FACULTY OF COMPUTING

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SECJ3553-13 ARTIFICIAL INTELLIGENCE

GROUP PROJECT: SMART TRAFFIC

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1 Progress 1: Design thinking-oriented proposal

1.1 Name AI Solution

SmartTraffic

1.2 AI Solution

The transportation and road infrastructure challenges faced by Malaysia involve issues such as delayed accident reporting, lack of proper signage, parking difficulties, toll payment confusion, and limitations in vehicle scanning methods. These challenges contribute to road safety concerns and inconvenience for both drivers and authorities.

A proposed comprehensive AI-driven solution includes immediate accident detection and reporting, marking accident locations for increased awareness, notifying relevant authorities of infrastructure improvements, displaying available parking slots, streamlining parking payments, automating toll payments, and implementing AI-based vehicle scanning for enhanced security and law enforcement. This integrated approach aims to address the diverse issues in transportation, promoting safety, convenience, and efficiency on Malaysian roads.

1.3 Goal of AI Solution

- AI for immediate accident detection and marking accident locations to alert drivers
- AI displaying available parking slots and streamlining the parking process
- AI automating toll payments and addressing manual payment issues
- AI scanning and reporting on vehicle status for security purposes

1.4 Emphasize in DT

Empathy for DT process

What do they SEE?

- See the collision, the involved vehicles, and potentially injured parties at the accident scene
- See the parking spaces are full
- See the current time to scrape parking coupon
- See long traffic queue waiting to pay the toll fees
- RFID or SmartTag is out of service, the car in front needs to reverse and use another method to pay the toll fees

What do they DO?

- Call emergency services and provide the location and details of the accident
- circle around the parking area multiple times if no spots are available
- Scrape parking coupon for current date and time
- roll down car windows to scan the card for payment(Tng)
- slow down or stop the car for payment (RFID, smartTag)

What do they THINK and FEEL?

- may feel shock, fear, empathy and a sense of urgency to help.
- The frustration of finding a parking space
- The constant cycle of purchasing and placing parking coupons can be quite annoying.
- apprehension about freeloaders using the RFID/SmartTag
- anxiety about the RFID/SmartTag installation being broken and unusable
- concern about the balance on the card

What do they SAY?

- Call for help and shout to seek attention
- Ask passenger in car to seek parking
- Ask about current time and parking period
- Ask for tools for scrape the parking coupon
- Say there are no more parking coupon
- Ask passenger for a card to use for the toll payment
- Ask which tolls payment method should use

What do they HEAR?

- Hear the sounds of the collision
- hear responses and instructions from the emergency services operators.
- Hear honk sound
- hear scratching sound when scrape parking coupon

1.5 Process of Define in Design Thinking

User	**Need**	**Insight**
The user is a driver who may be in a state of distress after encountering an accident while driving.	Requires immediate assistance and support to the accident such as medical help or police involvement	The user would like to have a feature that can immediately call the help of the police and ambulance when an accident occurs.
The user is unsure about the current traffic situation before leaving the house and while driving.	Requires real-time accident information about the cause of the accident.	The user would like to have a feature that can mark up the current location on the map and the information on the reason for it.
The user is a driver who has to scan the card to pay the toll fee manually.	Requires a technology that can automatically charge the fee from the account when going through the toll	The user would like to have a feature that can identify the car plate number that is linked to the account in order to charge the fee.
The user is a driver who needs a quick and easy roadside parking option.	Requires an effective way to get a free parking lot	The user would like to have a feature that can immediately provide information on any free parking spaces that are available and near to them.
The user is a driver who gets annoyed with paying the parking fee via a parking coupon	Requires an effective or automatic approach to make the payment	The user would like to pay the parking fee via an automatic payment method
The user is a government official who requires the analysis of the road situation and the information of the car entering the city.	Requires entire data and analysis to access the road condition, traffic congestion and detailed information of vehicles entering the city.	The user would like to have a feature that can immediately understand the cause of accidents and check the passing vehicles to prevent illegal vehicles from entering the city.

2 Progress 2: Assignment 1

2.1 Knowledge Representation

Accident Detection

IF impact_detector = true AND object_sensor = true, THEN accident_status = true

Explanation: If a vehicle impaction is detected by the impact detector and there are presence of objects, then set the accident status to true

Let:

1. p be impact detector
2. q be object sensor
3. r be accident status

Propositional Logic: $p \land q \rightarrow r$

p	q	r	p ∧ q	p ∧ q → r
T	T	T	T	T
T	T	F	T	F
T	F	T	F	T
T	F	F	F	T
F	T	T	F	T
F	T	F	F	T
F	F	T	F	T
F	F	F	F	T

Predicate Logic: $\forall w(\forall x \forall y\ (Is(X,W) \land Is(Y,W) \land ImpactDetector(X) \land ObjectSensor(Y) \land True(W)) \rightarrow \forall z(AccidentStatus(Z) \land Is(Z,W)))$

Explanation: For all ImpactDetector and ObjectSensor are activated (true), then AccidentStatus is true.

Accident Location Reporting

IF GPS_Access = true AND accident_status = true, THEN accident_notification = true

Explanation: If the accident status is true and the accident location is accessed by GPS, then an accident notification is sent to police, ambulance and general users

Let:

1. p be GPS_Access
2. q be accident_status
3. r be accident_notification

Propositional Logic: $p \wedge q \rightarrow r$

p	q	r	$p \wedge q$	$p \wedge q \rightarrow r$
T	T	T	T	T
T	T	F	T	F
T	F	T	F	T
T	F	F	F	T
F	T	T	F	T
F	T	F	F	T
F	F	T	F	T
F	F	F	F	T

Predicate Logic: $\forall w(\forall x \forall y\ (Is(X,W) \wedge Is(Y,W) \wedge GPSAccess(X) \wedge AccidentStatus(Y) \wedge True(W)) \rightarrow \forall z(AccidentNotification(Z) \wedge Is(Z,W)))$

Explanation: For all GPS Access and accident status that are activated (true), then accident notification is sent(true).

Parking Slot Detection

IF parking_slot_detector = true AND parking_available_status = true, THEN parking_display = true

Explanation: If a parking spot is detected and the parking slot is available, then indicating that the parking slots are displayed as available for the user to park.

