doi.org/10.54473/IJTRET.2023.7208
International Journal of Trendy Research in Engineering and Technology
Volume 7 Issue 2 April 2023
ISSN NO 2582-0958

ANALYSIS OF SOLAR-OPERATED MECHANIZED GROUND-CLEANING ROBOT

[1]S.Sanjay, [1]T.Prawin, [1]N.R.Kiran kumar, [2]M.Balasubramanian
[1]Undergraduate Students, [2]Professor , Department of Mechanical Engineering,
R.M.K college of Engineering and Technology, Thiruvallur Dist, Tamilnadu, India

Corresponding author: manianmb@gmail.com

Received 26 April 203 Received in revised form 30 April 2023 Accepted 02 May 2023
Available online 05 May 2023

ABSTRACT

The main difficulty faced by office professional people in cleaning the house is sweeping and mopping. Due to more work stress in the office, there is less time for maintaining the house for working people. This project is used to clean solid waste like solid papers, and dust particles in the house using renewable resources like solar energy. The main aim is to use the equipment even during the rainy seasons. It is designed in such a way as to remove the physical impurities such as dust particles from the floor along its path of motion. If they need to maintain it, they need to make separate slots for the maintenance of the house. The time required for cleaning the household dust by the robot is less compared to other mentioned robots (ROOMBA-IROBOT, Electrolux trilobite). Since it is a prototype model we are going to fabricate a small area which can be extended to a small room or area. It can be easily able to sweep and clean even at the corners, which cannot be done by the persons.

Keywords: eco-friendly, reliable, cleans waste particles, easily clean the room.

I INTRODUCTION:

A robot is an electromechanical machine that is used for various purposes in Industrial and domestic applications. Since the launch of iRobots, robotic appliances are making their way into the consumer market. Numerous comparable appliances from different manufacturers have been used [1]. Initially, having cleaning equipment was the primary concern. As time passed on many improvements were made and more efficient appliances were developed. In early, 2010 a floor cleaner Robot "Mint" was developed by Jen Steffen. Detachable clothes were attached for sweeping and mopping purposes. For tracking mint used the GPS-like indoor localization system. In this project, a floor cleaner robot based on ATMEGA328P has been Developed [2]. This robot is an electric home appliance that works based on the program input in the Arduino UNO board which is executed by the microcontroller [3-5]. The robot is programmed in such a way that the motor is controlled based on the IR sensor input. The revolving action of the robot is achieved by changing the rotation duration of the motors. The suction fan is placed in front of the robot and is capable of creating enough suction to suck dust particles and lightweight small objects. A round castor wheel is placed on the rear to provide support for the robot as it is navigated only by using 2 wheels.

II USE OF SOLAR PANELS:

Updated technology "ROOMBA-IROBOT", created by an American scientist, has the drawback of not operating well during the rainy season and having a very small dirt bin that quickly fills up but is easy to empty. It takes a bit longer to clean the brushes and the filter. Although you don't necessarily have to do that every single time you use the machine, it's a good idea to keep the mechanism clean, which gave me the idea of overcoming the difficulty faced by the robot [5-6].

Another new technology was invented by a Swedish scientist named "*ELECTROLUX* TRILOBITE*"*. This technology also had the disadvantage of not having the capacity to store the energy(less battery life) and also it does not clean the floor properly since the filter is thicker in nature.

In order to overcome the difficulties, we are going to design and analyze the robot by using solar energy.

III DESIGN CALCULATIONS:

Diameter of the Wheel D= 55 mm = 0.055 m
Speed of the Motor N= 200 rpm
Torque of the motor T= 5 kg cm = 0.4905 Nm

Power of the motor $P= (2\pi NT)/60$
$P= (2*\pi*200*0.4905)/60$
P= 10.27 W
P= 0.014HP

Time Taken for the machine to move 1m length = 5 sec
Hence, the Speed of motion of machine v = 1/5 = 0.2 m/s
Now velocity of the machine, $V = \pi*D*N'/60$

Speed of Motor after alteration in program
$N'= (0.2*60)/ (\pi*0.055)$
N'= 69.45 rpm , N'=70 rpm

FORCE CALCULATION:

The rpm of the motor taken into consideration: 40 rpm
Diameter of the tire: 100 mm

The distance that is covered in one revolution
of the tire is equal to the circumference of the tire.

