did some small projects that I created on my own, such as face detection, object detection, a simple neural network, and virtual assistance.

Vuong Viet Dung (s3878281@rmit.edu.vn):

skills: experienced using Git. Programming languages: Python, C++, Java, JavaScript. Writing documentations. Worked in many groups on different projects before, therefore, I have solid team-working skills and problem-solving skills.

Hobbies: Although I have learned a lot of programming languages and software engineering principles, I've always loved working with systems and networks.

IT interest, experience: I worked in a team that make a machine learning-based project before. Moreover, I've learned the tools and languages that may be needed for this project. However, I'm more interested in constructing networks and programming hardware components.

Kang HyeonSeok (s3963294@rmit.edu.vn):

Skills: MySQL, Database designing, Web programming, Git. Researching, report writing. Have adequate knowledge of Python. Time management and team-working skills

Hobbies: I spent a lot of time learning new programming languages such as java and javascript and also I like to watch programming videos

IT interest, experience: I have experience of java languages from other courses and I have also worked on java from online lectures before I entered RMIT University.

Group processes:

Despite the fact that one of the members of the group decided to withdraw from this class, the process of the project ran successfully. However, this shouldn't even cause a blip in the progress of our project at all. Every member of the team is responsible for each part of the project, and at the end of each day, we discuss what we've accomplished and make plans for the next day. As a result, the growth of our group will always remain on track. By understanding each member's strengths and weaknesses, they are distributed into which parts and tasks are suitable the most for them. That is the reason why our team operated like a well-oiled machine.

Career plans: Dung wants to become a penetration tester, while Sang and Kang intend to pursue a master's degree. Sang desires a post-graduation job as an AI researcher or AI application developer, while Kang has not yet made a decision. Each member's desired employment is connected to the information technology (IT) area. However, they are still distinct from one another. Dung's mission is to assist the company in identifying as many vulnerabilities as possible, thereby eliminating the risk of future assaults by repairing them. Sang's job requires him to do more research and work with algorithms in the area of artificial intelligence (AI) or the use of AI in real-world applications like virtual support or autonomous driving. Kang is willing to get a master's degree to fulfill his professional responsibilities or to transmit his expertise to future generations.

B. Tools

To build the UI prototype we used photoshop.

We also use HTML, CSS, JavaScript to create our website, which can be view at: https://vdvuong0502.github.io/ourItWorld/

Or view code at GitHub link: https://github.com/vdVuong0502/ourItWorld

C. Project Description

1. **Overview**
1. ***Topic:***

- **The big picture:**

● Traffic Clog is the primary concern of the rapid and growing planet. Due to the growth in the usage of more private automobiles and insufficient road network capacity controlling traffic using the old technique is onerous. Traffic has a significant impact on both pollution and individual productivity. Variable traffic congestion may not be effectively and significantly resolved by the use of conventional procedures. Today, artificial intelligence (AI) and machine learning (ML) play a significant role in the resolution of several real-world issues. Therefore, to handle this challenge, our group come up with the idea that utilising the application of artificial intelligence and machine learning. This can be the vehicle that leads us to the best answers. An AI-enabled traffic management system may provide cars with more freedom by allowing them to be more directed and controlled by their external surroundings. The primary objective of AI is to reduce manual interaction.

● The manual management of traffic congestion has been shown to be both unsuccessful and time-consuming. It is feasible to overcome the shortcomings of the manual technique by using automotive technology and other adaptive technologies. It is hard to provide an exact estimate of the amount of congestion

that will be present at a particular place due to the occurrence of unpredictable events. The key challenges associated with anticipating traffic congestion include a lack of capacity, uncontrolled demand, and predetermined times for the length of traffic signals. Thus, we need to maximize the traffic flow at the intersections and minimize the waiting time using AI applications in the systems to identify and manage the flow of traffic easily.

2. Ideal scenario:

- Reduce or eliminate driver-caused automobile accidents:

  Driver mistake is the leading cause of automobile accidents. Humans are too obstinate not to drive when distracted, inebriated, high, or tired, therefore it should not come as a surprise. The apparent answer to such unsafe driver behaviour is to give the wheel to something incapable of becoming distracted, inebriated, high, or sleepy as people do when driving. Consequently, vehicle autonomy is necessary. Self-driving cars are outfitted with state-of-the-art cameras, sensors, and radars to assess their surroundings and other road users in order to foresee the unexpected in ways that our limited and inferior senses could never do. These future automobiles and trucks also respond faster to potential dangers. Moreover, vehicle-to-vehicle connectivity might allow them to instantly share information and notify one another of surrounding threats.

- Identifying Risky Pathways:

  Vehicles driven by AI may operate on gasoline or electricity, but they are fuelled by data. Intelligent automobiles and trucks continuously collect data that, with the application of appropriate analytics, may provide actionable insights. Transport interests may utilize these insights to determine which parts of the road are intrinsically hazardous for one reason or another, allowing them to design safer routes for motorists.

3. Motivation:

- During rush hours, there is a great deal of traffic jams and accidents in HCM City, which causes transportation challenges for many residents. Due to working hours and finish times, a large number of residents used transportation at this time. AI-based traffic control systems are the subject of our discussion. It employs AI to handle traffic control systems. The traffic, people, roads, and timings of the transportation network can all be correctly anticipated and managed by artificial intelligence. In addition, AI provides the most efficient means of transportation, hence enhancing customer service. We were encouraged to tackle this topic because we have expertise with traffic, and we want to build AI solutions that will assist the inhabitants of HCM City in finding a solution to the traffic problem and reducing the number of accidents.

