Urban maze robot

G01

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Introduction

The aim of this project is to build a robot that is aware of its surroundings and can navigate through a relatively narrow urban maze which contains traffic lights and signs. It avoids crashing into the walls and follows rules set by signs and lights.

Robot's Components Design

Figure 1. Robot Design

Figure 4. Robot detecting green light

Figure 5. Robot detecting red light

Figure 6. Traffic lights

The robot is able to detect traffic lights (Red and Green). It stops when the light is red and continue driving when it changes to green.

Traffic light detection

Driving logic

We used camera input and image processing to recognize traffic lights and signs and make driving decisions based on that. While no signs are in sight, driving logic depends on the inputs of 3 ultrasonic sensors. US sensors also make sure that robot keeps its distance from the walls. For smooth movement of the robot we have implemented a proportional controller.

Figure 2. Robot driving in the maze

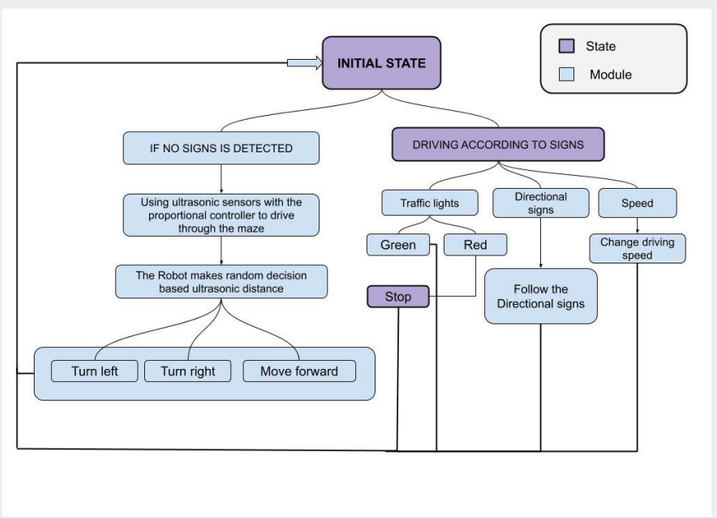

Figure 3. Robot's state machine

Figure 7. Robot detecting a speed limit sign

100

The robot can detect the text written on blue signs and thus receive driving directions. Two types of signs were used:

Speed limit sign -
If an integer is written on the sign, e.g "100", the robot would change the speed accordingly.

Speed detection

Figure 8. Robot detecting a directional sign

2R

Direction detection

Directional sign -
If a string is written on the sign, e.g "2R", the robot would drive for 20 cm and then turn **Right**, the first character being the distance from which to make the turn (multiplied by 10) and the second character the turning direction.

Figure 9. Robot detecting a directional sign

2L

The robot would read "2L" from the sign, drive for 20 cm and then turn **Left**.

Image processing -
If the robot detects a sign, a region of interest is mapped from the sign area, which then is binarized and processed by Tesseract OCR character detection library, which outputs the most probable text written on the sign.

Conclusion

Our robot showed the ability to navigate through the maze autonomously using its onboard sensors. Reaction to signs and traffic lights were correct and in timely manner. For the future we would like to use a more powerful platform such as GoPiGo3 to achieve a smoother driving experience. Implementation of line sensors would be another approach to navigate the maze in the future.

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