Let:

1. p be Parking_Slot_Detector
2. q be parking_available_status
3. r be parking_display

Propositional Logic: $p \wedge q \rightarrow r$

p	q	r	p ∧ q	p ∧ q → r
T	T	T	T	T
T	T	F	T	F
T	F	T	F	T
T	F	F	F	T
F	T	T	F	T
F	T	F	F	T
F	F	T	F	T
F	F	F	F	T

Predicate Logic: $\forall w(\forall x \forall y\ (Is(X,W) \wedge Is(Y,W) \wedge ParkingSlotDetector(X) \wedge ParkingAvailableStatus(Y) \wedge True(W)) \rightarrow \forall z(ParkingDisplay(Z) \wedge Is(Z,W)))$

Explanation: For all ParkingSlotDetector and ParkingAvailableStatus that are activated (true), then ParkingDisplay is set to true.

Parking Fee Calculation

IF car_sensor = true AND proximity_sensor = true, THEN parking_available_status = false, duration_counter = true

Explanation: If both the car sensor and the proximity sensor are true, then the parking available status will be set to false and enable the duration counter at the same time.

Let:

1. p be car sensor
2. q be proximity sensor
3. r be parking available status
4. s be duration counter

Propositional Logic: $(p \land q) \rightarrow (\neg r \land s)$

p	q	r	s	$\neg r$	$p \land q$	$\neg r \land s$	$(p \land q) \rightarrow (\neg r \land s)$
F	F	F	F	T	F	F	T
F	F	F	T	T	F	T	T
F	F	T	F	F	F	F	T
F	F	T	T	F	F	F	T
F	T	F	F	T	F	F	T
F	T	F	T	T	F	T	T
F	T	T	F	F	F	F	T
F	T	T	T	F	F	F	T
T	F	F	F	T	F	F	T
T	F	F	T	T	F	T	T
T	F	T	F	F	F	F	T
T	F	T	T	F	F	F	T
T	T	F	F	T	T	F	F
T	T	F	T	T	T	T	T
T	T	T	F	F	T	F	F
T	T	T	T	F	T	F	F

Predicate Logic: $\forall p(\forall q \forall r(True(p) \land CarSensor(q) \land ProximitySensor(r) \land Is(q,p) \land Is(r,p)) \rightarrow \forall s \forall t(ParkingAvailableStatus(s) \land DurationCounter(t) \land IsNot(s,p) \land Is(t,p)))$

Explanation: For all CarSensor and ProximitySensor that are activated (true), then ParkingAvailableStatus is false and DurationCounter is activated (true).

IF car_sensor = false AND proximity_sensor = false, THEN parking_available_status = true, account_charge = true

Explanation: If both the car sensor and the proximity sensor are false, then the parking available status will be set to true and the parking fee will be charged from the account.

Let:

1. p be car sensor
2. q be proximity sensor
3. r be parking available status
4. s be account charge

Propositional Logic: $(\neg p \wedge \neg q) \rightarrow (r \wedge s)$

p	q	r	s	¬p	¬q	(¬p ∧¬q)	r ∧ s	(¬p ∧ ¬q)→(r ∧ s)
F	F	F	F	T	T	T	F	F
F	F	F	T	T	T	T	F	F
F	F	T	F	T	T	T	F	F
F	F	T	T	T	T	T	T	T
F	T	F	F	T	F	F	F	T
F	T	F	T	T	F	F	F	T
F	T	T	F	T	F	F	F	T
F	T	T	T	T	F	F	T	T
T	F	F	F	F	T	F	F	T
T	F	F	T	F	T	F	F	T
T	F	T	F	F	T	F	F	T
T	F	T	T	F	T	F	T	T
T	T	F	F	F	F	F	F	T
T	T	F	T	F	F	F	F	T
T	T	T	F	F	F	F	F	T
T	T	T	T	F	F	F	T	T

Predicate Logic: $\forall p(\forall q \forall r(True(p) \wedge CarSensor(q) \wedge ProximitySensor(r) \wedge \neg Is(q,p) \wedge \neg Is(r,p)) \rightarrow \forall s \forall t(ParkingAvailableStatus(s) \wedge AccountCharge(t) \wedge Is(s,p) \wedge Is(t,p)))$

Explanation: For all CarSensor and ProximitySensor that are deactivated (false), then ParkingAvailableStatus is true and AccountCharge is set to true.

Toll Fee Detection

IF vehicle_detector = true AND toll_pass = true, THEN account_charge = true

Explanation: If a vehicle is detected and it is passing through the toll gate, then the toll fee will be charged from the account

Let:

1. p be vehicle_detector
2. q be toll_pass
3. r be account_charge

Propositional Logic: $p \wedge q \rightarrow r$

p	q	r	$p \wedge q$	$p \wedge q \rightarrow r$
T	T	T	T	T
T	T	F	T	F
T	F	T	F	T
T	F	F	F	T
F	T	T	F	T
F	T	F	F	T
F	F	T	F	T
F	F	F	F	T

Predicate Logic: $\forall w(\forall x \forall y\ (Is(X,W) \wedge Is(Y,W) \wedge VehicleDetector(X) \wedge TollPass(Y) \wedge True(W)) \rightarrow \forall z(AccountCharge(Z) \wedge Is(Z,W)))$

Explanation: For all VehicleDetector and TollPass that are activated (true), then AccountCharge is set to true.

Car Status Checking

IF PlatNo_Detector = true AND Roadtax_Validity = false, THEN JPJ_Report = true

Explanation: If a plat number and road tax are detected and the road tax is invalid, then a report will be sent to JPJ

Let:

1. p be PlatNo_Detector
2. q be Roadtax_Validity
3. r be JPJ_Report

Propositional Logic: $p \wedge q \rightarrow r$

p	q	¬q	r	p ∧ ¬q	p ∧ ¬q → r
T	T	F	T	F	T
T	T	F	F	F	T
T	F	T	T	T	T
T	F	T	F	T	F
F	T	F	T	F	T
F	T	F	F	F	T
F	F	T	T	F	T
F	F	T	F	F	T

