Intelligent Agents Design for Parking Lot Management

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1. Introduction

The purpose of this study is to design two intelligent agents.
I. Agent A: an agent that would park a car at a parking lot
II. Agent B: an agent that would control parking lots
Moreover, a demonstration of the designed prototype showing that Agent A and B are implemented successfully.

2. Methods

Based on the given requirements this study will focus on the design of the two Agents and the logics which consists them. For Agent A (parking system) this study will implement A-star algorithm for computing the most efficient route. Moreover, image processing technology to track the location of the vehicle. For the second agent, this study has decided to implement image recognition technology to provide the license plate data of the vehicle. For the parking space allocation, prediction model based on bigdata collected will be used. ex) The longer the parking time further from the entrance

3-1. Design (Agent A)

Agent A is an agent that would park a car at a parking lot. The following is the chart of PEAS specification.

Performance	calculate waypoint, send data signal to vehicle communication with Agent B
Environment	parking lot, route, vehicle, Agent B
Actuators	communication module
Sensors	Camera

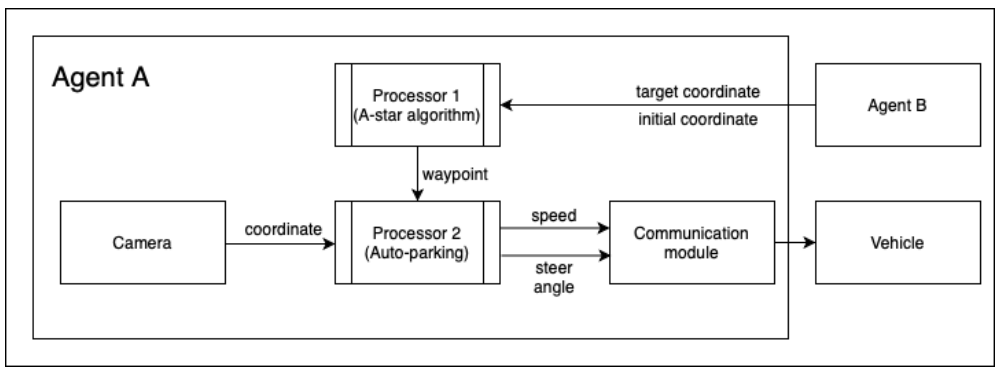

Diagram 1 Agent A System diagram

Agent A is an intelligent system which allow the vehicle to safely park at an empty cell. Four main components consist the agent.

Camera (Image processing)

Camera uses image processing technology to track the current location of the vehicle and sends the current coordinate C_k to processor 2.

Processor 1 (A-star algorithm)

Processor 1 take target coordinate C_{target} and initial coordinate C_0 from Agent B as input and calculate the most effective route for the vehicle to drive and defining it as waypoints W_k . The process of calculating W_k is done by A-star algorithm setting C_{target} as the goal and C_0 as initial point.

Processor 2

Processor 2 takes C_k, C_{k-1}, and W_k as variables and calculates the speed and steer angle for the vehicle to drive. This calculation is done by setting C_k, C_{k-1}, and W_k as three points of a triangle, then computes the angle value and the vector value to draw the speed and steer angle. Then the result is delivered to the communication module.

Communication module

Communication module sends the $speed_k$ and $steerangle_k$ to the vehicle. This is done by wireless communication(Zigbee). This process allows the vehicle to successfully drive at the given condition ($speed_k$ and $steerangle_k$) and to safely park at C_{target}.

3-2. Design (Agent B)

Agent B is an agent that would control parking lots. The following is the chart of PEAS specification.

