Simple Floor Sweeping Robot

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Abstract: With the development of society, robots are now integrated into our lives. Humans' life now gradually become inseparable from the existence of robots. There are several different types of robots, such as services robot used in restaurant, entertainment, or even house cleaning purpose. In this work, we propose a sweeping robot, that can sweep the floor by tracking the black line on the ground using the infrared and distance sensor. The sweeping robot is developed using Zumo robot, which is a tracked robot that can be developed using Arduino. By using a line tracer, the robot can detect the black lines and move with it along a route. After reaching the designated position, the robot automatically returns to the starting point of the route and runs through the same route repeatedly to achieve the effect of reciprocating movement. A broom is placed on the back of the robot to clean the floor. The experiment showed that Zumo robot can successfully pick up tissue paper that was dropped on the route.

Keywords: Zumo robot, Sweeping robot, Line tracer.

1. Introduction

Nowadays more people tend to use robots to assist daily activity, such as talking robot, calculating robot, and cleaning robot [1]. Cleaning robot industry has developed long time since 1990 [2], cleaning robot have now become a mature industry [3].

Commercial sweeping robots are convenient, but they are more expensive compared to canisters, upright, handheld brooms [4]. If we can find a robot that costs less than ordinary sweeping robots, but also has the effect of cleaning the ground, then we can solve the cost problem.

In this study, we proposed the use of a low-cost and easy to control robot to simulate the operating principle of a real sweeping robot, which can be used in scenarios that are appropriate for line tracing movement, such as use of sweeping robot on a fixed route in the factory.

2. Proposed Method

2.1 Zumo Robot

In order to achieve a low-cost sweeping robot, we will use Zumo robot. Zumo robot can widely use by putting different sensor on it. For example, the Zumo robot can measure temperature and humidity using Zumo Shield [5], play music with functions, make a rubber band gun [6], or fight with each other [7].

In our project, we used "Zumo Shield for Arduino" shown in Fig. 1(a), which is equipped with 6 Infrared (IR) sensors to tracking black lines as route and directions. Fig 1(b). shows the IR sensor is installed under the robot. There are two motors inside robot, one motor on each side, to control the robot's direction.

For sweeping part, we installed a simple and lightweight broom at the backside of the robot (Fig. 2), set with strong tape. When the robot moves along the black line, it drags the broom, to clean the floor. Since this is our first prototype of simple sweeping robot, the broom is used to drag and hold the large-size garbage only.

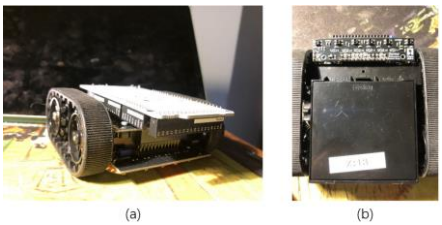

Fig. 1 (a) Zumo Shield for Arduino (b) IR sensor installed under the Zumo Robot.

Fig. 2 Broom installed behind the Zumo robot.

2.2 Robot Controller

We used Arduino board connecting to the upper part of Zumo robot (Fig. 3).

Fig. 3 Arduino board is connecting with Zumo robot.

Arduino is an open-source electronics platform [6]. The Arduino code uses in all process of controlling the robot.

2.3 Robot Movement/Algorithm

From beginning, the code will allow the robot to start/stop

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by controlling the switch manually, the location of the switch is shown in Fig 4. When the robot starts, it will rotate three times on the spot to find a black line, use the IR sensors to confirm the direction of the black lines on the floor. Then, the robot will track the black lines and moves along.

Fig. 4 shows the switch.

At the intersection of black lines, the robot will decide the direction according to the following algorithm. The flow chart of this algorithm is shown in Fig. 5.

We define *m1speed* as the left-side motor speed, and *m2speed* as the right-side motor speed. We limit robot's motor speeds to be between 0 and *Max_Speed.*

If M1speed = Max_Speed
Then go left Else
If M2speed = Max_Speed
Then go right
Else M1speed ≠ Max_Speed, M2speed ≠ Max_Speed,
Then rotate itself.

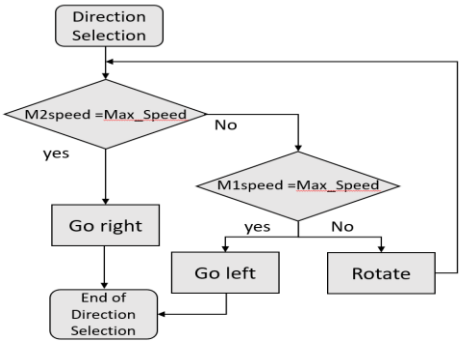

Fig 5. robot moving direction determination algorithm.

After rotation, it repeats process again to find direction. When the road has an intersection, it chooses the right side as the priority.

3. Experiment Procedure

We tested the algorithm in this experiment by using the route described in Fig. 6.

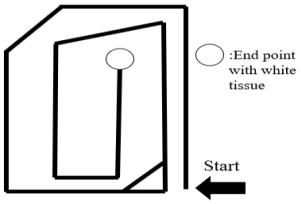

Fig 6. The illustration of the route used in the experiment.

Fig. 7 (a) (b) shows the picture captured from the experiment when the robot detected the white tissue (garbage) and bring it back to the original point. The robot detects the paper successfully, and then carry the paper back to the starting point.

(a) (b)

Fig. 7 (a) Movement of Zumo robot (b) Sweeping robot detecting the garbage and carry it back.

4. Results and Discussions

From the experiment, we confirmed that our proposed Zumo robot algorithm successfully follows the black line that is drawn on the floor, picked up the garbage around the black line.

However, the robot has the limitation that it would turn right when it meets the intersection, which could cause the robot to return to backside. Therefore, the section in front of the intersection will not be cleaned.

5. Conclusion

In this study, we proposed the prototype of a low-cost sweeping robot, the experiment results showed that the robot can picked up and bring the garbage to the starting point. In the future, this prototype can be improved by attaching an ultrasonic sensor [10], which allows the robot to detect the walls, and does not require black line route.

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