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An Investigation into Artificial Intelligence and Robotics and the Methods and Technologies that are used in the Production of the Applications

1. Introduction

"The global autonomous car market is expected to grow from $5.6 billion in 2018 to $60 billion in 2030. The market definition includes component production and investments" [1]. This statistic clearly shows a demand for these applications, this project wanted to implement different techniques within a robotic system to simulate this. The initial plan to do this using a blend of techniques using sensory input along with a form of machine learning algorithm.

2. Aim

An investigation into Artificial Intelligence and Robotics and the methods and technologies that are used in the production of the applications

2.1. Objectives

1. An Investigation into Autonomous Robotics and what methods and technologies are used to produce them.
2. To design and develop an Automated Robotic System to simulate an autonomously driven vehicle.
3. To evaluate and synthesize the development project of an Automated Robotic System.

3. Literature Review

There was a vast quantity of topics covered. Some of these included, the History of AI, History of Robotics, Applications used, Machine Learning Applications

During research, it was found that following Asimov's laws isn't entirely possible as by following one, you sometimes ignore another.
The levels of autonomy were also researched, this helped gain an idea of what makes a car autonomous.

Types of machine learning algorithms were researched, these were; Supervised Learning, Unsupervised Learning and Reinforcement Learning.

Research was also found which was similar to the focus of the project. This indicated an idea of what sort of components could be used, such as choices for the sensors. For the project it was found that the Reinforcement and Supervised Learning techniques have been used in similar projects

The gap in the research which was noticed was that C++ wasn't widely utilised for AI research which made a gap to research and initially I planned to exploit this by using OpenCV (as it's written in C++) to produce a computer vision application to recognise road signs. I would have liked to cover more in-depth topics in Robotics, such as a complete and full understanding of the inner workings of an electronic circuit/robotic circuit

5. Conclusion

The first objective was met, this was met once the literature review had been conducted as the investigation had been done, the second objective wasn't met in its entirety. This is because an automated system algorithm was designed but it wasn't fully developed to the level to which was originally wanted. The third objective wasn't entirely met either, although I tried to evaluate it with what I had, in reality I felt I needed more results to create more depth and scope to do this so although it was met, it wasn't met in the way which was intended
This doesn't solve a real-world problem as it is hard to pre-determine how a car should react to any situation. It's a good use of AI in terms of computer vision as this is great for the car to react to road signs, but a real car couldn't be trained in a way a reinforcement algorithm is trained as the car shouldn't be making errors.

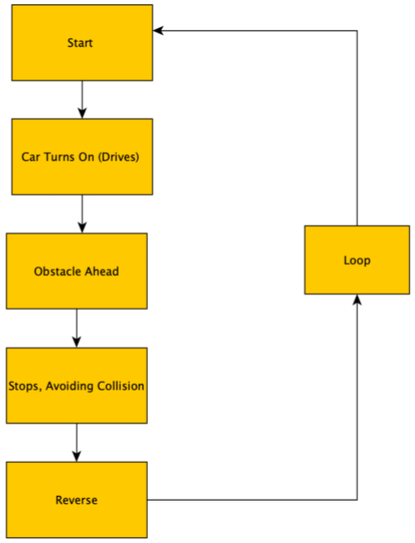
7. References

[1] N/A, "35 Statistics about Self-Driving Vehicles Market in 2021," N/A, 2nd February 2021. [Online]. Available: https://research.aimultiple.com/self-driving-cars-stats/. [Accessed April 2021].

[2] F. L. Ronald Leenes, "Laws on Robots, Laws by Robots, Laws in Robots: Regulating Robot Behaviour by Design," *Law, Innovation Technology,* vol. N/A, no. N/A, p. 33, 2014.

4. Design & Implementation

There were a few design decisions in the building of the project, So the design was a flow diagram, for each of the features. To then build an algorithm around that, flowcharts were done for 2 features, but not completed entirely in the sense it didn't make it to the next stage of that design. The second feature was quite simplistic in the sense as it would have used 3 ultrasonic sensors, so when it was going around an object, depending on the side the cart was facing the ultrasonic on that side would be used to detect if the object had been cleared or not at that stage. Implementation only made it to 1st feature level functionality so wasn't a success overall.



6. Further Work Recommendations

Reinforcement Learning Algorithm – The design was completed for this, but not fully implemented. This would allow the car to train through trial and error, when it hits the bumper during simulation, it would then do this until the algorithm learns not to hit the bumper.
Computer Vision – This would explore the gap in the research as it would utilise C++ to use OpenCV to write powerful computer vision applications to recognise road signs and then react depending on the road sign
Supervised Learning – The other area to improve the project further would be through using a Neural Network to train the car