- Artificial intelligence (AI) is progressing at an accelerating rate. Currently, new technical applications and systems are employed to imitate, extend, and increase human intellect. With the continuous advancement of AI technology and the expanding simulation of the human mind and mental information processes, AI has garnered ever-increasing interest in a variety of industries, including transportation.

- **Competitors and differences:**

- There are several contenders for AI applications in traffic management at now. Such as autonomous cars, intelligent traffic signals, traffic flow analysis, intelligent traffic management and monitoring systems, artificial intelligence (AI) cameras, intelligent parking, and driver monitoring. Our efforts are similar; we integrate the majority of them to produce AI-based traffic management with two subsystems:

    - The traffic control system which includes the transportation controllers attached to the vehicles and the traffic lights controllers. Using intelligent cameras, driver monitoring, and self-driving vehicles allows communication between vehicles and systems hand in hand.

- Command control system. Utilizing intelligent traffic management and monitoring systems to control traffic flow and enable vehicle communication.

However, this is still the concept behind our project. We are unable to compete against all of our competitors owing to a lack of human resources and infrastructure, as well as finances, and all of these things are compounded by the fact that we have a restricted amount of knowledge.

II. Detailed Description

1. Aims

We aim to create a traffic control system that uses AI technology to reduce traffic jams and car accidents. Our AI Traffic control system will analyze various real-life factors such as population, road conditions, time, etc. and make predictions to allow the most optimal flow of traffic in any given condition.

We will make this work with the following functions:

- Observational: Observe the current road condition, such as traffic, weather condition, and time of day. This will be done by retrieving available online data, some personal data necessary such as current location, and camera real-time images to process and detect the number of vehicles per amount of time. will be retrieved through the user's phone or computer's built-in sensors/trackers.

- Analytical: Use the data obtained through the observational functions to analyze and create a decision and prediction to give the user the best option while on the road, change the light signal at the appropriate time of the day, and demonstrate the data in chart format.

- Announcement: Announce the decision the program makes to the drivers when they change to assistant mode, through on-screen or sound notification.

2. Plans and Progress

Having been experiencing the horrible traffic in Ho Chi Minh City helped us come up with an idea to bring down the situation. With the rise of machine learning in many industries lately, we thought that we could apply it to analyze the traffic situation and give predictions, and decisions about the traffic lights' time, and control autonomous cars. The team conducted much research about the applications of AI in this field, what we had already been able to do and what we could do with our knowledge at the time. We spent the first week discussing the scope, and sometimes we argued, but I believed it only made our decision more insightful and accurate. Finally, we could decide what we want our system to do. We wanted to divide the system into 3 main parts:

- The first part will be a subsystem attached to a car to take information about the speed, nearby objects, and vehicles, and the distance between them. It will combine all this information, make predictions, and automatically control the car.

- As for the second part, we planned to attach cameras at each intersection, use a deep learning algorithm to detect and study the vehicle flows, then calculate and give the most accurate time.

- The third part will be a central control system to monitor each intersection and the data at 2 other subsystems sent, then it will generate charts and results to demonstrate to the supervisors. We also want to create a private server for these subsystems to communicate to provide the most precise conclusions.

We then quickly made a plan in order to bring this idea to life. We agreed that this project is not a small one and there were many things we didn't know regarding AI, hardware, and network, so we planned to create the prototype of the system and the functions for the first phase. We spent the next week researching and listing down the tools and technologies that might involve. This is a machine learning-based project, so when we thought of the tools the first thing that came to our mind was Python. There are many reasons: it has a powerful math library to help us calculate the predictions; it has a lot of modules that help process machine-learning algorithms; it is greatly supported by the community etc. But the most important reason was we all knew Python beforehand. It would take less effort to learn the language and allow us to focus on researching other technologies and algorithms. After having decided on

the language, we started to dig into the libraries we would need for this project. As expected, since the language is highly supported for machine learning, we took no time to list down all the packages and technologies. Those included **MySQL** (for storing processed data for each intersection and vehicle that were registered); **NumPy, Keras,** and **TensorFlow** (for image processing and AI training), and **Pandas** (for creating data charts). Since we will be coding together, we decided that each member should grasp how to use every tool. We thought it would only take us 2 weeks. However, after the first few days, we realized that each of these tools and technologies might be hard for newcomers, so we made a new arrangement: every member needed to know the basics of all the tools, but each will specialize in different ones. In the end, it took us nearly 3 weeks to be able to learn what we planned.

We were behind the schedule, so we decided to split the jobs. One person will design the UI for the command system, one will design the system architecture and the other two will research all the algorithms involving the project, and all must be done in 2 weeks. It was at that moment, we got horrible news, which is that one member of our team decided to withdraw. We were short-staffed, but the project had to go on. We had to learn the left member's specialized technologies and take up more work. It never rains but it pours, and we hit another wall. More precisely, it was our mistake in the first place, we should have investigated the automatically controlled cars. In order to archive the autonomous state, we need to perform the neural network method in deep learning and use an ADAS (Advanced Driver Assistance System). To do this, the hardware requirements are high. Moreover, ADAS is much beyond our budget and scope. We had to change our scope. All the functions regarding controlling the car and making driving decisions were removed. Thus, the scope became much smaller and more achievable. The system will still contain 3 parts:

- The first part will just collect the car's state such as speed, nearby objects, vehicles, and distance between them. Receiving response from server and display notifications on the screen

- The second part will not have any change.

- The third part will have an additional function, which is posting the processed data and charts so that these data can be used by other applications to update the city traffic news to other people.

Assembling the server is not in the scope so we planned to hire a cloud server to run some machine learning algorithms, respond to other parts and store processed data.

