An Intelligent Agent based approach for controlling the Traffic Light in Sultanate of Oman- A Java Simulator

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ABSTRACT

The agent is anything that uses sensors to perceive its environments and actors to act on that environments. In general, the agent runs in a cycle of thoughts, acting, thinking, and perceiving, and the world around us is full of agents including cameras, cellphones, and even ourselves, so an agent can be a human, robotic, and software agent. Now the most popular agents are the intelligence agents that are a self-contained entity that uses sensors and actuators to communicate with its environments to achieve its objectives by learning from its surroundings, so it's anything like a thermostat. This paper aims to simulator an agent using Java language that's can control and maintain a traffic light at four intersections with two roads intersecting and traffic following in both direction, and there are three main lights in the traffic light green, yellow and red, as well as the pedestrian indicator. the implementation of this simulator will help to understand the traffic light function in just a simple and intelligent way by concentrating on the action that's can be taken, the precept that can be used to take those actions, and the performance measurements that can be used. The output of this study is a simulation of an ideal agent that controls the traffic light in the Sultanate of Oman using Java.

Keywords: *Agent; Intelligence; Traffic light; pedestrian indicator; Java*

Introduction

The ability of digital machines and computers to perform specific tasks that simulate and resemble those carried out by intelligent beings; Such as the ability to think or learn from previous experiences or other processes that require mental operations, and artificial intelligence aims to reach systems that have intelligence and behave in the way humans behave in terms of learning and understanding so that these systems provide their users with various services of education and guidance. Interaction, etc (Frankenfield, 2021).

Machines can learn from their experiences, adapt to new inputs, and perform human-like tasks thanks to artificial intelligence (AI). Deep learning and natural language processing are used extensively in most AI today, from chess-playing machines to self-driving vehicles (Russell and Norvig, 2015).

The analysis of the rational agent and its environment can be described as an AI system. The agents use sensors to sense their surroundings and actuators to act on their surroundings. Awareness, belief, and purpose are all mental properties that an AI agent may have. The agent is a self-contained entity that interacts with and understands its environment using sensors and actuators to achieve its goals (Java Point, 2021). This research paper provides and discusses the implementation of an ideal agent (simple – reflex) that controls the traffic light at four intersections.

Literature Review

Theresa Schachner et.all has published a literature review about the AI enabled conversational chatbot agent for health care industry for providing support to patients who has chronic disease by interacting them frequently from different leading journals and found that 2052 articles and found only 10 papers with good informations.

Kristin M Tolle has done a research on autonomous and behavior based agents. He has explained about the importance of autonomous and behavior agents and its effects on the future of computing and artificial intelligence.

Chavez, A et.al. has presented a challenger multi agent system for distributed resource allocation. He has developed the challenger using an agent which would allocate the local resources by itself by communicating with other resources like CPU. He says that challenger behaves like a market based control system there the role of challenger is a buyer and that of seller is market place. In this he has added that the challenger is developed by adding more learning algorithms so that the challenger could produce a better result [3]

Michael Travers et.al developed a graphical environment which helped to take care the programming base on rule like agent which allow the object to response to their environment [4].

Weld et.al. elaborated on the basics and status of intelligent agent along with its application and impact of such agents on our society and how does it will be helpful for the organization. He has also discussed various concerns related to such agents [5].

Paul J. Reaidy et.al discussed about new approach to be employed for intelligent agents on the production systems. The intelligent agents were able to do automatic reconfiguration of the system by identifying the right task assignment. They incorporate quantitative and cognitive data processing pertaining to the learning abilities [6]

Ioannis N has designed an Abacus a multi agent system for handling the data received from radars. Scientist need to spend lots of efforts and time to process and interpret the data generated from radars. This multi-agent system does the management and visualization of data by extracting the statistical features and predict the weather conditions. The agent designed was also able to identify the dangerous events and provides warning services through email [7].