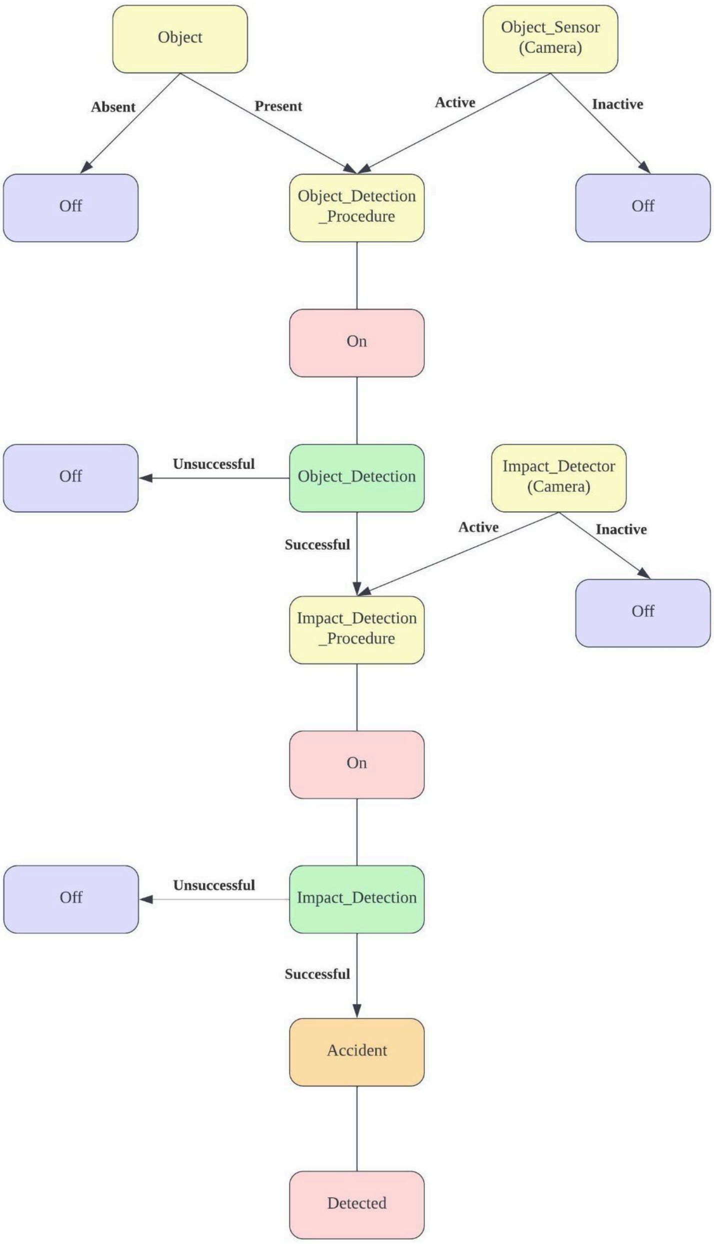
Predicate Logic: $\forall w(\forall x \forall y\ (Is(X,W) \wedge \neg Is(Y,W) \wedge PlatNoDetector(X) \wedge RoadtaxValidity(Y) \wedge True(W)) \rightarrow \forall z(JPJReport(Z) \wedge Is(Z,W)))$

Explanation: For all PlatNoDetector are activated (true) and RoadtaxValidity that are false, then JPJReport is set to true.