The distance covered in one revolution
= 2 * π * 100 = 628.32 mm

For 40 revolution
= 40 * 628.32 = 25132.8 mm
In one minute, 25132.8 mm or 1.5 kmph
Vacuum force on suction:
A mass of 0.8kg can be held by each cup of 40mm diameter.
Therefore, 4 cups can hold 3.2kg
The total weight of the arrangement is 2.1 kg

IV MICROCONTROLLER PROGRAMMING:

```
  turnleft ();
  forwardbot ();
}
void loop ()
{
  pinMode (1, OUTPUT); //enable motor1
  digitalWrite (1, HIGH);
  pinMode (2, OUTPUT); //enable motor2
  digitalWrite (2, HIGH);
  incrementcount ();
}
void intpins ()
{
  pinMode (rmotor1, OUTPUT);
  pinMode (rmotor2, OUTPUT);
  pinMode (lmotor1, OUTPUT);
  pinMode (lmotor2, OUTPUT);
  pinMode (rsensor, INPUT_PULLUP);
  pinMode (lsensor, INPUT_PULLUP);
  pinMode (msensor, INPUT_PULLUP);
}
void incrementcount ()
{
sensor=digitalRead(rsensor)||digitalRead(lsensor)||dig
italRead(msensor);
  if (sensor==1)
  {
    count++;
    if ((count%2) ==0)
      {
        turnleft ();
        delay (1400);
      }
      else
      {
        turnright ();
        delay (1400);
      }
  }
  else
  {
    forwardbot ();
  }
}
void turnleft ()
{
    digitalWrite (rmotor1, LOW);
    digitalWrite (rmotor2, LOW);
    digitalWrite (lmotor1, LOW);
    digitalWrite (lmotor2, HIGH);
}
void turnright ()
{
    digitalWrite (rmotor1, LOW);
    digitalWrite (rmotor2, HIGH);
    digitalWrite (lmotor1, LOW);
    digitalWrite (lmotor2, LOW);
}
void forwardbot ()
{
    {
     digitalWrite (rmotor1, LOW);
     digitalWrite (rmotor2, HIGH);
     digitalWrite (lmotor1, LOW);
     digitalWrite (lmotor2, HIGH);
    }
    delay (50);
    {
    digitalWrite (rmotor1, LOW);
    digitalWrite (rmotor2, LOW);
    digitalWrite (lmotor1, LOW);
    digitalWrite (lmotor2, LOW);
    }
    delay (50); }
```

International Journal of Trendy Research in Engineering and Technology
Volume 7 Issue 2 April 2023
ISSN NO 2582-0958

