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AUTONOMOUS VACUUM CLEANER

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ABSTRACT

Our paper discusses a modern approach at designing and building an autonomous mobile vacuum cleaning robot. The robot is an autonomous robotic vacuum cleaner that has intelligent programming and a limited vacuum cleaning system.

In this robot, Infra red pairs are used for sensing the obstacles and IR leads are used for transmitting and receiving infra red rays. Using infrared rays it will find out the obstacles present in front of it and move right or left from its current position and move forward.

KEYWORDS: ATMEGA8, L293D

INTRODUCTION

The need for having a robot that automatically senses its obstacles and moves around in a room to vacuum clean the floor has become essential.

Though the human operator cannot be replaced easily by “artificial intelligence" [Schraft et al., 1994, Scho_eld and Grunke, 1994], we present a system which comes very close to replacing it as it vacuum cleans the floor of a room or area without any human interaction other than just starting, thereby saving valuable human time.

Thus it is able to navigate a living space while vacuuming the floor.

REQUIREMENTS OF THE SYSTEM

Requirement 1: The first and the foremost requirement of this system is to avoid obstacles that come in its way.

Requirement 2: The robot should be able to vacuum clean the floor area.

Requirement 3: The robot should cover maximum floor area in the room.

SYSTEM ARCHITECTURE

The I-R Sensor Element

The IR Sensor element is made up of an IR Tx, IR Rx and few resistors. The schematic is given below. We need four such elements mounted in front of the robot to sense obstacles in front of it. As you can see the sensor element has two pins for power supply and an Output pin.

The output is a variable voltage between 0 and 5V depending on the type and distance of the obstacle. It tends to 5V as some obstacle comes near it.

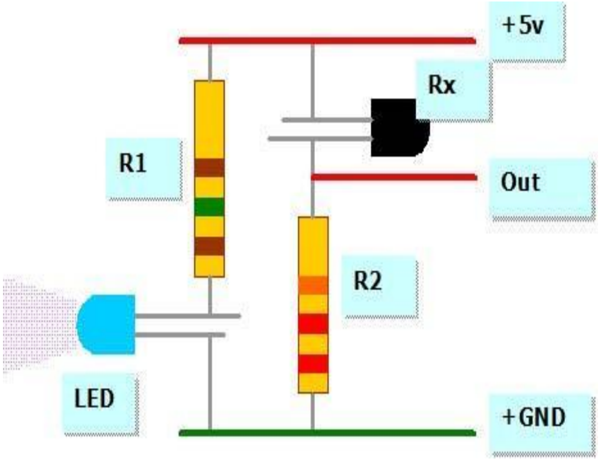

Figure 1: IR Sensor Element

Four Motors with Differential Drive

Deferential drive is a drive system in which both motion and steering can be done by two set of powered wheels. In deferential drive, there is a set of LEFT wheels and a set of RIGHT wheels. Both are powered. It does not require turning of front wheel for the steering like we steer car or bikes. To turn the vehicle (or robot), the LEFT and RIGHT wheels are rotated at “different” speeds. That is why its called deferential drive. For example, if the RIGHT wheel rotates faster than the LEFT wheels then the robot will turn towards LEFT. For this robot we will use the following rotation of wheel for the steering and straight motion.

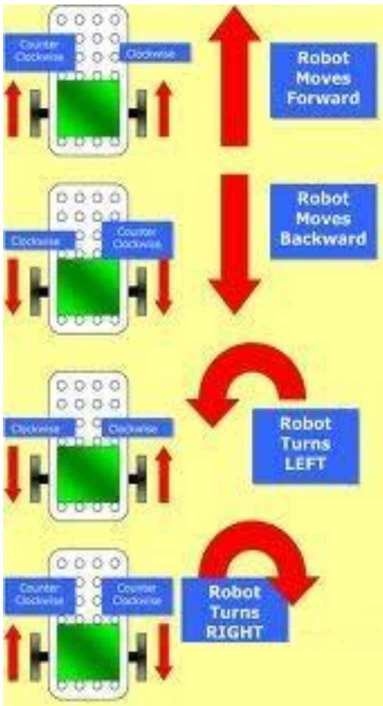

Figure 2: Differential Drive

At Mega 8 Microcontroller

We use at mega 8 microcontroller for the system. It is a high performance, low-power AVR – 8 bit microcontroller. It has an advanced RISC architecture. Ithasanon-chipanalog comparator. It has a master/ slave SPI serial interface. It has optional boot code section with independent lock bits.