Stepping into the world of AI turned out to be much harder than we thought since we do not have the required knowledge in both the IT and machine learning fields. Although we quickly finish the UI design (which contains a main screen with small windows to display the current situation at every intersection. Users can click on a window to zoom in. This UI will contain a menu for users to switch pages to view analyzed data and charts.) and the system architecture (after having modified the scope), we needed nearly a month to read through all the material we found, and finally, we were able to list down some of the most effective algorithms that we can make and suitable components to use. Still, which one to use is the question that we cannot answer when we haven't really implemented these functions.

Having all the information that we needed, we then got our hands on making the first prototype. The trouble in the past made our work more effective this time. We created a prototype, which you can view later in this report, that demonstrates the UI of the command control system and provides the clearest vision of how the whole program will work. After that, we wrote this report with all the project descriptions that we believed not only will be a useful document when explaining the project to people who are not from the field but will also be a reference document for us to make sure the project is still on the right track (or any other team might take up on this project if we are not able to complete it)

3. Roles

a. The roles

After carefully discussing, our team decide there will be 6 main roles involved in this project.

Team Leader: The team leader oversees the overall performance, and organization of the team. He also makes sure team members work well together and are on schedule to deliver the product.

UI / UX designers: Design the user interface of the command control system as well as the method of displaying processed data to the drivers. Moreover, they are responsible for ensuring that browsing experience and features are accessible to users, analyzing the target audience's behavior.

Software developers: Code the software and closely collaborate with other roles to make the team's plan a real and working product.

Testers: handle the manual job of the testing stage. Testers are directly responsible for product quality.

Technical Designer: Responsible for choosing tools and technological solutions for the whole development process, establishing relationships among the components in the system and the roles of each component, updating the system design, and the process of development, testing, and deployment.

Product Manager: Supervises the development process, does research about alike systems and the market, controls and plans the tasks, makes decisions about the team's ideas, responsible for documentation and maintenance.

b. Who should be which?

Despite the team structure has been different from when we started, we decided to stick to the old responsibilities that were assigned to each member in the proposal to decide who will take which roles if the team cannot recruit more members.

Vuong Viet Dung: s3878281@rmit.edu.vn

- Roles: Team leader, lead software developer, tester.

Kang HyeonSeok: s3963294@rmit.edu.vn

- Roles: Lead UI/UX designer, software developer, tester

Pham Phuoc Sang: s3975979@rmit.edu.vn

- Roles: Technical designer, software developer, product manager.

4. Scope and Limits

a. Scope:

The main structure of the scope will be pretty much the same as our proposal except for some removals of the features that we decided we would not be able to complete:

- Automatic Distance Recognition (ADR): Utilizes sensors to track and detect the distances between objects and vehicles. The fundamental purpose: maintain safe distances and ease the risk as well as drastic accidents as well as retrieve and send data to the cloud system.

- Vehicle Detection: Detect types of vehicles around the car.

- Traffic lights signaling: Display the signal on the traffic lights with the corresponding timer by receiving the data from the server.

- Master Controller: monitoring application to view what is happening inside the application and charts that demonstrate data processed.

- Machine Learning-based forecasting: Uses machine-learning algorithms in the cloud server to process real-time traffic data to evaluate and interpret for predictive maintenance to determine signal timings. Determines indicator timings by using advanced machine learning algorithms to scrutinize real-time traffic data for predictive maintenance.

- Real-time reports and API service: publish real-time data as API service for other vendors or developers. Can be used to help decide the road for a map system or report the news for drivers to know the current traffic situation.

Limitations:

-AI methods:

- AI methods (such as neural networks) are often seen as “black boxes” that merely attempt to map a relationship between output and input variables based on a training data set. Which was previously alluded to in the article by “Van Zuylen”. This is a significant argument against several approaches to artificial intelligence. Therefore, immediately prompts concerns about the instrument's capacity to generalize to situations that were not well represented in the data set.

- AI-based search methods, (such as genetic algorithms and ant colony optimization) are never guaranteed to reach the “optimal” solution. When utilizing AI-based search techniques to solve an issue, it is frequently difficult to acquire meaningful insight into the nature of the problem and the solution, as is available when using mathematical programming approaches, for instance. The inability to conduct sensitivity studies fast is a prime illustration of this restriction. In order to obtain insight into the issue, it may be necessary to repeat the model numerous times to examine the sensitivity of the solution to the different assumptions and parameters of the problem, which may be resource-intensive or time-consuming.

- For several AI methods, there is minimal information on how to determine the optimal values for a method's tuning parameters. Before applying this approach to a particular issue, every aspect of neural networks, for example, the usage of hidden layers, the number of neurons to use in the hidden layer, and the kind of trigger functions to use in the neurons, must be built perfectly. To determine the optimal values for these parameters, a lengthy trial-and-error method is required.

In the transportation industry, the capacity to predict short- and long-term traffic flow is crucial. The difficulty is in forecasting in the face of unforeseen occurrences and poor weather conditions. Unfortunately, current AI approaches are incapable of handling such occurrences and circumstances. To achieve high precision, it is essential to build weather and incident-responsive algorithms and forecast methods. Incorporating AI into the design of these algorithms would increase the efficiency of online calculations and the standardization of criteria for geographical and temporal data coverage. As a restriction, the majority of AI techniques, such as NN (neural networks) in time series transport applications, seldom involve any testing of the error characteristics and model design.

