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Autonomous Trash Collecting Robot

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***Abstract* – In this present era, people live a very busy life. In such a situation, a person will always finding the way to saving time. Especially for working women it becomes difficult to handle both home and office work together. So proposing an autonomous robot this can collect waste from an environment. Then it will discharge the waste to the area which is already predefined autonomously. The robot tested in a designed region. It performs the task like avoiding the static and dynamic obstacles, sucking of waste mechanism. Combination of S-shaped algorithm and wall follow algorithm is used to clean the entire room efficiently.**

Keywords – Trash Collecting Robot, obstacle avoidance, S-shaped and wall follow algorithm

I. INTRODUCTION

Now-a-days people are living in a busy life. So their working time will be more and irregular. In this situation people always find a way to save their time for relaxation. So cleaning a room or particular area will be considering as a boring and tedious job. So far, various bulky cleaning devices are used for cleaning domestic and industrial waste. In order to avoid this boring task, an autonomous robot was proposed for cleaning purpose [9].

The iRobot Roomba and Neato are the most widely used robot for autonomous cleaning purpose. In 2002, iRobot launched a first vacuum cleaner robot named Roomba. After that a series of Roomba product were released. Initially its cost was $500. At present Roomba 980 is used for cleaning purpose with the cost of $150[10]. In Roomba auto charging mechanism is used. After that Neato, a cleaning robot was developed. Its cost is $399. Here laser finder technology and SLAM algorithm is used for localization and mapping [6]. These two robots are efficiently cleaning the entire area. But these two robots are cost effective [5]. In order to avoid this cost effective problem, we are proposing an autonomous robot for cleaning which is very less expensive than iRobot and Neato. The path planning is a very important factor because the efficiency of the cleaning process is mainly dependent on this path planning [1]. The S shaped algorithm is used for path planning. This algorithm can reach the entire room fast as compared to other algorithm like spiral algorithm, random walk algorithms [2]. Here Combination of S-shaped algorithm and wall follow algorithm is used to clean the entire room efficiently [3].In this paper, section II describes the block diagram and its explanation, section III describes design, and section IV describes algorithm and flow diagram.

II. SYSTEM OVERVIEW

A. Block diagram:

Overall block diagram of our model is shown in Figure 1. Ultrasonic sensors and IR sensors are used to avoid obstacle in robot's moving path. Waste collection is done by Vacuum cleaning device. Suction method is used to collect the waste; controller is used to control Vacuum cleaning device suction.

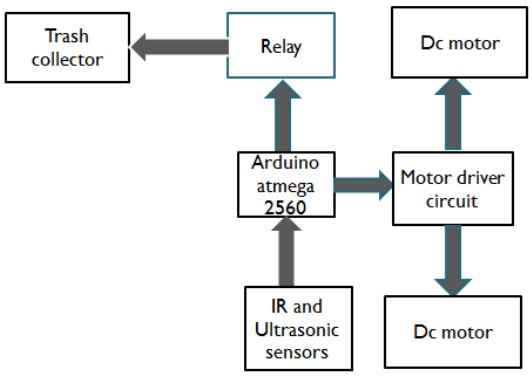

Figure 1.Overall block diagram

B. Description:

1 .ARDUINO ATMEGA 2560

Arduino atmega 2560 is a microcontroller board based on atmega 2560. It has 54 digital input/output pins along with 15 pins are used as PWM output, 16 analog inputs , 4 UARTs, 16MHz crystal oscillator, USB connection, reset button, a power jack and ICSP header. The atmega 2560 has 256 KB of flash memory for storing the code. The analog pins provide 10 bit resolution. In order to start the arduino, simply connect it to the computer by using USB cable, or power it by using battery. Its operating voltage is 5V [7].

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2. Ultrasonic Sensor

Ultrasonic sensor is a device used to measure the distance of an object by using sound waves. It can measure the distance by sending the sound waves at a specific frequency and listen the sound waves to bounce back. By using the elapsed time between the sound wave generated and sound wave bounce back, the sensor can be able to calculate the distance between the sensor and the object. The sound waves can be able to travel 2 times the distance to the object before it was detected by the sensor. This is referred as round trip. The working diagram for ultrasonic sensor is shown in Figure 2.

