International Journal of Engineering Research in Electronic and Communication Engineering (IJERECE) Vol 3, Issue 5, May 2016

Swing Robot

[1] Anitha K [2] Thilagavathy R
Assistant professors, Department of Electronics & Communication Engineering
GSSS Institute of Engineering & Technology for Women ®, Mysuru, India
[1] ckmanitha@gmail.com, [2] thilagavathy@gsss.edu.in

Abstract: **Our paper discusses a modern approach at designing and building a Swing robot mainly used as table cleaning robot. The robot is an autonomous cleaner that has anti-falling function. This project is used in domestic purpose i.e. used to clean the table surface automatically. If the battery is charged, then ON it to moves overall table at the same time it cleans surface as it passes over it. When it detects the obstacle, it turns left/right and moves in forward direction. This robot is mainly designed and built which is capable of cleaning the surface of a table or area without any human effort other than just starting the unit.**

Key words **– Atmega8, L293D, Cleaning robot, Autonomous robot, Geared DC motors, Wheels, IR Sensors, H-Bridge**

I. INTRODUCTION

In this present era, people live a very busy life. People in cities have irregular and long working times. In such a situation a person will always find ways of saving time. Household chores are the ones that are most dreaded upon. And cleaning a home tops the list. There are many cleaning robots available in market like vacuum cleaner robot, floor mopping robot, floor scrubbing robot, floor cleaner robot.

Most of us usually use hand controlled vacuum for cleaning which requires human efforts, but the disadvantages of those robots are mainly high power consumption & more cost, for example : vacuum cleaner robot which requires more power for operation due to its dust suction ability and the vacuum unit is a bit costly and even they are not compatible with all kind of surfaces.

Due to usage of vacuum in the robots they are very expensive and they are not safe to use on sensitive glass tables. If vacuum cleaner robot is used on glass table top due to its suction power it causes vibration and due to that vibration there may be a chance of glass to break and they require more power to operate.

This robot is mainly designed and built which is capable of cleaning the surface of a table or area without any human effort other than just starting the unit. This project has a versatile usage in many fields like home, business places, research laboratories, educational institutions, etc. This project is mainly used to clean a surface of a table where the obstacle sensing and anti falling function of the unit is required so that the unit does not fall from the top of the table.

II. METHODOLOGY

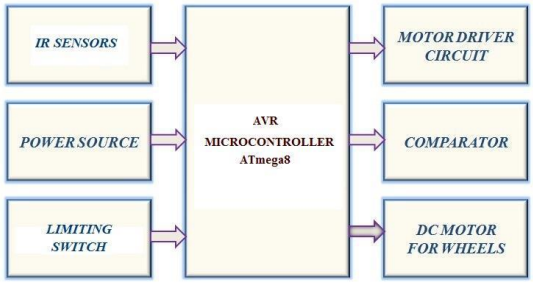

Fig. 2.1 Block diagram

Swing robot mainly consists of 3 parts namely motor controlling, obstacle sensing and controlling parts as shown in above block diagram. Motor driver controls the motors connected to the robot for the robot movement, the sensors are used to detect the floor and the obstacles present on the surface and the microcontroller is the heart of the robot which controls the complete operation of the robot according to the software program. The software coding is done in such a way that the IR sensors have to continuously monitor and sense the floor and if floor is sensed the robot have to move forward and if any obstacle is detected by limiting switch the robot have to turn left or right and must avoid that obstacle.

The motors are used for the wheel movement and supporting wheels are also added for external support and the motor is controlled by the motor driver circuit. The micro controller (ATmega16) and the memory compose the computational hardware of the system. The micro controller coordinates all of the robot's operations; it collects data from the sensors, performs analog-to-digital (A\D) conversions, runs a multi-tasking operating system,

runs the consumption program, and controls the DC motors. The memory holds the operating system and sensor data. The third main component of the robot is the program. The program describes a set of rules for the robot to follow.

This tells the micro controller how often to sample the sensors, what to do base on the current state of the sensors, and how to implement actions through the output devices. The final component of the robot is the output.

This component consists of two DC motors. The robot interacts with its surroundings using these devices. ATmega8 is a widely used micro controller that is flexible enough for a variety of applications. A DC motor relies on the fact that like magnet poles repels and unlike magnetic poles attracts each other. An H bridge is an electronic circuit that enables a voltage to be applied across a load in either direction. These circuits are often used in robotics and other applications to allow Geared DC motors to run forwards and backwards.