Agents have also been employed in assisting the teachers in the evaluation process of the activities given for lessors in LAMS. An agent has been designed to monitor and collect the information from LAMS database at different time intervals. Agent could identify the conflict in the process of learning and collaborating among the students. The agent was capable of issuing alert message to the faculty members. The agents designed were also able to generate the useful reports from LAMS[8].

Methods

The implemented ideal agent (simple – reflex) controls the traffic light at four intersections, resulting in a two-lane scheme where every two roads cross the traffic flow (east-west and north-south) directions figure 1, and when a traffic flow is staring at crossing roads, the pedestrian indicator will start in the opposite directions, and the surveillance and speedometer devices were used to track the roads and vehicles, as well as performance assessment and protection to reduce the number of accidents (Java Point, 2021)
.

So the implemented agents have been implemented according to the traffic light PEAS figure 1, where the PEAS is a type of model that an AI agent uses to function (Java Point, 2021). We can group the properties of an AI agent or rational agent under the PEAS representation model when we describe it. It consists of four words:

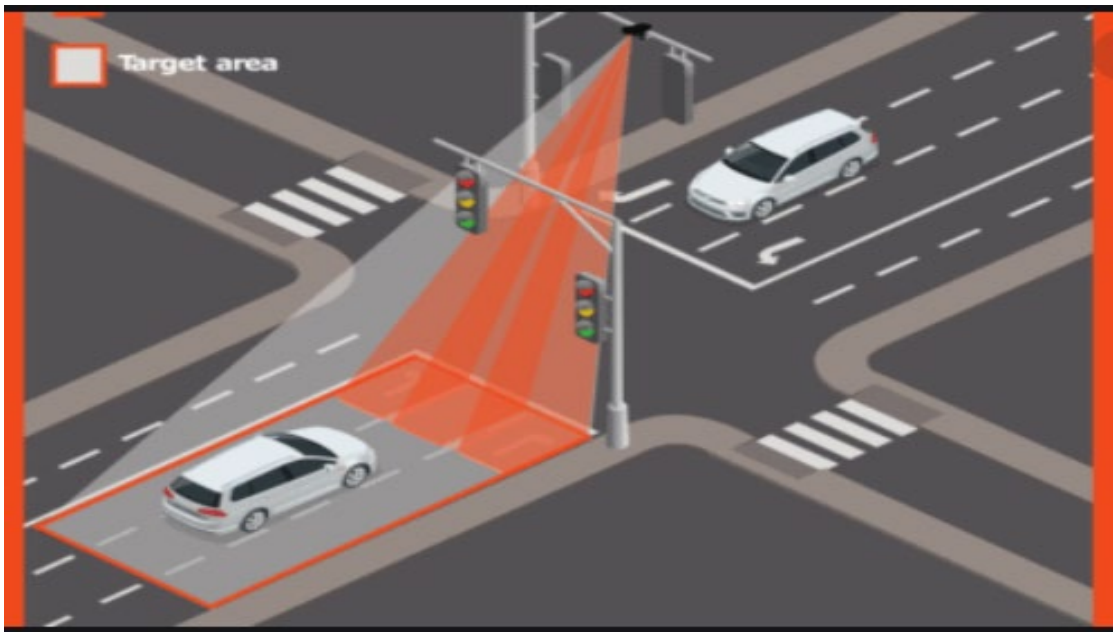

Figure 1. Traffic Light PEAS.

1. **Performance**: safe, reducing the overall waiting time, fast, confutable, maximum rodes rganization.
2. **Environments:** roads, traffic, pedestrians, vehicles.
3. **Actuators:** traffic lights (Red -green-yellow), pedestrian lights (red-green).
4. **Sensors:** a pedestrian indicator (light), cameras, speedometer.