2 Progress 3: Assignment 2

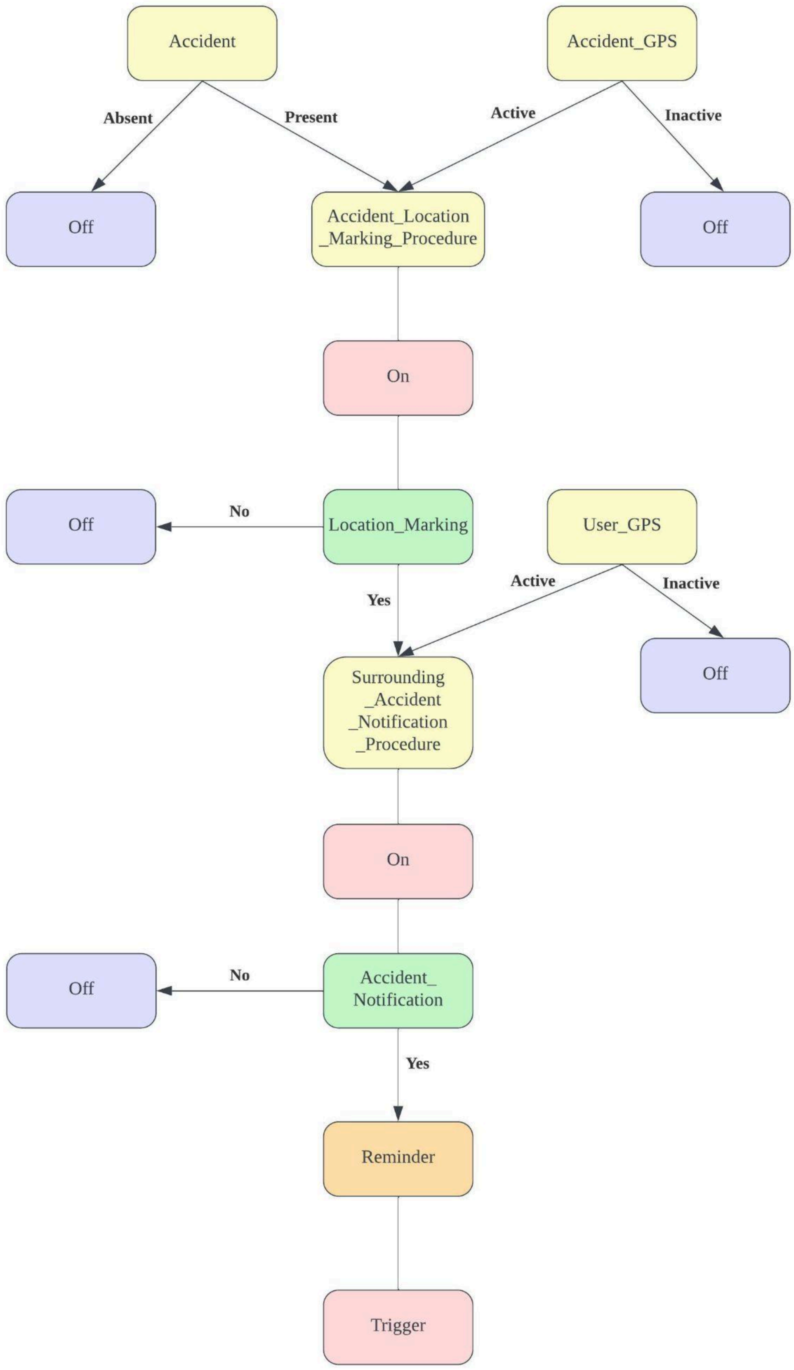
3.1 State Space Search

3.1.1 Accident Detection



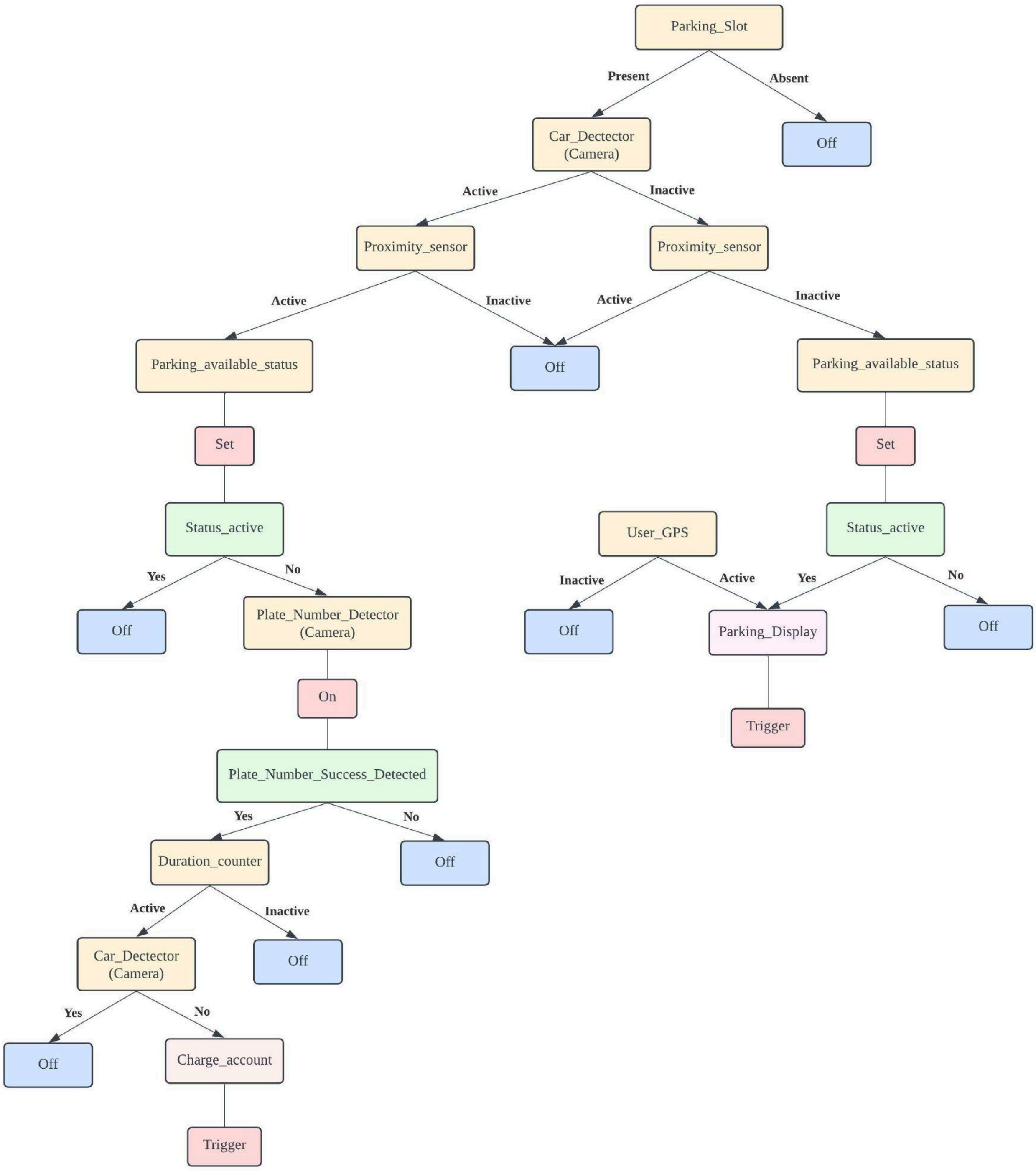
The solution starts from the presence of the object and the object sensor is active. When the object is present and the object sensor is active, the object detection procedure will be turned on. If the object detection is successful and the impact detector is active meanwhile, the impact detection procedure is turned on. If the impact detection procedure is successful, the accident is detected.

3.1.2 Accident Notification



The solution starts from the presence of the accident and the accident GPS is active. When the accident is present and the accident GPS is active, the accident location marking procedure will be turned on. If the accident location marking is successful and the user GPS is active meanwhile, the accident notification is turned on. If the accident notification procedure is successful, the .reminder is triggered to notify the user of the accident location in their surrounding.

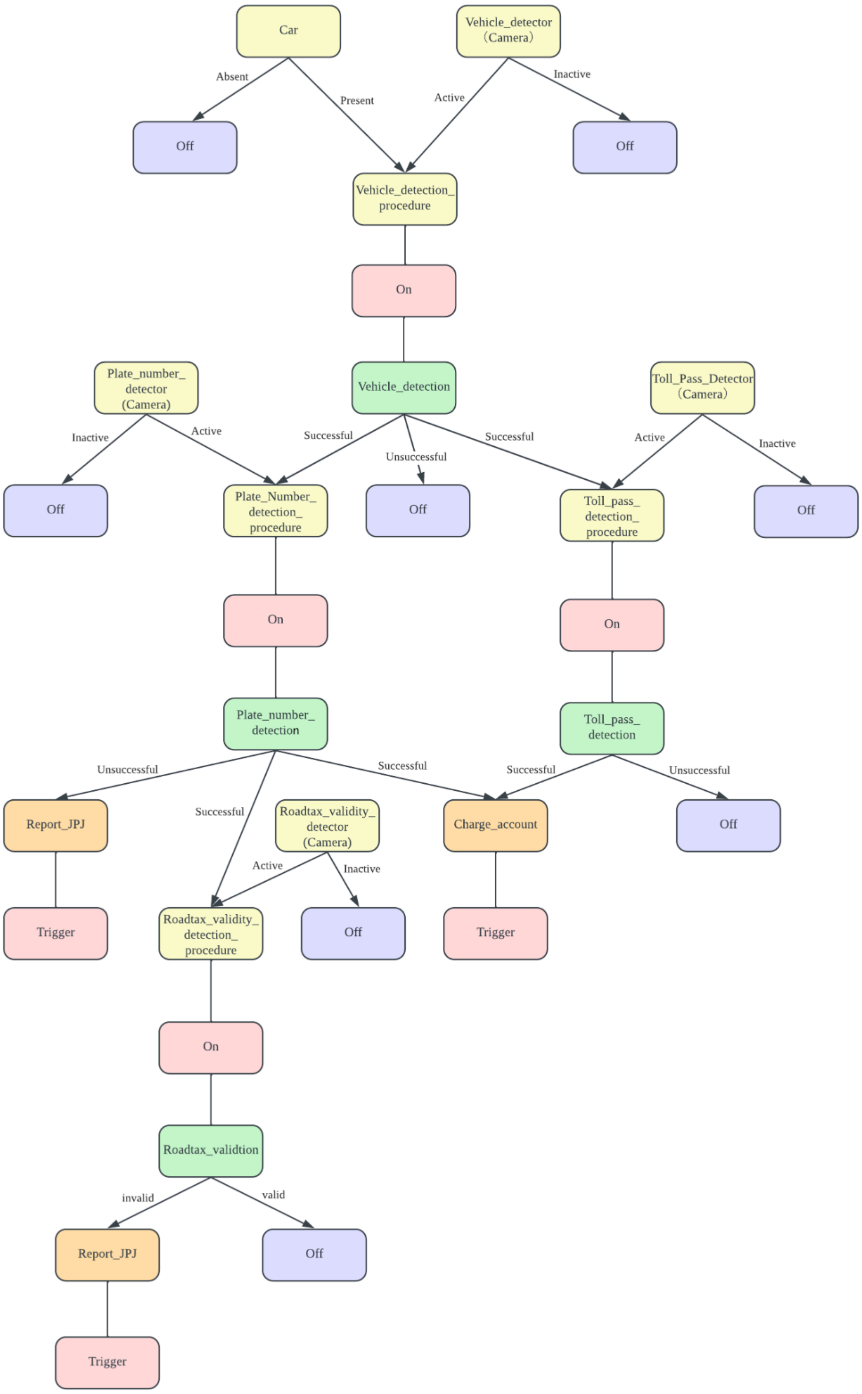
3.1.3 Parking Slot Detection and Parking Fee Calculation