2.1 Hardware Implementation

In this project, we have designed an obstacle avoidance function with AVR ATmega8 microcontroller using a limiting switch. This robot is an automatic robot and no manual control is needed. This robot changes its direction of movement, whenever it detects any obstacles in its path from any side. Here, we have used 2 sensors for detecting the floor in order to give anti-falling function. The 2 sensors will be placed in the front left side and front right side of the robot pointing towards their respective side. It will continuously monitor the signals from detecting floor and it will send to the comparator, there will be a change in the output of that particular Analog IR sensor and this change will be detected by the comparator and it is sent to the microcontroller. But the outputs of all 2 analog sensors are analog in nature, so these signals cannot be processed directly by the microcontroller.

For this, we have used the ADC of the microcontroller o convert those analog values to the digital values. After converting the analog signals of IR sensors to digital values, the ATmega8 microcontroller will compare the sensor values with a reference value I,e. threshold value (3v). According to the output of the above comparisons, the ATmega8 microcontroller will send the robot in forward, left or right direction.

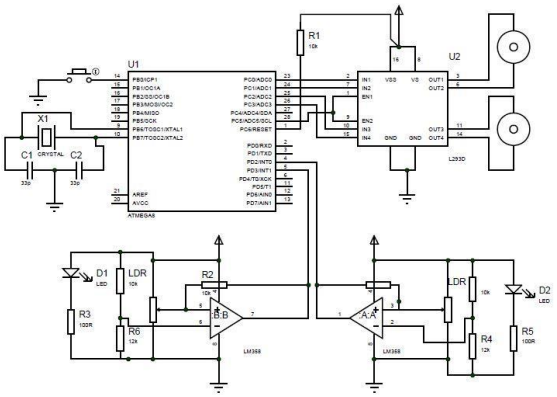

Fig. 2.1.1 Functional diagram of swing robot

The cleaner is mainly built on a piece of board. It uses a rotating sponge underneath the unit to clean a surface as it passes over it. DC motor is used to change direction of wheels which connected at middle of the platform. DC motor is used to move the robot overall table surface freely & small wheels are attached as supporting wheels.

Here to detect obstacles proximity sensor i.e. IR sensor are used & to detect the table surface Cliff sensors are used. When unit faces any obstacle or any air gap in case of stairs it will move reverse and will turn left or right and moves further.

This can be made to operate in horizontal, vertical and circular directions and according to the need it can be made to rotate in step wise or continuous motion and even clockwise and anticlockwise directions. Block diagram is shown in above figure 2.1.1.

2.1.1 IR transmitter and receiver

An IR sensor is basically a device which consists of a pair of an IR LED and a photodiode which are collectively called a photo-coupler or an opto-coupler. The IR LED emits IR radiation, reception and/or intensity of reception of which by the photodiode dictates the output of the sensor. Now, there are so many ways by which the radiation may or may not be able to reach the photodiode.
If the IR LED emissions become incident on the photodiode, the photodiode's resistance comes down to a finite value. The drop across the 10K series resistor is what we use as the input, which is compared with the threshold. The point to be noted here is that more the incident radiation on the photodiode, less will be the drop across it, and hence more will be the drop across the series resistor.

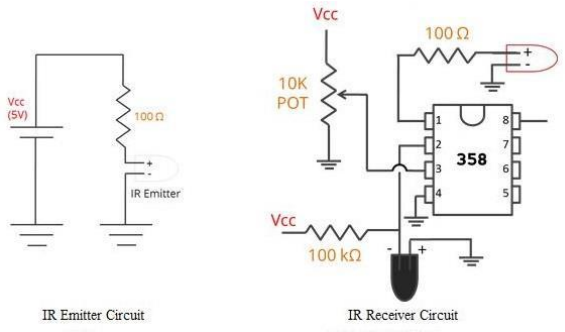

Figure 2.2 IR sensor circuit

Hence, if our reflected radiation is never strong enough to be greater than the threshold and we have a constant low as output, we can reduce the threshold voltage by turning the "minus shaped" slit in the variable resistance towards its terminal where we connected Gnd. In case our threshold is very low and the output is always high in spite of no radiation or if it is just too sensitive, then you can increase the threshold by turning the slit the other way. When the emissions are absorbed by a black surface, the resistance of the photodiode becomes very high due to no incidence of IR emissions on it, and the output remains low. I like to use an LED to indicate the output, even if I have the output going to the main circuit, but it is totally up to you when you make it.