- **Computation Complexity in AI Algorithms:**

- An algorithm is a collection of rules designed to solve a particular issue. Designing and analyzing algorithms is an essential component of AI technology. It must be efficient in terms of the amount of time necessary to process a large quantity of input data. Additionally, the effectiveness of an algorithm will be determined by its memory use. Big O notation is the most well-known approach to assessing an algorithm. In an ideal environment, the number of operations remains constant as the volume of data rises. However, this cannot be accomplished in real-time. In a scenario with a basic algorithm, the quantity of input data and operations rises at a constant pace. In complex algorithmic situations, the number of operations and calculations is expressed in terms of polynomial time (X^2), exponential time (2^X), and factorial time (X!) [1]. In transportation, data may be acquired from a variety of sources, including sensors on the road, connected devices, toll gantries, GPS, and cloud apps, among others. Therefore, it complicates the calculation required to address a particular issue.

5. Tools and technologies

Hardware:

Cloud server: We can rent a cloud server to act as the primary server for the purpose of transmitting and receiving real-time data. Therefore, those data can be calculated and computed with practical and associated algorithms. Other subsystems are then able to receive the signals being transferred from the server in order to carry out the task and arrive at the best possible decision.

Raspberry pi 3B+: This is a little computer that functions similarly to a mainboard in that it is used to receive signals that are sent from the primary server and to provide the server with real-time data. As a result, the Raspberry Pi is able to carry out the work in accordance with the signals that are sent from the primary server.

Infrared obstacle avoidance sensor: When the distance between the vehicle and the obstacle was measured by the sensor, the data was communicated to the raspberry pi so that it could be used to modify and maintain a safe distance.

Camera: Real-time data collection is accomplished by first collecting a picture and then identifying the features included within it. Consequently, these features should be supplied to the raspberry pi, and the data should continue to be delivered to the main server for the purpose of computing and calculating.

Software:

- OpenCV: OpenCV is a machine learning library based on computer vision that detects the item. This library is used to distinguish between a vehicle, pedestrian, traffic congestion, traffic incident, and traffic signs.

- Pandas: This is the data manipulation software library. This is used to generate a flowchart that represents real-time data in order to manage traffic flow. Creating a flowchart based on real-time data used by administrators to maintain the system. Additionally, authorities and correspondents may utilize this to gather data for statistics works.

- TensorFlow & Keras: The fundamental algorithms for the system are included inside these software libraries. Both of these APIs are high-level, allowing for rapid model development and training.

- NumPy: We used NumPy to quickly process images and arrays using matrices and arrays. Increasing their computational speed

- Python: This language is used because of its effectiveness, adaptability, and compatibility with machine learning and artificial intelligence. Additionally, Python is compatible with several operating systems, including Linux, macOS, Windows, and Ubuntu.

Algorithms:

  - CNN: This convolution-based Neural Network method is used to recognize objects inside images. Which can recognize traffic signs and road layouts in addition to detecting automobiles. Calculations are performed to extract features from a picture. This may contain

convolution, pooling, rectified linear units, and layers with complete connectivity. Which may improve the effectiveness of categorizing items and making the right decisions.

- KNN: As a nonparametric regression approach, we use K-nearest neighbor. It has been shown to be an accurate strategy for predicting short-term traffic flow. To identify the dataset's closest neighbours and cluster them. The value of k should neither be too little nor too large since this results in inconsistent output. When a new item is received, its Euclidean distance is calculated and it is placed in the cluster with the smallest Euclidean distance. Then, the similarity between real-time data and sample data is evaluated.

- ANN: The artificial neural network (ANN) technique is used to recognize the non-linear connection between input and output characteristics and to propose generalized solutions for traffic volume forecasting. At each epoch, the error is estimated by comparing the computed output of each input to the predicted output. Backpropagation is the most common error propagation method. A random weight is first allocated to each processing unit. In the training, cross-validation, and testing stages, the primary aim of the neural network optimization procedure is to decrease the mean square error. We evaluate the efficacy of the ANN model for short-term traffic prediction under mixed traffic scenarios.

- Although the members of this group have some familiarity with the libraries and algorithms relevant to the area of AI, they have not delved too deeply into the subject matter. Thanks to this research, every one of us will have the opportunity to not only get a fundamental understanding of the role that AI plays in the management of traffic but also to have an insight into the algorithms themselves

6. Testing

Based on the scope of our project, we will divide the testing into 3 phases.

The first one will be conducted along with the development of the software functions. We will test the machine learning algorithms for analyzing and predicting traffic flows with a collection of sample data that we are planning to collect to see if they give us correct results in an efficient amount of time. Due to busy traffic in Ho Chi Minh City, and the expectation that the system will report real-time results, we hope these algorithms can work out the conclusion in under 2 seconds.

The second phase will be put into action when we finish the algorithms. In this phase, we will test if the hardware components we choose work well and are able to communicate through the private network and send data to the cloud server. We need data on how fast the connection is, how the weather condition will affect the results given by the components, and what is the minimum requirements of the cloud server to be able to process the data in the given amount of time.

Lastly, we will test the system on the streets. This phase will be the hardest. We will need permission from the local government and residents to be able to collect camera data at intersections. Moreover, we will have to rent cars and assemble the needed components, drive them through the city's streets to collect real-time data, then analyze the data to have the system modified if needed before putting it to work. At this phase, we will need volunteers to test the UI of the command program. We aimed to create a UI that required minimal training to use it. Therefore, we can invite non-trained users such as friends, families, or students because they are most likely to be found. We will let them use the beta version of the command system and give them a survey to evaluate it based on their experience.

7. Risks

Human resources shortage

During the development of the project, some members of the group might have unexpected problems and must temporarily or permanently withdraw from the project. This will affect the pace of our group. We will have to cover their works, which contain the knowledge and skills we do not possess.