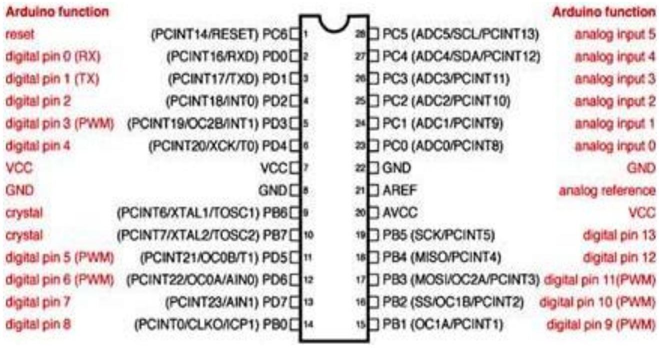

Figure 3: At Mega 8 Pin Diagram

L2938 Motor Driver

It features a unit rode L293 and L293D. It has a wide supply voltage range of 4.5 V to 36 V. It has a separate input logic supply. It includes internal ESD protection along with thermal shutdown. It features high noise immunity inputs. It has a output current of 600m A where as a peak output current of 1.2 A.

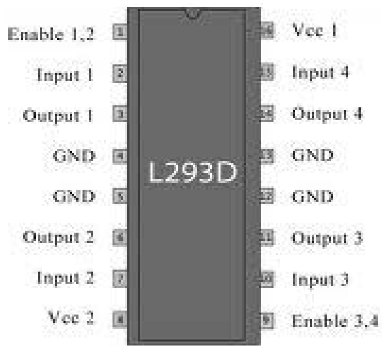

Figure 4: L293D Motor Driver Pin Diagram

SYSTEM WORKING

Vacuum Initialization

The vacuum cleaner should be connected to a battery DC battery source.

System Flow

When the IR sensors senses an obstacle in its path, it send digital 0 to the digital pin of At mega 8 and hence according to the code, voltage is supplied to the motor driver and hence to the motors which leads the robot to stop and turn and thus avoid the obstacle.

Proposed Algorithm

The proposed algorithm is as follows:

- Connect the IR sensor analog outputs to the board
- Set a threshold value for the left and the right sensor
- Check the reading (analog value)
- If there a ding is greater than both the threshold values, the board should send a digital high to the motor driver.
- If one/both reading/s is/are lower than the threshold values, the board should send appropriate digital high and low values to the motor driver.