2.1.2 Sensors placement

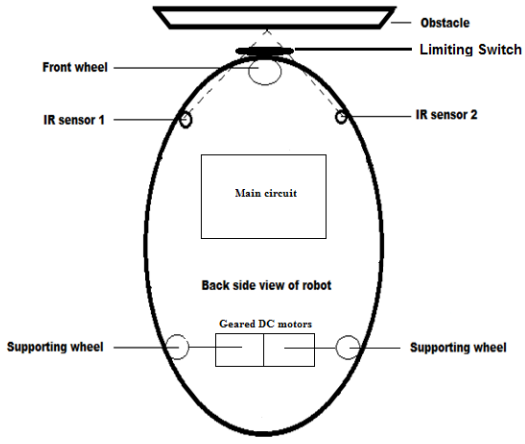

Fig. 2.3 Mechanical shape of the robot

2.2 Software Implementation

Micro Vision is the Keil Integrated Development and Debugging Environment that helps you quickly create and test embedded applications for ARM7, CORTEX-M3, C16x, ST10, XC16x, C251, and C51 embedded Micro Controllers. It combines all aspects of embedded project development including source code editing, project organization and management, revision control, make facility, target debugging, simulation, and Flash programming. Micro Vision offers a significant advantage to new users and to developers who must get projects working quickly

2.2.1 Path planning Algorithm

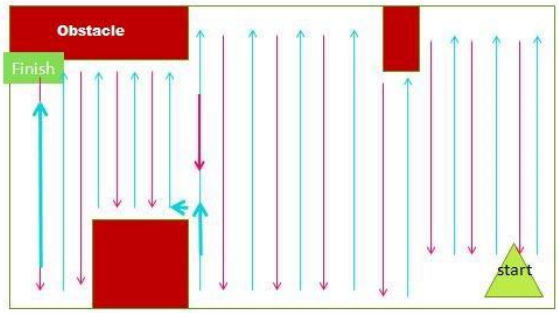

Fig. 2.4 Path planning

Algorithm:

Step 1: Start the robot by switching it ON.
Step 2: Robot moves in forward direction.
Step 3: Check the signal by detecting floor.
Step 4: If floor detected move forward.
Step 5: If floor not detected Stop.
Step 6: Initialize the port and set direction for robot.
Step 7: If obstacle detected go to step 6.
Step 8: If no obstacle move forward.
Step 9: If no floor stop.

2.2.3 Program flow

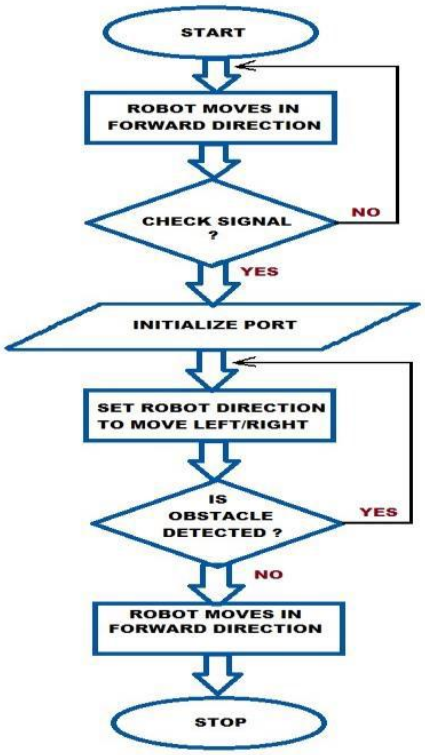

Fig. 2.5 Flow chart

III. RESULTS AND DISCUSSION

Even though we faced many problems while completing this project but still we found the methods to debug those errors and problems and we completed the project. The final design accomplished all of the goals initially set. The robot performs better than had been anticipated. The design chosen is not only very flexible, but also steady. New features can be easily added to the robot. Completion of this project brings a new product to the world of industry to increase speed and efficiency while reducing the loss.

In developing this project, new and innovative solution were needed to tackle the design challenges that were encountered. Each problem was dealt with further research and trial and error method in a timely manner. Overall the learning objective of this project provided an opportunity to research beyond the academic requirements. The final output is as shown in the below figure