Performance	manage cell status, payment control, time record communication with Agent A, data management
Environment	Agent A, parking lot, customer, vehicle
Actuators	payment machine
Sensors	camera

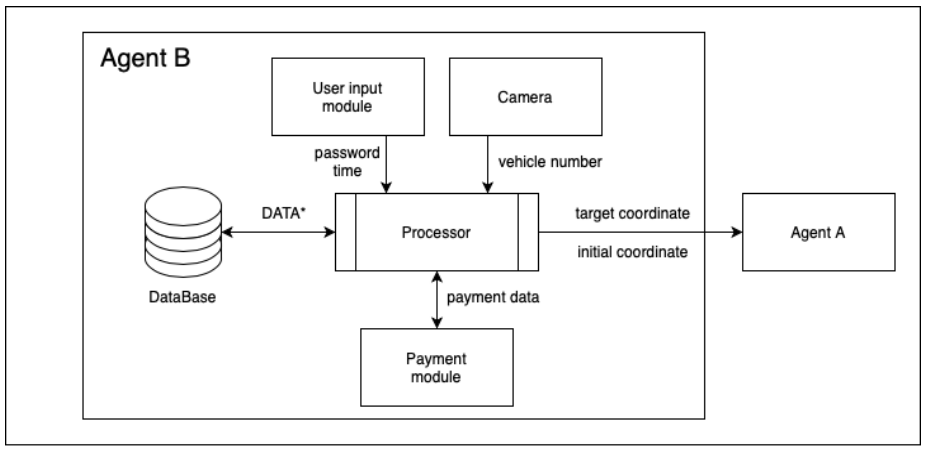

Diagram 2 Agent B System diagram

Agent B is an intelligent system which manages the overall parking lot from payment and cell management. Five main components consist the agent.

User input module

User input module record the inputted data(password) by the customer. Moreover, it checks the time which the data is given. Then it is delivered to the processor.

Camera (Image recognition AI)

Camera uses image recognition technology to recognize the vehicle license plate. Then the data is sent to processor.

Processor

The processor mainly holds three roles for Agent B. First, it collects all the data sent from user input module and camera transform into the right format and sends it to the database. (DATA*: $[Vehicle_n][Cell_n][t_0][t_1][pw]$) Second, it computes the suitable $Cell_n$ based on prediction model and delivers to Agent A as C_{target}. Third, it calculates the parking fee $(t_1-t_0)*Cost$ and transmit to payment module.

Database

Database holds all the given DATA* from the processor. Moreover, it collects data overtime to provide a more accurate prediction model.

Payment module

Payment module also interact with the customer and collect parking fee based on the payment data provided processor.

4. Prototype demonstration

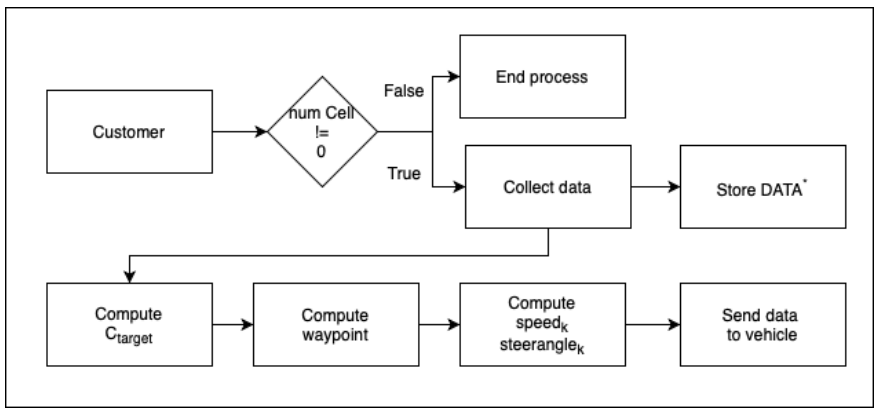

Diagram 3 Flow Chart of parking process

5. Limitations and Conclusions

The given prototype Agent A and B can successfully manage the parking process and the general status of the lot. However, due to the structure Agent A holds (send speed and steer angle data signals), this solution has a limit that it can only target vehicles equipped with self-driving function. However, it has advantages of easy implementation and low cost.