Schedule risks

Although we have planned to spend 3 weeks on tool learning, it is possible that it will take longer than expected. Delays may force us to extend the schedule or cut down on lower-priority functions to meet the deadline of the presentation date.

Network down

We need a common network for the sub-systems of the project to communicate to calculate and predict the situations from different perspectives. A backup connection method may be required for such circumstances.

Cyber security

Presently, cyber security is a vital consideration that has a significant effect on the modern-day technologies on which society depends. Given that systems such as AI-based traffic management are mainly concerned with regulating road traffic and are vulnerable to cyberattacks, which are capable of inflicting major harm. Thus, cyber security is a crucial component of tech operations.

Due to the vulnerability of computer-based technologies such as GPS, websites, smartphone applications, or interconnected systems with multiple chances of being hacked, road traffic management systems can be effortlessly manipulated by hackers, which might interrupt traffic flow or cause drastic accidents.

Researchers have intentionally hacked into cars since 2015 as part of experiments to highlight the presence of vulnerabilities in the systems of the high-tech automobile. Soon, this can be capitalized on to fulfil hackers' illegal purposes.

Ethical issues

As a matter of fact, the fully autonomous automobile has not yet evolved, and the limitations of AI sensor technologies are unavoidable. Therefore, when it comes to ethical concerns, there is no possibility for such vehicle tracking systems to become a reality one day. To accurately address this situation, it is essential to perceive the philosophical concept called "the trolley problem/dilemma" (see Appendix A).

The research showed most of the people who were asked, tended to turn the trolley, and prevent five deaths at the cost of one [2]. This led to the scientists' confusion, as they found it difficult to comprehend what makes it right to put the priority of five people's lives over one. For humans, this kind of thinking takes thousands of years to develop and become our reasoning style. Neuroscientists are continually finding new truths about the human brain and its logical processes. Teaching the computer what is ethically right or wrong or transmitting the notion of emotional thinking is determined to be impossible to accomplish.

Computers do not have emotions, human brains, or the ability to express instinctive emotional responses based on righteous judgment or intuition – this purely human characteristic must be taught to the machine via coding and programming, a task reserved for science fiction.

Unstable lighting conditions

One of the crucial issues to address during system development is unstable lighting conditions. One of the prominent features that help traffic signs be distinctive is their unique colours, which differentiate them from background information and facilitate identification. However, in outdoor conditions, illumination changes have a significant impact on the colour of traffic signs. Therefore, detecting traffic signs would be complex under those circumstances.

Visibility

The light produced by arriving cars' headlights, shadows, the fading and blurring of traffic signs affected by illumination through rain or snow, and other weather-related factors may all contribute to poor visibility. Identifying traffic signs in such instances is a difficult process, and a sensor may miss these signals. As a result, the mentioned factors may increase the possibility of AI making false detections and diminish the system's efficacy.

Numerous occurrences of the sign

Multiple traffic signs emerging at the same time and similar form human-made components may induce overlapping of signs and lead to a false detection when detecting traffic signs, particularly in metropolitan areas where signs are more densely packed. Rotation, translation, scaling, and partial occlusion may all have an impact on the detecting process.

8. Group processes and communications

Meeting progress

We met twice per week (we found that twice a week was the optimal number of times to meet in a week), and every meeting lasted between 30-60 minutes. Even while we were working independently, we used team chat to communicate about our work. The

project component and the workload were split and distributed to each team member as evenly as could be, and we regularly checked on each other's progress and shared feedback.

Communication methods

We always preferred in-person meetings over online meetings, which were often held at cafes or on campus. An in-person meeting allows for greater focus during meetings, prevents digressing, and allows the team members to get to know each other better. We believe that we could have more and better ideas to work with if we knew and understood each other better.

In some circumstances where we were forced to have the meeting online, we used Discord, because of its useful functions such as screen and file sharing, and higher call quality, and because it is the program that allows the closest experience to an in person meeting.

Outside of meetings, we used Facebook Messenger for short communications and such. We chose to use Messenger because it is a communication medium that we all already use.

Problem and solution

At one point, a group member was completely unresponsive, and one team member attempted to contact him and found out that, for whatever reason, he'd quit the group without notifying us. So, the three of us had another meeting and re-distributed our workloads to cover for the member that quit.

D. Skill and Jobs

Technical skills:

- Python Programming: Needed as most of the programming will be done in Python.

- Mobile and Web Development/Application skills: Needed to create the UI/UX Component.

- Knowledge in:

- Database (SQL): To form a data set to feed the AI/ML System.

- Machine Learning & Image Processing Tools (NumPy, Keras, TensorFlow): Analytical functions will be made with these tools.

Soft Skills:

- Project Management: Includes leadership, documentation, time and quality management, meeting requirements model, task management, conflict resolving