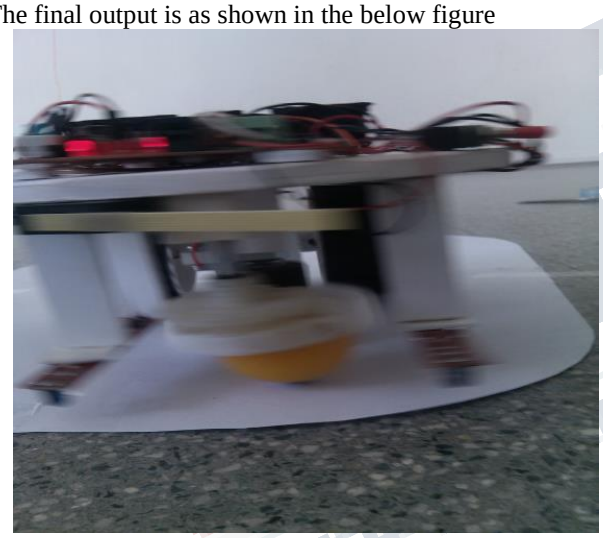

Fig. 3.1 Swing robot moving forward

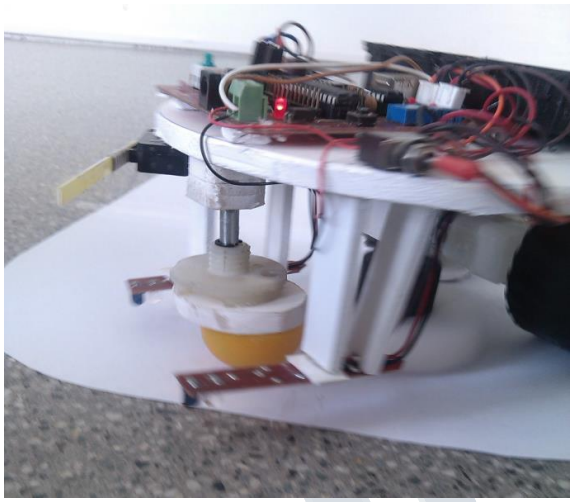

Fig. 3.2 Swing robot detecting the edge

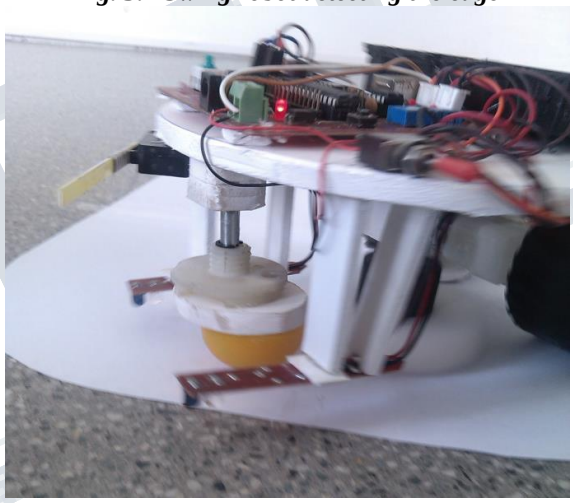

Fig. 3.3 Swing robot changing direction to avoid the edge

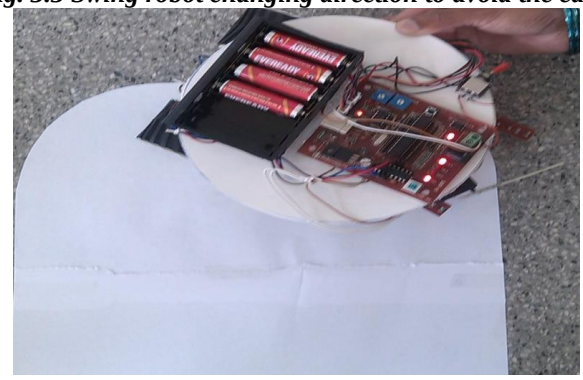

Fig. 3.4 Swing robot moving back to its path

As we can see in the above figure 3.1 when the IR sensors senses the floor it moves in forward direction if any edge is detected the sensor LED glows and if right side sensor is detected any edge the right side sensor LED will glow and for the left sensor the left sensor LED will glow and that we can see in figure 3.2 the robot changes its direction and when changing direction the output LEDs

will glow according to the programming, for example if the output LED shows the digital value 0101 by glowing the LEDs the robot moves right direction and for 0110 it moves left direction and we can see in above figure 3.3. When both sensors not detecting the edges the robot moves back to its path and moves forward till the next cliff

IV. ADVANTAGES & APPLICATIONS

4.1 Advantages

Due to its simple design it requires less components hence it is cost efficient. It works with the rechargeable battery hence it requires less power so it is power efficient. Due to its simple body structure is light in weight. Due to its less weight body it can be carried to any place hence portable size. Due to its automatic operation it is easy to handle. Can be used to clean both floor and table. Ability to clean different kind of surfaces. It will reduce the time required for household floor cleaning.