For (performance) measurement, safety is described as a reduction in the number of accidents at the instructions, a reduction in overall waiting time, and adherence to traffic laws, a comfortable journey for the car driver, a quick to the optimum speed for the car driver legally, a minimum of waiting time, and maximum rodes organization. The traffic light for the (Environments) is at four intersections, with two crossing rodes, pedestrian lights, and various vehicles. There are two types of (Actuators): traffic lights, which use red to stop traffic, yellow to warn drivers, and green to begin traffic, and pedestrian lights, which use red to stop pedestrian crossing and green to begin pedestrian crossing. The pedestrian indicator, cameras, and speedometer are used to record the condition of the road's environments for the sensors(Poole and Mackworth, 2010)

.

Results

The PEAS method was successfully awarded to implement the simulation for an ideal agent that controls the traffic lights at a four-way intersection with a two-road crossing and a pedestrian indicator in Java.
The performance is a simulation for the ideal agent that describes how cars and trucks travel at a four-way intersection with a two-road crossing, as well as pedestrian signs and traffic flow directions (east-west and north-south) figure 2.

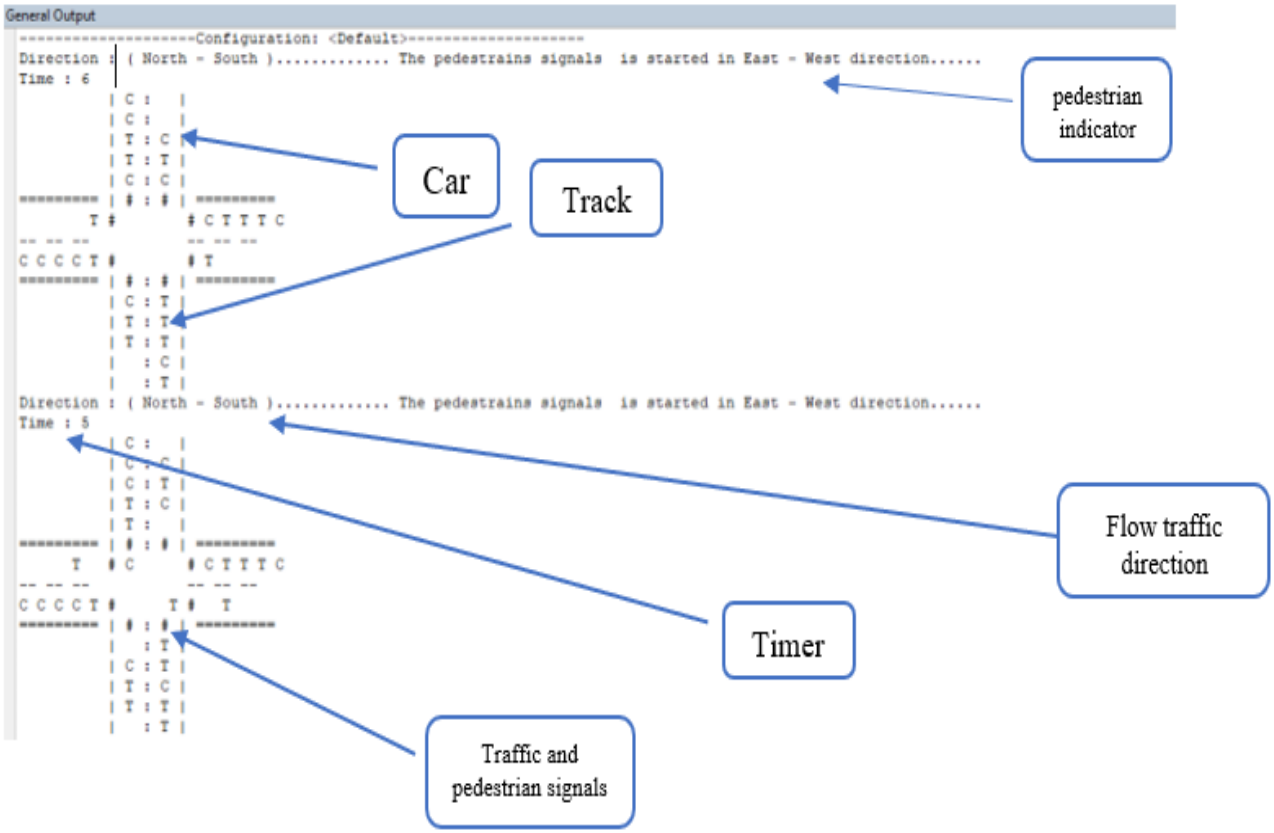

Figure 2. The implemented Simulation Using Java

Discussion

In java, the designed agent controls traffic lights at four intersection ways where their two roads cross with the traffic flow, so the performance of this simulator shows the movements of cars and tracks in four intersection ways where two rods cross with the flow traffic direction, and each rode has a pedestrian crossing and a traffic light by (#) symbol figure 3.

In the designed agent the traffic flow is split into two directions, north-south figure 3, and west-east, and when one direction begins to travel, the other stops automatically, causing the traffic lights to turn off and the pedestrian crossing signal to activate. For example, when the traffic light in the north-south direction is green, the movement begins; however, when the traffic light in the east-west direction is red, vehicle movement ceases, and the pedestrian signal activates (Ghazal et al. 2016).

A traffic light has three colors: red for stopping, yellow for preparing, and green for moving. The red color takes one second to change from red to yellow, and yellow takes one second to change from yellow to red, and green takes one second to change from red to green, as for the green color its takes 4 seconds to change from 5 to 2 and captures the condition of the road's environments using pedestrian indicator (light) sensors, so when the traffic signal starts, the pedestrian crossing signal stops (Ghazal et al. 2016)