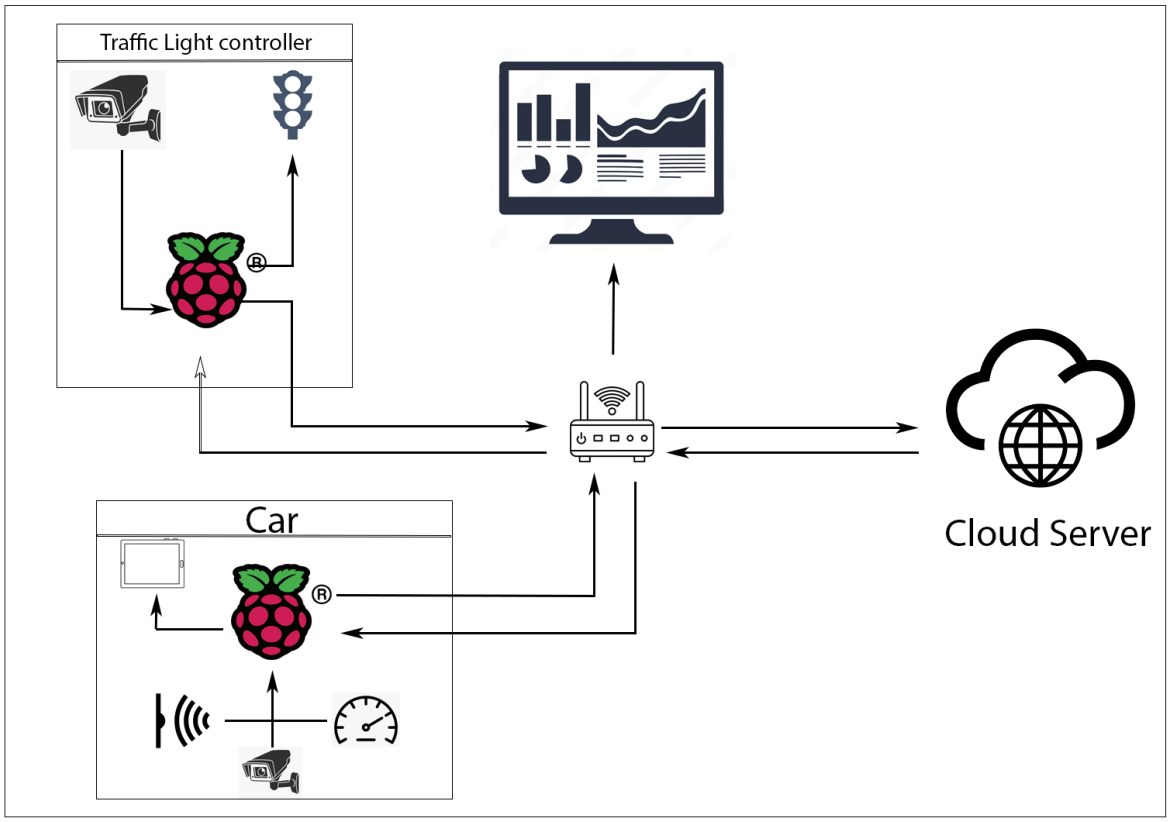
- Needed to assure the quality and timely delivery of the project.

- Team skills: Communication between project members, supporting each other, team spirit, etc.

- Needed to minimize conflict and maximize collaboration and individual input to the project to be as efficient as we can be with our efforts.

E. Project outcomes / Prototype

We've made a simple system design diagram to demonstrate what functions it may have and how the parts work together.



1. System design

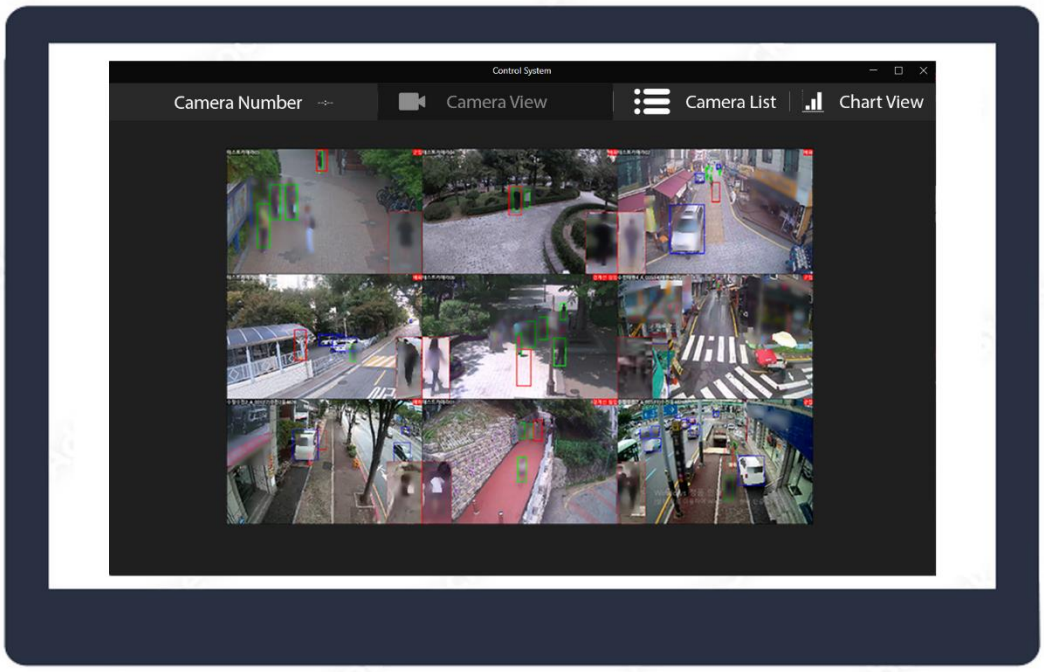
- The cloud server we hired to run all the machine learning algorithms and data processing algorithms.

- The subsystem in a car: A raspberry Pi will collect the data from a camera attached to the car (to recognize nearby vehicles), speed, and other objects (using IR sensors), then send those data to the server. Then receive the response and display it on the screen or by voice.