The initial step in the proposed parking solution involves detecting the presence of a parking slot. A camera car detector checks the surroundings to verify if a car is present. If not, the system utilizes a proximity sensor to confirm if a car is occupying the parking space. If the space is vacant, the parking status is marked as active. The user's device GPS, when enabled simultaneously, activates the parking display, indicating a **successful** parking status update.

The second solution starts with the present of a parking slot. When the parking slot is present, the camera car detector will detect whether the car is present in the surroundings of the parking slot. If not, it will continue to the proximity sensor to identify if the car has placed one the parking space or not. If there is a car in the slot, the parking available status will be set to inactive. The plate number detector will be activated after this and it will start the duration counter if it is successful to detect. The duration of the car parking will be counted and recorded until the car detector does not detect the car. Then, the system can **charge a fee from the user account**.

3.1.4 Toll Fee Detection and Car Status Checking



The first solution starts from the presence of the car and the Vehicle_detector. When the car is present and the vehicle_detector is active, the vehicle_detection_procedure will be turned on and start the vehicle detection process. After the vehicle_detection_procedure is successful, if the plate_number detector and toll_pass_detector are both active, the plate_number_detection_procedure and toll_pass_detection_procedure will be turned on accordingly. Last, if both plate_number_detection and toll_pass_detection are successful, trigger the charge_account action which means **successful**.

The second solution starts from the presence of the car and the Vehicle_detector. When the car is present and the vehicle_detector is active, the vehicle_detection_procedure will be turned on to start the vehicle detection process. After the vehicle_detection is successful, if the plate_number_detector is active, the plate_number_detection_procedure will be turned on to detect the car plate number. If the plate number is successfully detected and the roadtax_validity_detector is active, turn on the roadtax_validity_detection_procedure. Lastly, if the toadtax_validation returns an invalid would trigger the Report_JPJ.

3.2 Problem Formulation

The problem is formulated by asking questions on the steps of how the system works. Below are some of the questions our team have proposed:

1. What are the steps of detecting an accident?
2. What are the inputs to the system to notify the user about the surrounding accident location?
3. How does the system determine whether the parking slot is available?
4. How is the charge calculated for the parking section?
5. What are the steps of a car to pay the toll fees when passing through the toll?
6. What will happen if the car plate number fails to detect?

What is the sequence of procedures from detecting a car to triggering the Report_JPJ action in case of invalid road tax?

4 Progress 4: Assignment 3

4.1 PEAS Model

4.1.2 Formulate the solution by using the PEAS model

	Before using Smart Traffic	After using Smart Traffic
P: Performance Measure	● Delayed accident reporting to suitable agencies. ● Inaccurate accident detection and location marking. ● Difficulty in finding available parking spaces. ● Lack of real-time information on parking slot availability. ● Collection of parking fees based on traditional, manual methods. ● Manual accuracy in determining parking duration. ● Queues and frustration in toll fee payment ● Inability to validate the tax status of a vehicle	● Significantly reduced response time to accidents. ● Improved accuracy in accident detection and location marking. ● Real-time information on available parking spaces. ● Improved accuracy in detecting parking slot presence ● Accuracy of vehicle presence detection. ● Timely recording and retrieval of car number plates. ● Elimination of occasional out-of-service RFID or SmartTag systems. ● Smoother traffic flow without queues for toll fee payment. ● Increased confidence in toll payment security and fairness
E: Environment	● Challenges in handling driver injuries promptly. ● Limited GPS coverage and marking accuracy. ● Wasted time in searching for parking spaces. ● Negative environmental impact due to fuel consumption and emissions. ● Urban roadside parking spaces with a manual recording of vehicle presence.	● Highly accurate and extensive GPS coverage. ● Improved road network. ● Positive impact on the ecosystem's health. ● Reduced fuel consumption. ● Roadside positioning of parking spaces with automated data recording. ● Updated information about parking space availability

	● Lack of information about parking space availability. ● Need to wait for toll booth gates to open for toll fee payment ●	● Automated toll payment processing, eliminating the need for toll booth gates.
A: Actuator	● Lack of automated response mechanisms. ● Basic procedure for marking accident locations. ● Manual searching for parking spaces. ● Lack of guidance for efficient parking. ● Manual collection of parking fees using physical coupons. ● Issuing physical tickets or receipts for parking payment ● Toll booth gates. ● Toll payment scanner for manual scanning. ●	● Automated detection and response to accidents. ● Advanced algorithms for precise accident location marking. ● Concentrated searching with guidance for available parking. ● Notification system informing users about open parking slots. ● Charging system for deducting parking fees automatically. ● Notification system to inform users about successful fee deduction ● Removal of toll booth gates, streamlining traffic flow
S: Sensor	● Reliance on human observation and reporting. ● No sensors for detecting objects on the road or collisions. ● Reliance on visual observation to find empty parking spaces. ● Absence of sensors to detect parking slot availability or vehicle presence. ● Human attendants visually assessing parking spaces. ● Manual recording of vehicle presence	● Implementation of advanced object sensors. ● High-precision GPS technology for accurate accident location tracking. ● Object sensors detecting the presence of objects along the road. ● GPS provides accurate location detection for efficient parking solutions. ● Presence sensors to detect the arrival and departure of vehicles. ● Time sensors to measure the duration of

	and parking duration ● Lack of detectors for vehicle presence ● Lack of detectors for vehicle plate numbers	parking ● Sensors detecting the presence of vehicles at toll booths ● Sensors to validate the status of vehicles