.

These are used logic for the traffic light and Pedestrian lights :

1. Traffic light logic:

For both directions (north-south and west-east), the traffic light switches every 6 seconds, so it starts by descending from 6 to 1, for example: (East-West figure3):

Time 6: in the second 6, the traffic light will change from red to yellow, indicating that the vehicles are ready to pass, and it will turn red in the North-South direction, as well as the pedestrian crossing light in the East-West direction figure 3.

Time 5: The traffic light will change from yellow to green in the second 5, and vehicle movements will begin in the East and West directions figure 3.

Time 4: In the fourth time, the vehicles begin to drive East and West figure 4.

Time 3: the vehicles begin to drive East and West in the third time frame figure 4.

Time 2: in the second 2, the cars will begin to travel but will be prepared to stop when the traffic light turns yellow figure 5.

Time 1: Vehicles will come to a halt because the traffic light has changed to red and the pedestrian crossing light has changed to green. Following that, the traffic flow will shift to the North-South, and the process will repeat itself figure 5.

2. Pedestrian lights logic:

The pedestrian light contains only red and green lights, and its color varies every 6 seconds for both directions (north-south and west-east), so it begins by descending from 6 to 1, for example: (East-West figure3):

Time 6: Since the traffic flow will begin in this direction, the pedestrian crossing light will be red figure 3.

Time 5: The pedestrian crossing light in the north-south direction will be red because traffic has begun to flow in that direction figure 3.

Time 4: Since traffic is still flowing, the pedestrian crossing light will be red in the north-south direction figure 4.

Time 3: Since traffic is still flowing, the pedestrian crossing light will be red in the north-south direction figure 4.

Time 2: the pedestrian crossing is already red in time 2 because the traffic light would turn yellow in figure 5.

Time 1: in the second 1, the pedestrian crossing will turn green because the traffic light has turned red and all vehicle movements have come to a halt; the traffic flow will then turn in north-south, and the steps will be repeated in figure 5.