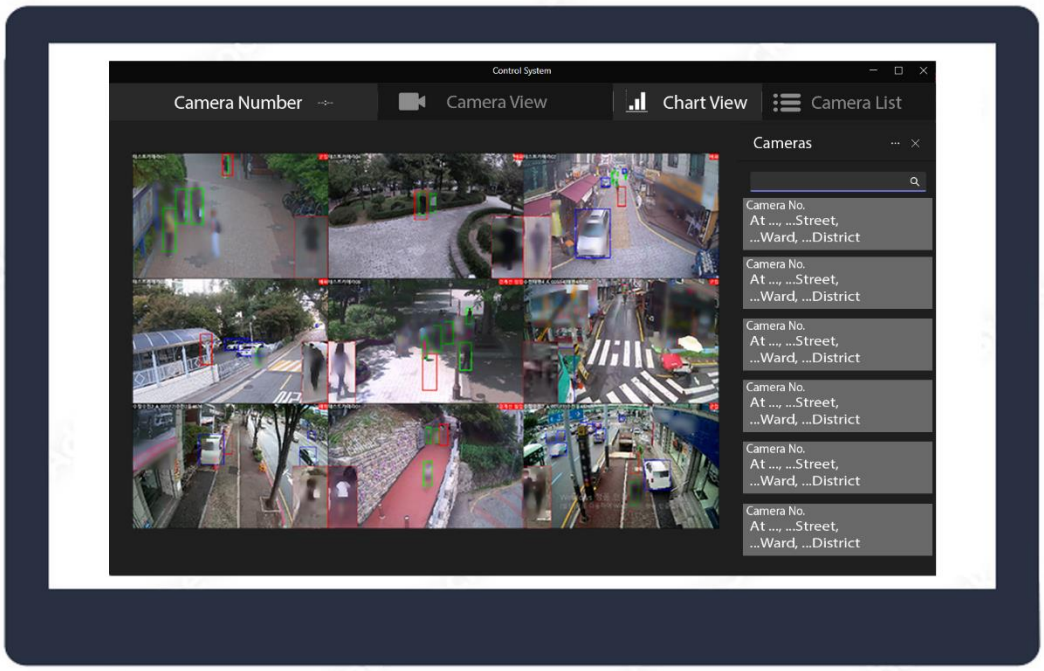
- Traffic light controller: collect real-time video on the road, send it to server, receive the processed video and the signal for the traffic light.

- And finally, the master control system, can be used to monitor all the cameras' status and locations of those cameras. It can also display the traffic situation predicted by the server in the form of charts.

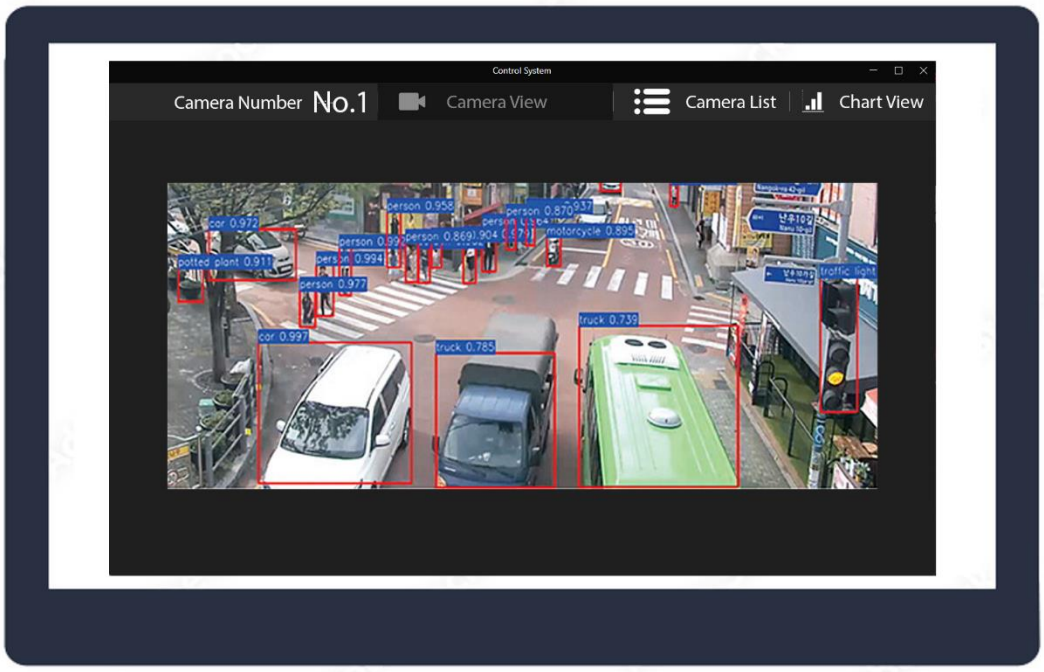
Below is the prototype of the UI design for the master controller. The other 2 subsystems will only work in the backend so there is no UI design for them.



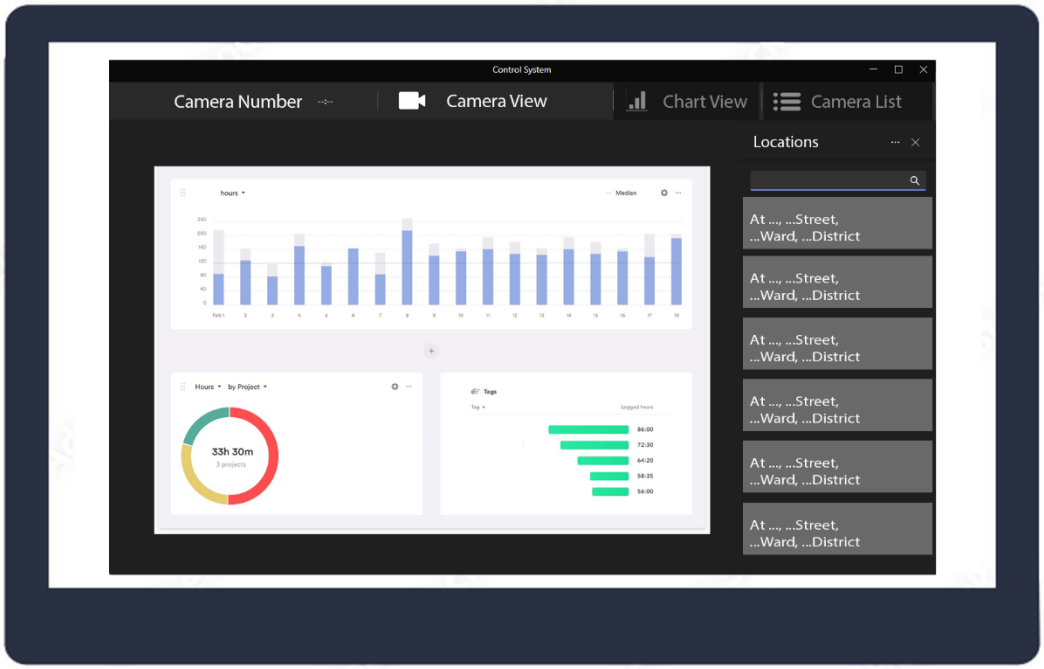
Firstly, it will display small windows for monitoring the cameras.