System Flow Chart

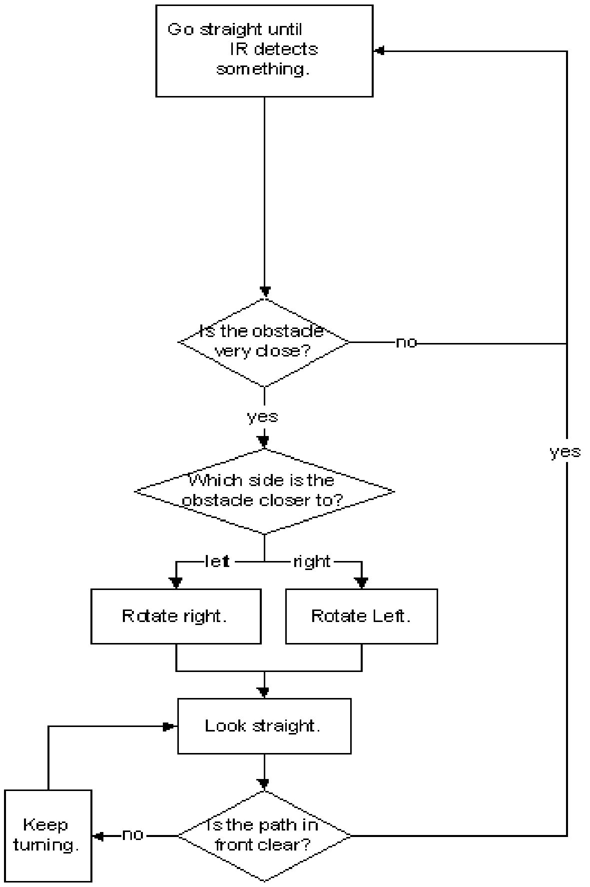

Figure 5: System Flowchart

Circuit Diagram

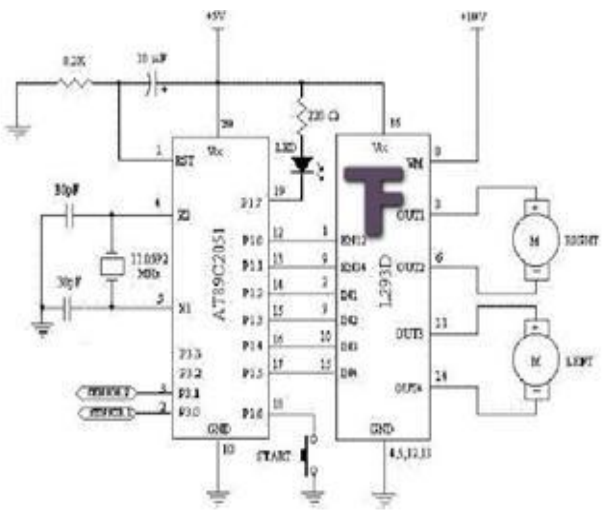

Figure 6: Circuit Diagram

As seen, this is the circuit diagram of the system. The two IR sensors are connected to the pin no. 3, 2 of the at mega 8. [Technical Report Memo 1439, MIT AI Lab.]

Depending on the readings of the sensors, the at mega 8 sends digital values (0, 1) to the motor driver (L293D), which in turn sends the analog values (0 V, 5V, -5 V) to the motors.

Flow Chart of the Code

- Check the readings from both the sensors
- If both there a dings are greater than the set threshold values, then send a digital high to the motor driver which in turn powers the motors to move in the forward direction.
- If both the readings are less than the set threshold values, then send a digital low to the motor driver which in turn powers the motors to move in the backward direction.
- If the reading of the left sensor is greater than the threshold value but that of the right sensor is lower than the set threshold value, then it implies that there is an obstacle in front of the right side of the robot.
- In this case, the robot should move backward and rotate left, hence avoiding the obstacle.
- Hence the at mega 8 sends a digital high (right motor) and a digital low (left motor) and the motor driver in turn powers the right motor to move in the forward direction whereas the left motor to move in the backward direction.
- If the reading of the right sensor is greater than the threshold value but that of the left sensor is lower than the set threshold value, then it implies that there is an obstacle in front of the left side of the robot.

In this case, the robot should move backward and rotate right, hence avoiding the obstacle.

Hence the at mega 8 sends a digital high (left motor) and a digital low (Right motor) and the motor driver in turn powers the left motor to move in the forward direction whereas the right motor to move in the backward direction.

Implementation

Figure 7: The Obstacle Avoiding Vacuum Cleaner

As it can be seen from the diagram, there are two sensors attached in the front of the robot. The vacuum cleaner is attached at the centre of the robot and its mouth faces downwards so that it can vacuum clean the floor beneath.

ADVANTAGES

- Time saver
- Useful for people with disabilities

FUTURE SCOPE

While working on the evolution of the system, we got an insight of the plethora of new features that can be added through little alterations. The features are as follows:

- Remote control for starting and stopping the robot.
- Image processing for sensing the obstacles.

CONCLUSIONS

In this paper we have presented a way in which we can implement and design an obstacle avoiding vacuum cleaner. This technology has immense scope in the future. We have illustrated in detail the principle and explained how the robot practically works.

ACKNOWLEDGEMENTS

Every project is a culmination of the hard work put in by many. Our project is also not different in this respect. So we hereby take this opportunity to thank all the professors and others who helped in making this project successful.

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