4.2 Define PEAS model

Agent: Smart Traffic

I. **Performance measure**: Safety, Accuracy, Precision, Response Time, Reliability, Effectiveness

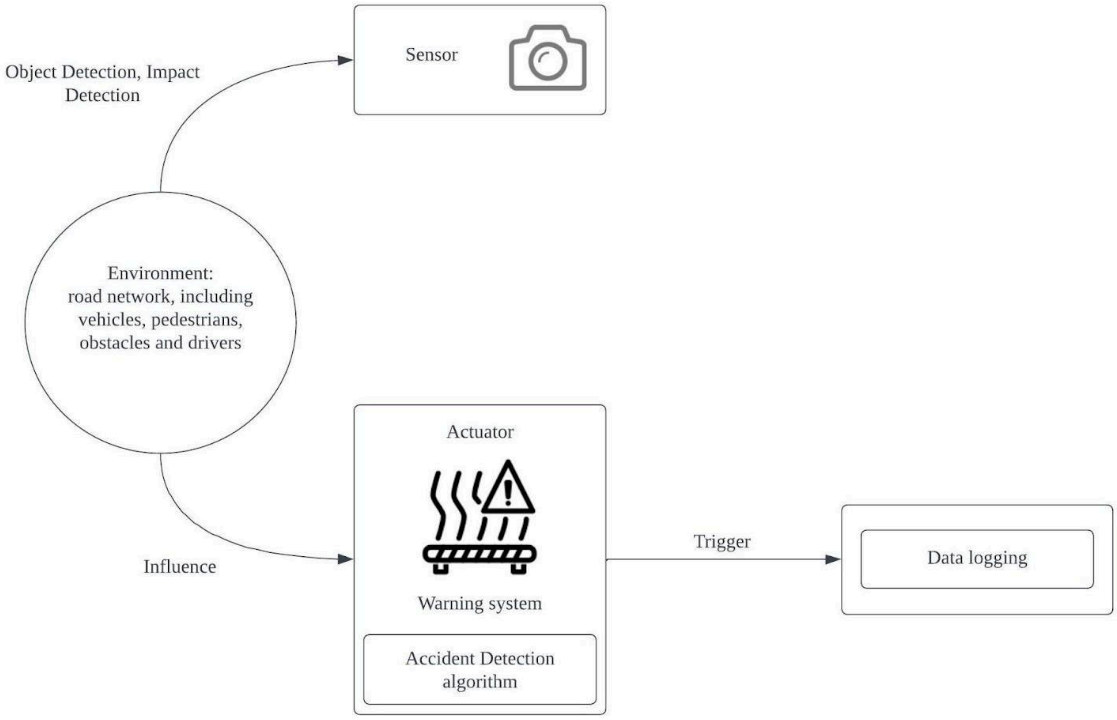
II. **Environment**: vehicles, pedestrians, obstacles, drivers, roads, road signs, parking lot, buildings

III. **Actuators/Effectors**: Notification Systems, Automated Response Mechanisms, Smart Toll Booth

IV. **Sensors**: Object sensor, Impact detector, GPS, Vehicle detector, Plate number detector, Toll pass detector, Road tax validity detector

4.3 Diagram represents all the relations for each property

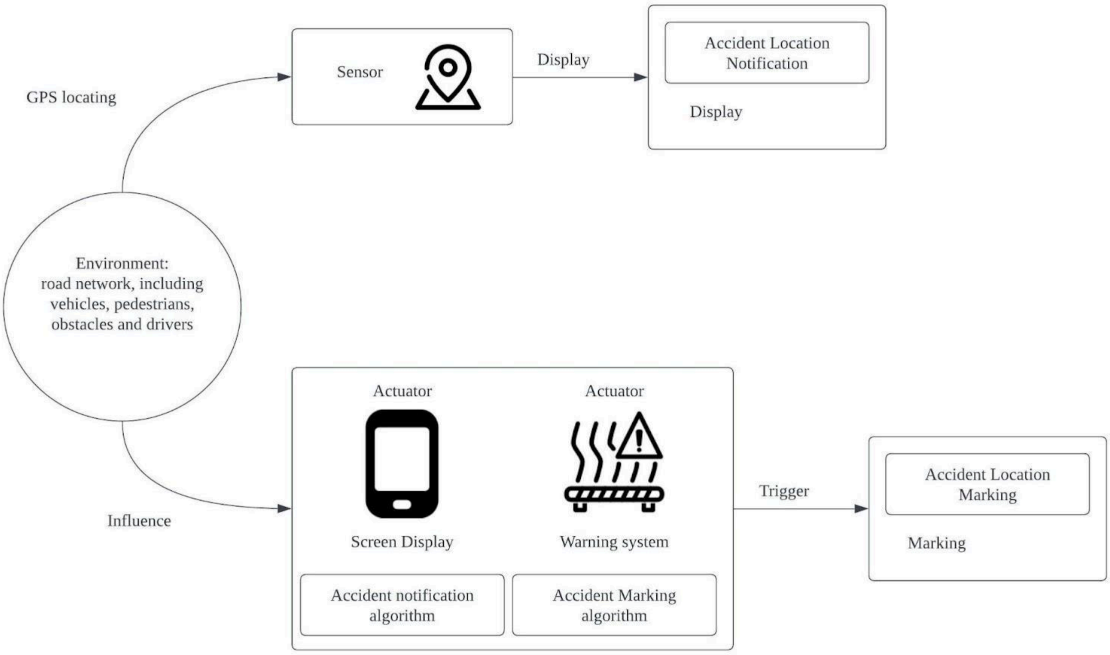
Accident detection



In the Proof of Concept (POC), the accident detection system's properties will be represented through the interaction of various components. The performance measure focuses on accurately detecting accidents, and relevant accident data will be logged into the system. The smart traffic system, acting as an agent, interacts with the environment, including vehicles, pedestrians, obstacles, and drivers. The warning system serves as an actuator, and accident data is logged based on algorithms triggered by inputs from the object sensor and impact detector.