If users cannot find the road, they can turn on the list as below. It will show them each camera location. They can also search the cameras on the road they want to find.



They can click into 1 window, the system will zoom in on that window. They can click on the screen again to go back.



Finally, they can view the charts that I mentioned.

We believe with the carefully calculated data, we will be able to control the traffic lights, distance, and speed of vehicles, and with the monitor system. It may help people from pushing each other on the road, reduce traffic jams, and help drivers to make better driving

decisions. With all the real-time information, the residents can know which road is crowded at the moment and choose to take other roads.

The system now lacks the ADAS (Advanced Driver Assistance Systems). We want to have this to apply autonomous driving, but the knowledge and budgets do not allow us to do this. So in the future, when we learn more about AI training and get some funding from other investors, we hope to add this feature to bring the original idea back to this project.

F. Group Reflection

Hyeonseok Kang (s3963294)

While we were already in the middle of working on the project, we had an unexpected turn of events, as one of our group members quit without notifying us. However, we didn't let this interfere with our progress, and quickly adjusted to this change by re-distributing each member's workload and rearranging the tasks. Besides the one member that quit, we believe our collaboration and teamwork skills were some of the things that went as well as they could have gone.

One thing we had a challenge with was that we set the goals too high. At first, we had overestimated our capabilities and planned on creating functions in our project that we realize now were impossible to create with our current skills and knowledge. Naturally, we had to make some compromises and give up on some of the functionalities that were not feasible. We learned that the next time we go on about a project, we should first see if we are capable of actually making the product on our own.

During our project, we were surprised to learn that AI technology was much more advanced than we thought. We were amazed to see that AI was already performing so many of the tasks that could only be done by humans and the sheer hold AI already had on society.

Initially, the project seemed impossible to do, but we learned that with effort and teamwork, even the most difficult of tasks were possible. Another thing we learned was the importance of collaboration. After finishing the project, we could see that we couldn't have pulled this project off on our own, and working as a team made things a lot easier.

Pham Phuoc Sang (s3975979)

During our project's development, an unanticipated circumstance led one of our team members to abandon this course without alerting us until I inquired about it. Nonetheless, this unexpected occurrence cannot allow us to halt our development. Again, we reprocessed and redistributed each member's task. I anticipated this catastrophe might significantly impede our development and throw everything into disarray. However, thanks to our collaboration and effort on this project, we can maintain the expected rate of advancement.

I was unprepared for the fact that we set our group project's objective at a level that made it impossible to produce the desired end and prototype. Initially, I believed that we would be able to provide a result for this, but the needs of the project were out of control, making it almost impossible with just three people remaining. The function, algorithms, and infrastructure requirements are beyond the group's capability. To learn from experience, I will establish a target based on the group skills for the next assignment.

Everything has two sides; despite the high goal, I discovered a lot of things that I did not know. This understanding and the powers of AI astound me. AI was a highly sophisticated technology that could do a variety of jobs requiring human thinking.

In conclusion, the project results and prototype seem unachievable, but I have learned that collaboration and effort may make things easier than working alone.

Vuong Viet Dung (s3878281)

I can say that the group works together smoothly. The tasks were divided well and the deadline we set for each other was appropriate. Moreover, the team members are all responsible that always finishing their work before the deadline with excellent quality. They also were helpful to each other. Not only they checked others' parts, but also did they offer help even if other people did not ask for any.

However, I believe there is always space for improvement. For example, we could have drawn the software architecture first to really visualize hose the system will be constructed, so that we can see if there are any holes in the scope we made. In addition to that, I think my presentation skills need to be improved because presenting projects to investors is such an important part of this career.

Working on this project really gave me wonderful knowledge. For example, I didn't know we have to plan this much before starting a project. Moreover, after we thought the plan was excellent, many problems can come up and we will have to change many things such as the scope, timetable, etc. I was also surprised that being a developer, I may also need to know a bit about designing and how to operate some basic image editing software to make prototypes and demos for the system.

I had the chance to work with excellent people, knowing their backgrounds, personalities, and especially their career plan and interest. Knowing this may also help me in my learning and career path. Knowing their interest, they and I may find some common and attend courses together, help each other in the future, and know more about the jobs others are pursuing.

G. References

[1] R. Abduljabbar, H. Dia, S. Liyanage, and S. A. Bagloee, "Applications of Artificial Intelligence in Transport: An Overview," *Sustainability*, vol. 11, no. 1, p. 189, Jan. 2019, doi: 10.3390/su11010189.