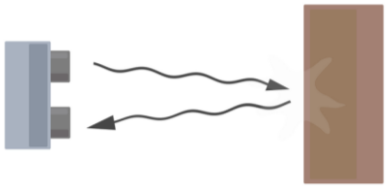

Figure 2 Ultrasonic sensor working

To find the distance to the object, the below given formula can be used,
Distance = (speed of sound * time taken) / 2

3. IR Sensor

An infrared sensor emits and/or detects infrared radiation to sense its surroundings. The basic concept of an Infrared Sensor is used as Obstacle detector is to transmit an infrared signal, this infrared signal bounces from the surface of an object and the signal is received at the infrared receiver.

There are five basic elements used in a typical infrared detection system: an infrared source, a transmission medium, optical component, infrared detectors or receivers and signal processing.

4. Motor Driver (L298D)

The L298D H-bridge module is used to control the speed and direction of the DC motors. Here 12V rechargeable battery is used to the driver module. This L298D can be operated in the range of 5 V TO 35 V DC source. It is a high current motor driver IC. This dual H-bridge can control up to two motors at a time with low power saturation. The motors are connected to the out pins in the driver modules. The enable and input pins are connected to the arduino pins to drive the motor.

5. Trash Collector

In trash collector, suction Motor is attached to the fan. When electric current flows to the motor, fan will rotate. Whenever the fan rotates, it forces the air to move forward towards the exhaust port. When the air particles are driven forward the density of trash increases in front of the fan and decreases behind the fan [8].This pressure drop creates suction inside the vacuum cleaner because the pressure inside the vacuum cleaner is lower than the pressure outside. Whenever the fan is rotating, a constant stream of air is moving out in the exhaust port. This will absorb the dust and small waste particles around the trash collector [4].

III. ROBOT MOTION CALCULATION

Let assume

Wheel radius = r,
Wheel to center point distance = R,
Number of revolution per second = N.
Robots body diameter is L.

Then time required for moving forward, backward and turning is calculated by using the below given formula:

Backward = L/ (6*3.14*r*N)
Forward = L/ (2*3.14*r*N)
Turning = R/ (4*r*N)

In our robot's model,

Body diameter L= 36.5 cm
Wheel radius r = 3 cm,
Number of revolution per minute is 10,
Wheel to center point distance is 8 cm.

So calculated robot movement

For backward movement = 0.538 seconds
For forward movement = 1.614 seconds
For turning = 0.56 seconds

IV. ALGORITHM

A. Wall follow Algorithm:

Wall follow Algorithm:

1. Move forward
2. Read the Ultrasonic sensors value
3. If no obstacle, go forward until obstacle is detected.
4. If obstacle is detected, turn right until sensor value is zero.
5. Move forward for T time and turn left, Go to step1

B. S- Shaped Flow

The map of this algorithm is same as the shape of letter "S". The S shaped path for our environment is shown in Figure 3.

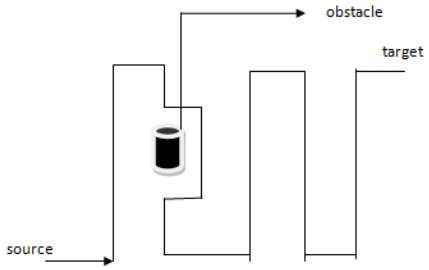

Figure 3. Map of an environment

The S shaped algorithm flow is shown in the Figure 4.