The verification process in the POC aims to demonstrate the product's viability in real-world scenarios, specifically addressing challenges in the four essential properties. Testing involves the object sensor and impact detector providing inputs, the agent interacting with the environment, and the warning system generating outputs based on user experiences and reactions. The accuracy of accident detection is then evaluated in terms of detection speed, robustness, and reliability to assess the system's effectiveness.

<u>Accident Notification</u>



In the Proof of Concept (POC), the accident detection and notification system's properties are demonstrated through key components. The performance measure focuses on the accuracy of accident location information and the effectiveness of notifications displayed on the screen. The smart traffic system, functioning as an agent, interacts with the environment, while the warning system acts as an actuator for accident location marking triggered by algorithms using the accident GPS sensor. The screen display, acting as another actuator, shows notifications based on algorithms using inputs from the user's GPS. Testing involves input from accident and user GPS sensors, with user experiences and reactions serving as outputs for assessment. The effectiveness of the system is then evaluated in terms of practicality, time efficiency, and associated costs.

Parking Slot Detection

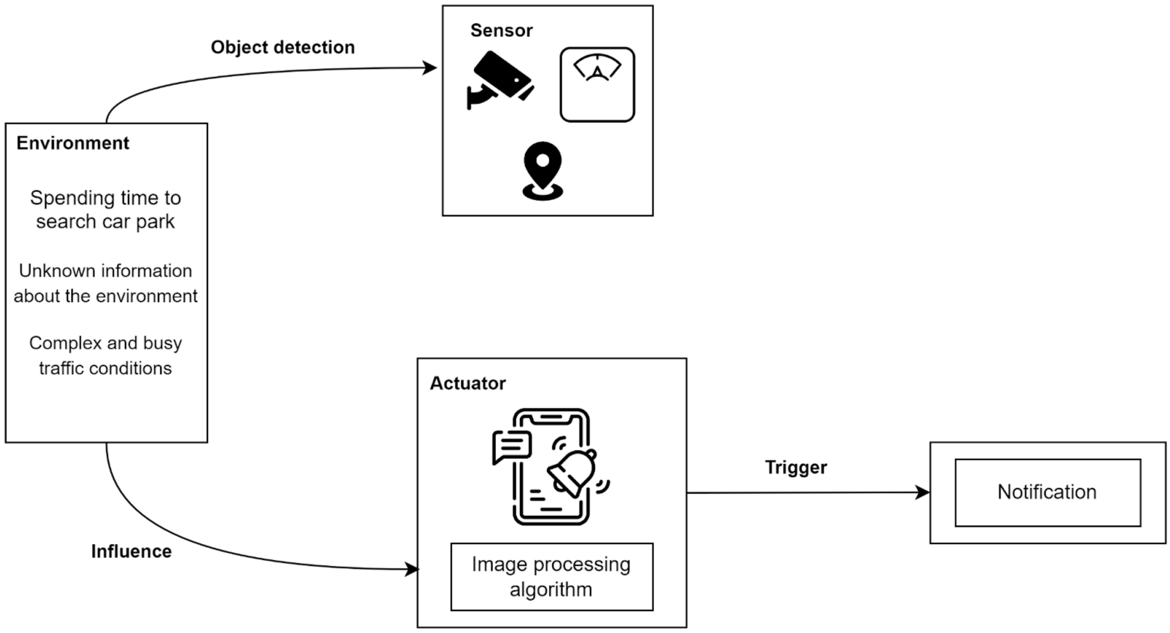
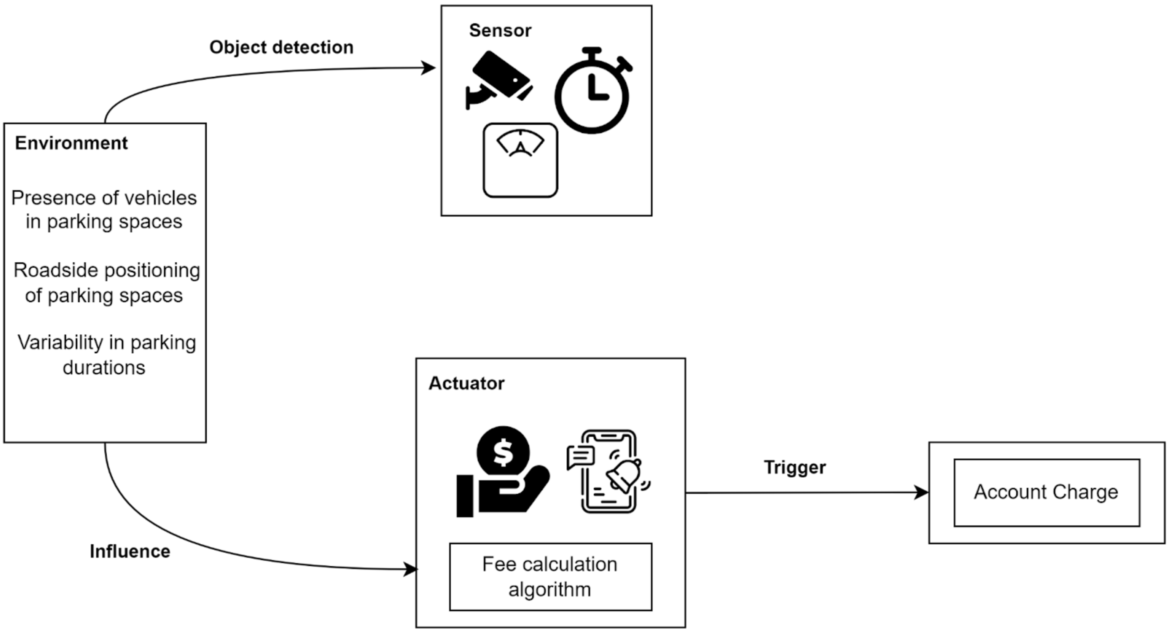


Figure 2: PEAS model for Parking Slot Detection

In the Proof of Concept (POC) for the smart parking system, each property is represented through specific components. The performance measure, focusing on accurate parking space detection, is visually displayed to users. The smart parking system, as an agent, interacts with users, parking areas, and traffic conditions. The screen display acts as an actuator, triggering notifications based on algorithms and inputs from the camera detector, proximity sensor, and GPS.