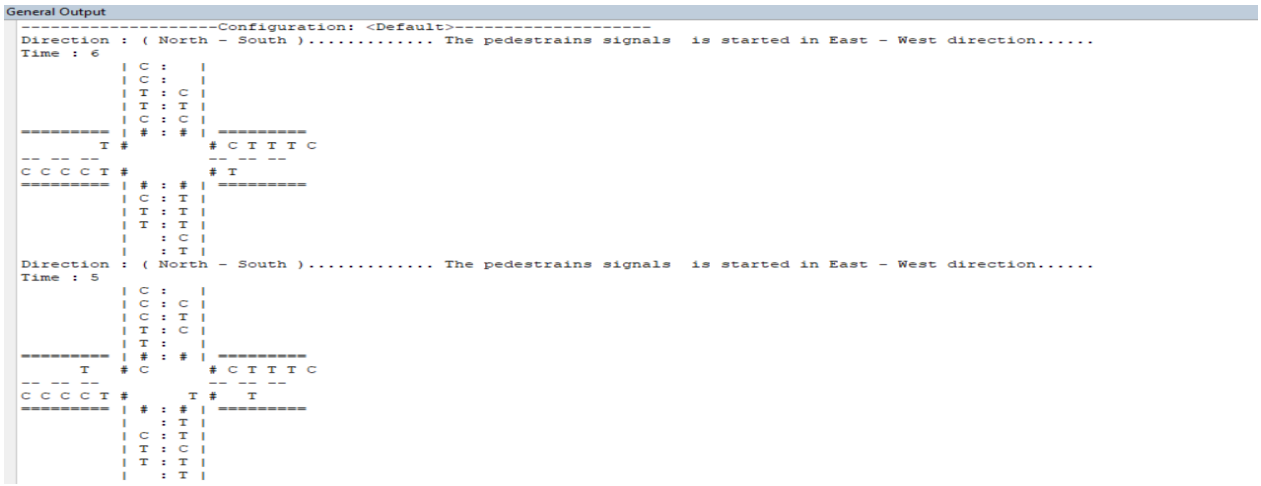

Figure 3. The traffic follows in East-West direction Time 6 and 5

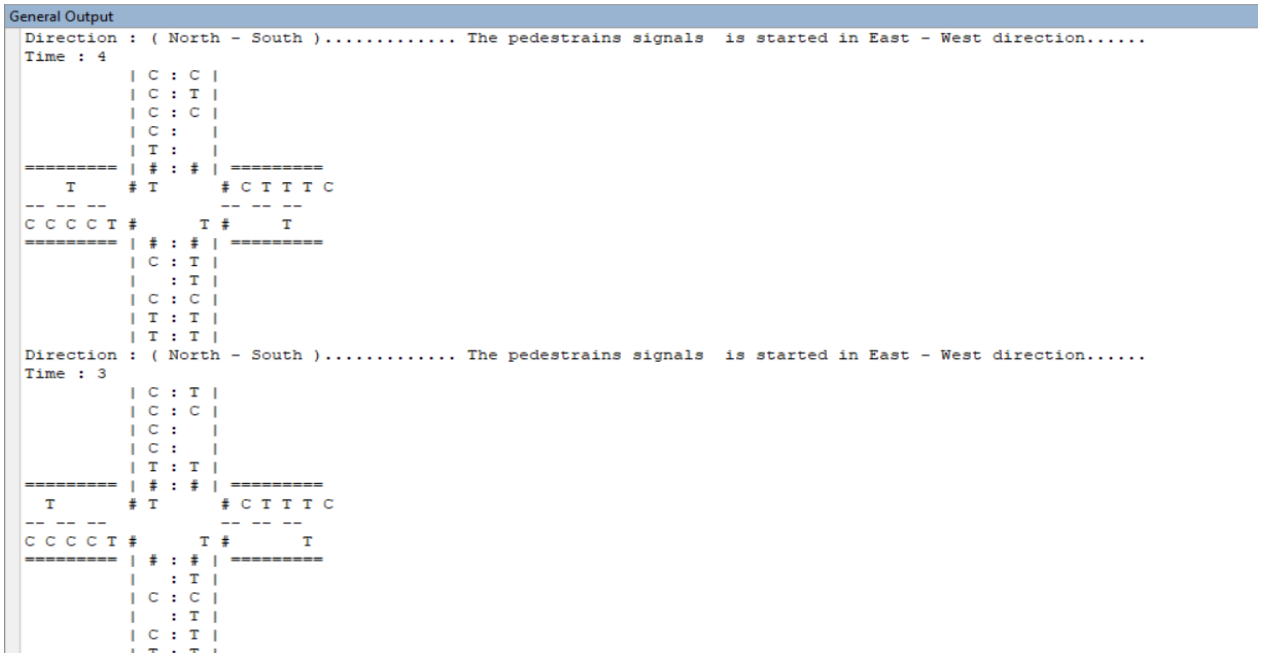

Figure 4. The traffic follows in East-West direction Time 4 and 3

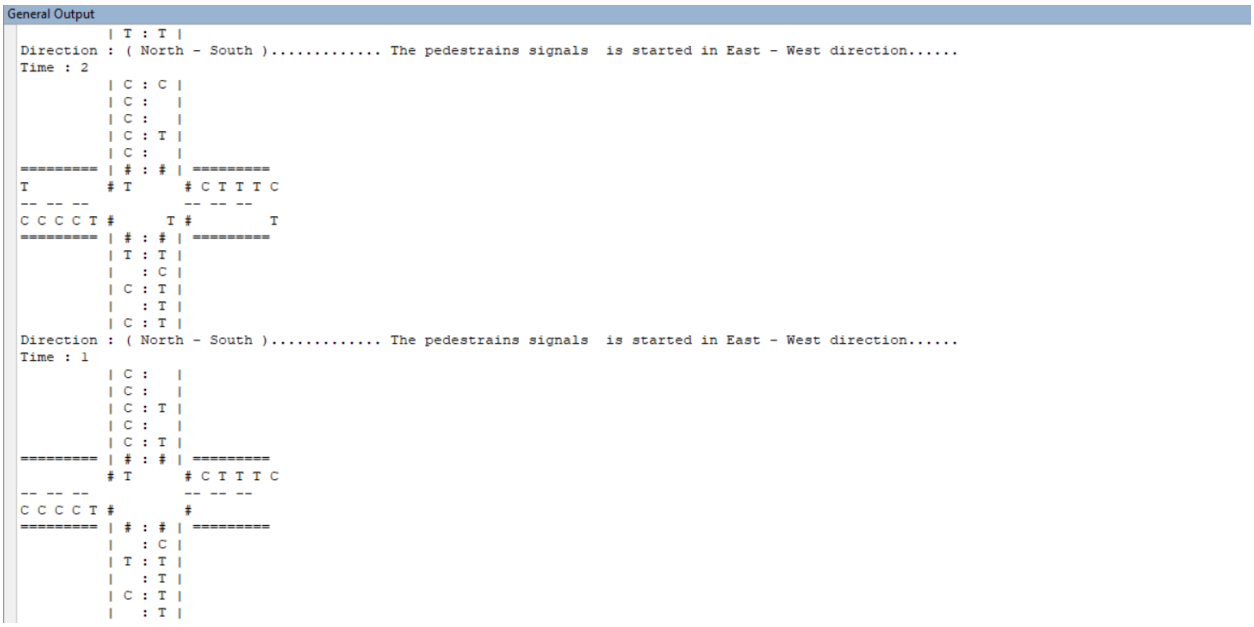

Figure 5. The traffic follows in East-West direction Time 2 and 1

Conclusion

When the world is completely measurable, this agent function succeeds. Infinite loops are always inevitable for simple reflex agents working in partly measurable environments. If the agent can randomize its acts, it might be possible to break out of infinite loops. The output is a simulation for an ideal agent that describes performs the cars and trucks' movement at a four-way intersection with a two-road crossing with flow traffic directions (east-west and north-south) and pedestrian indicator in Java, and its was clearly showing how the traffic light and pedestrian indicator logic can be working in Sultanate of Oman. This simulation can help to understand a new way of controlling the Traffic Light in the Sultanate of Oman, which will help to reduce accidents that occur at traffic lights, especially at a four-way intersection with a two-road crossing with flow traffic directions that spread in Sultanate of Oman.

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