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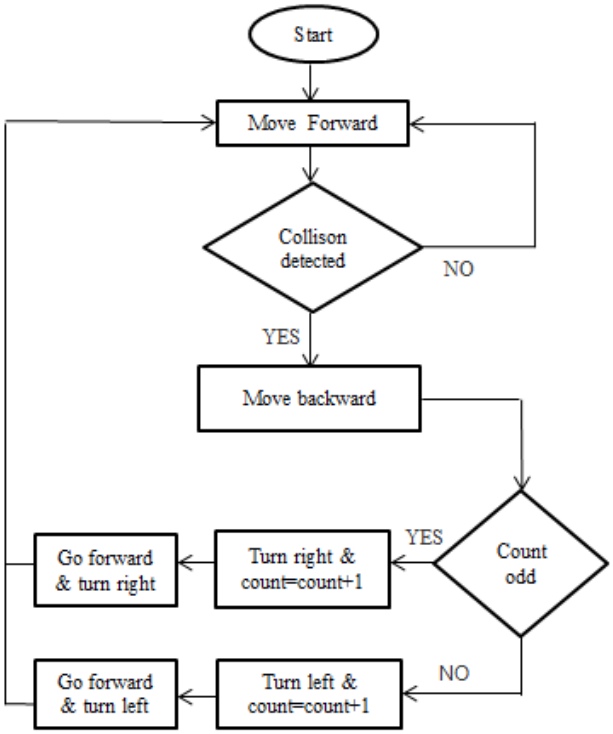

Figure 4 S shaped flow

V IMPLEMENTATION

Simulation result in Matlab is shown in Figure 5. Navigation of robot from source to destination using wall follow algorithm is shown in Figure 5a and S-shaped algorithm is shown in Figure 5b.

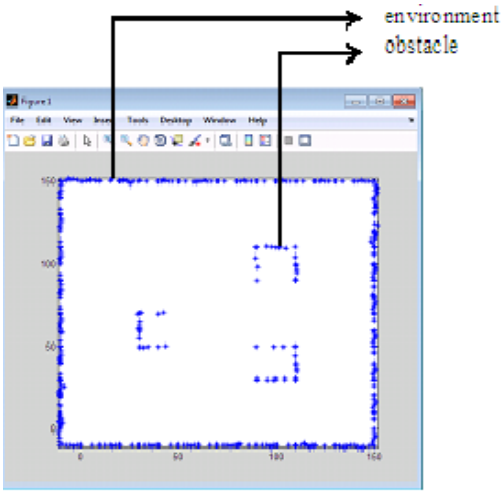

Figure 5a Wall follow algorithm simulation result

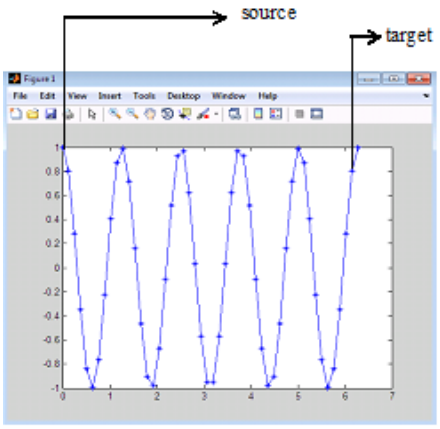

Figure 5b S – shaped algorithm simulation result

Experimental working model of proposed trash collecting robot is shown in figure 6.

Figure 6. Side view of the robot

Comparison of various algorithms with proposed system result is shown in Figure 7.

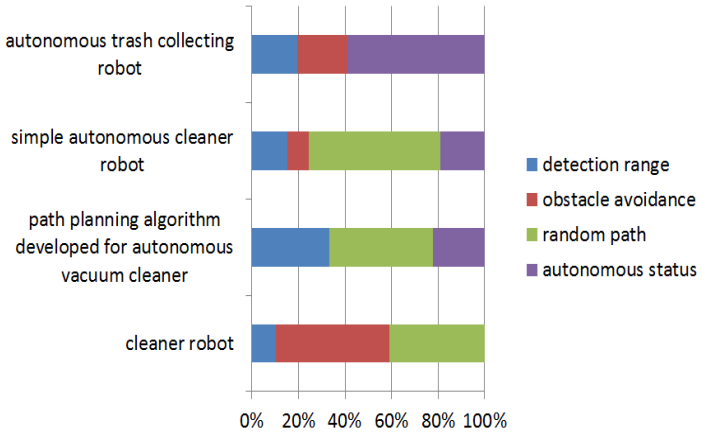

Figure 7. Performance comparison.

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VI. CONLUSION AND FUTURE WORK

Our main aim is to design and implement an algorithm for autonomous movement along with trash or waste collection by means of suction inside a small room or home with obstacle avoidance. Proposed algorithm is verified using MATLAB simulation and done it on real time using Arduino. Future work includes complex environment and obstacles in mobile robot navigation.

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