The POC testing involves these components providing inputs, and the agent interacts with the environment, collecting experiences and reactions. The screen display conveys outputs, and the accuracy of parking space detection is evaluated in terms of product feasibility, time efficiency, and associated costs. Feedback obtained during testing informs revisions across each property, contributing to the development of an intelligent and effective smart parking system.

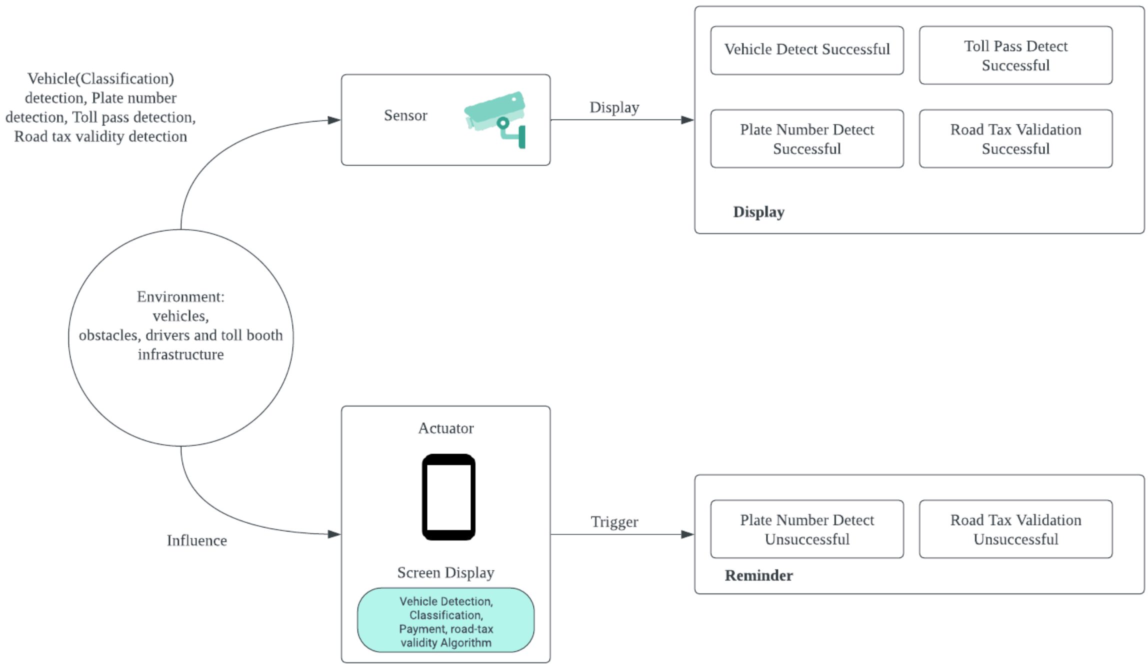
Parking Fee Calculation



In the Proof of Concept (POC) for the smart parking charge calculation system, each property is represented through specific components. The performance measure, reliant on accurate vehicle presence detection, is visually displayed on the screen interface. The agent interacts with the parking environment using presence sensors, time sensors, and license plate recognition. The notification system, acting as an actuator, notifies users upon successful recording and retrieval of vehicle license plates.

The POC prioritizes accuracy in charging based on parking duration, subtracting parking costs through the charging system actuator. The notification system informs users about fee calculations. Evaluation involves measuring the precision of fee calculation, the timeliness of recording and retrieving license plates, and the accuracy of vehicle presence detection. Real-world scenarios and user interactions are analyzed, and the system is refined based on feedback for optimal performance in terms of detection accuracy, time efficiency, and fee precision.

Toll Fee Detection and Car Status Checking



In the Proof of Concept (POC) for the PEAS toll system, each property is represented through specific components. The performance measure, dependent on several factors including car presence detection, accurate vehicle classification, toll transaction success, and road-tax validation, will be visually displayed on the system interface. The toll system's agent engages with the tolling environment, while the interface acts as an actuator, triggering alerts for unsuccessful toll transactions or inaccuracies and indicating road-tax validation outcomes.

The POC testing involves processing sensor inputs from toll booths, with the agent interacting with the environment to gauge user experiences. Outputs on the system interface provide insights and feedback. The evaluation focuses on the accuracy of vehicle detection, considering product feasibility, time efficiency, and incurred costs. The gathered feedback informs refinements to each property in the toll system model, facilitating the development of an intelligent tolling product.

4.4 Self Reflection on Team Working

- **4.1 Ng Kai Zheng**

  In our team with Lew Chin Hong, Gan Heng Lai, and Yeo Chun Teck, everyone shows exceptional teamwork, earning each a scale 3 categorization. Lew Chin Hong's dedication and creative problem-solving get 3 marks. Likewise, Gan Heng Lai's collaborative approach and innovative contributions make him worthy of category 3. Yeo Chun Teck's proactive involvement, effective collaboration, and problem-solving skills make him a crucial part of our team, so I will categorize him to scale 3.

- **4.2 Gan Heng Lai**

  Throughout the project development, our team places a significant emphasis on collaboration and values teamwork. Ng Kai Zheng plays a pivotal role in guiding the team and contributing to key project decisions. Thus, I give 3 marks. As Lew Chin Hong actively contributes to idea generation and oversees the project's documentation, I give him 3 marks for his managerial role. Yeo Chun Teck brings valuable insights and logical perspectives to the project, particularly in the realm of artificial intelligence. Therefore, I give 3 marks for his rating as his contributions to knowledge and logic in our AI project.

- **4.3 Lew Chin Hong**

  Throughout our project development, our team places a strong emphasis on collaboration and values the synergy that comes with teamwork. Ng Kai Zheng plays a pivotal role in guiding the team and contributing to key project decisions, earning him a solid 3 marks for my leadership and strategic input. Similarly, Gan Heng Lai's collaborative approach and innovative contributions qualify him for a rating of 3 in our assessment categories. Yeo Chun Teck, with his wealth of insights and logical perspectives, particularly in the realm of artificial intelligence, is a valuable asset to our project. I give him 3 marks for his outstanding contributions to knowledge and logical thinking in our AI project.

- **4.4 Yeo Chun Teck**

  Throughout our project development, our team places a high priority on collaboration and values the synergy that results from cooperation. Ng Kai Zhang has 3 marks for his strategic contribution and leadership, and he continues to be a pillar of the team ‘s guidance and decision-making. Gan Heng Lai also deserves 3 marks for his creative contributions and cooperation. Similarly, I give Lew Chin Hong 3 marks for his excellent knowledge contribution and logical reasoning in our AI project.