4.2 Applications

Swing robot can be used in Research laboratories, Business associations, Educational institutions, Medical applications, Hotel management, Residential purpose, Railway stations

V. CONCLUSION

The great advantage of course is that no longer have to worry about pushing or pulling a vacuum cleaner around the house or the tables, with the stress that often places on a bending back and shoulders. Neither now do you need to be constantly on the lookout for the right plug socket to plug in the vacuum cleaner and pulling the long mains lead out of the way of the vacuum cleaner constantly?

Using Swing Robot is as simple as placing it in the room or on the table that you want cleaned and letting it to clean. This project is used in domestic purpose i.e. used to clean the table surface automatically. If the battery is charged, then ON it to moves overall table at the same time it cleans surface as it passes over it. This robot is mainly designed and built which is capable of cleaning the surface of a table or area without any human effort other than just starting the unit.

By designing this robot we conclude that it can be useful to replace human being in order to clean the surface. It is a low cost and low power consuming swing robot due to that each and every family can afford it

VI. FUTURE SCOPE

As we mentioned in the objectives of this survey, we were able to demonstrate the intended application of the system. This concept has proven to be an efficient way of saving time and helping physically disabled people. This system is especially beneficial to working women. As specified the user can switch on the device and go for any other work and the robot will automatically clean the floor by detecting and avoiding the obstacles on its way. As the device has a manual mode, the user can also control the robot as per his/her wish.

The microcontroller can be easily used to modify and enhance the various capabilities of any bot, evolving its capabilities to explore new pathways of working efficiently. Sensors, IR and bump, are effective in movement of bot around cliff and boundaries of the room. These sensors, with, greater resolution can give the correctness of movement to degrees which lead to smooth cleaning of the room.

With advancement in manufacturing technology and computational speed of microprocessors, a swarm of cleaner robot can perform the above mentioned actions. Companies are now releasing scrubber versions of the same breed of domestic robots which can work in tandem if synchronized correctly. GSM modules can be added to the domestic robots making them easy to operate and accessible from any part of the world.

The technology seems a bit farfetched and difficult to implement on a great technological level, but the advent of these ideas can lead to a breakthrough in modern domestic robot industry.

- In future can make the robot smart enough to detect all objects in any position of room.
- In the future can make the robot smarter such that when the robot cleans any surface it will save the information about obstacle and its location and if the user want to clean a room it just will restore information and will clean faster.
- In future can a camera to detect edges and it will clean the tables without falling down.

REFERENCES

[1] International Journal of Computer Applications (0975 – 8887) Volume 97– No.19, July 2014 “Design and Development of Floor Cleaner Robot” (Automatic and Manual)

[2] International Journal of Scientific and Research Publications, Volume 4, Issue 4, April 2014 1 ISSN 2250-3153 “A Technological Survey on Autonomous Home Cleaning Robots”

[3] International Journal of Advanced Research in Computer and Communication Engineering Vol. 2, Issue 3, March 2013Copyright to IJARCCE www.ijarcce.com 1462 "Design and Development of Microcontroller Based ROBO Cleaner"

[4] Fahimi and Farbod, "Autonomous Robots- Modeling, Path Planning, and Control" in Springer 1st Edition 2nd Printing, 2009, XVIII, 329 p. 86 illus.

[5] Y D Zhang, K L Fan, B L Luk, Y H Fung, S K Tso "Mechanical Design of A Cleaning Robot" in 8th IEEE Conference on Mechatrinics and Machine Vision in Practice (2001)

[6] XueshanGao, Kejie Li, Yan Wang, Guangliang Men, Dawei Zhou, "A floor cleaning robot using Swedish wheels" in 2007 IEEE International Conference on Robotics and Biomimetics ROBIO (2007)

[7] Ryo Kurazume, Shigeo Hirose, "Development of a Cleaning Robot System with Cooperative Positioning System" in Autonomous Robots (2000) Volume 9, Issue: 3, Publisher: Springer, Pages: 237-246

[8] SanghoonBaek, SuyongAhn and Se-Young Oh, "Fast Localization Algorithm for the Cleaning Robot By Using Self-Organization Map" in IEEE 2007 International Symposium on Computational Intelligence in Robotics and Automation (2007), Pages: 19-24

[9] MPGI National Multi Conference 2012 (MPGINMC-2012) 7-8 April, 2012 "Recent Trends in Computing" Proceedings published by International Journal of Computer Applications® (IJCA)ISSN: 0975 - 8887 1 "Autonomous Cleaning Robot"