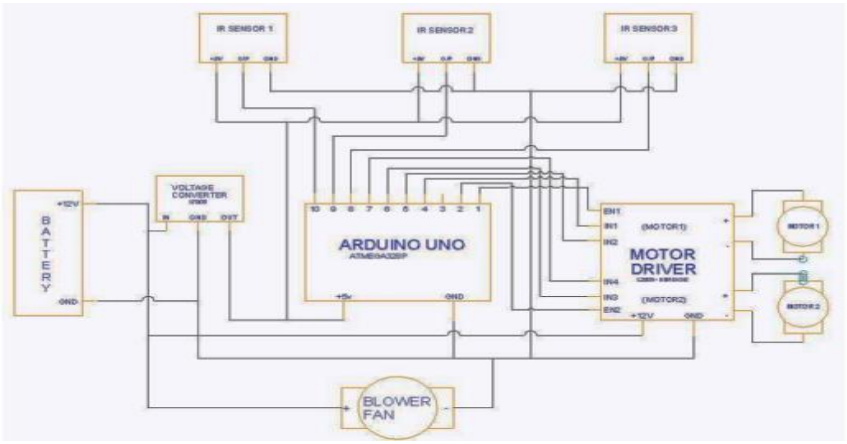

Fig.1 Circuit layout

Here the Arduino Uno is the main processing unit of the robot. The safe operating voltage of both Arduino and IR sensors is 5v DC. Hence the power supply for Arduino and sensors is given through the output of the L7805 Voltage converter output. Then the connections between the Motor driver and Arduino are given through the Digital Pins provided in the Arduino. The Enabler Pins 1 and 2 in the motor driver are connected to Digital Pins 1 and 2 of Arduino. Also, the Input pins 1, 2, 3, and 4 are connected to Digital pins 4, 5, 6, and 7 of the Arduino respectively. The Motor Driver is powered directly by the 12V battery and also by solar controllers and panels. Motors 1 and 2 are connected to their corresponding terminals of the Output pins of the motor driver. The output pins of the 3 IR sensors are connected to Digital pins 8, 9, and 10. The Blower fan is directly connected to the 12V battery and solar controller and panels (Fig.1).

V FABRICATION AND WORKING PRINCIPLE

The main objective of this machine is to cover the area completely by following a pattern and avoiding collision with obstacles. It is obtained by using the IR sensor input for obstacle detection and by varying the speed of the motor to change the direction of the motion of the machine. The program is fed to the microcontroller in such a way that when the first obstacle is detected, the model turns towards its right and then another right for odd-numbered obstacle detections and two consecutive lefts for even-numbered obstacle detections. Hence the model covers the given entire rectangular area. As long as no obstacles are detected, the motion of the two motors does not vary thereby making the machine keep moving continuously in a straight path. For turning right, the controller stops the motion of the rear right wheel and only the rear left wheel is in motion in order to achieve the turning and vice versa. A suction fan is placed on the machine, which removes the physical impurities along the path of the machine. Thus an efficient cleaning of the area is obtained.

VI LIST OF COMPONENTS

The Components required are:

- Base Board made of Laminated Plywood
- U-Clamps (x2) made of steel
- Bolts and Nuts (As required) made of steel
- DC Geared Motor(x2) of 12V operating voltage and 60RPM speed.
- Blower Fan comprising of 12V DC Brushless Motor
- Arduino UNO board with ATMEGA328P microcontroller
- Motor Driver board with L293- HBridge IC chip
- IR Modules (x3)
- Wheels (x2) made of plastic with synthetic rubber outer threading.
- Round Castor Wheel with steel roller
- Voltage Converter L7805 chip (12v to 5V step down)
- Bread Board
- 12V Lead Acid Battery
- Single-strand wires (As Required)
- Male to Female Wire (As Required)

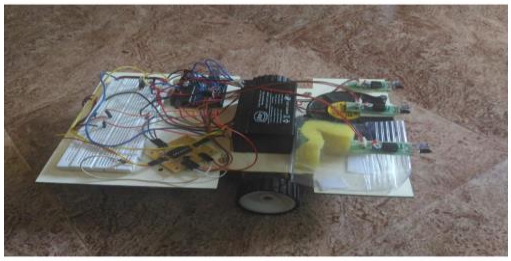

Fig.2 Front View

Fig.3 Top view

The assembled model is shown in Figs(2-3)

VII ANALYSIS

The dry wiping technique improves cleaning efficiency. This system uses a storage tank and a 12V DC submersible pump to manufacture the dust, which travels down the pipes to the front sponge wiper and then percolates into the floor through a chamber of perforated pipes. The right knobs are used to stop the outflow of dust. A tube extends from the little tank to the front perforated wiper. These cause the top to dry. The last roller wiper gathers the dirt from the surface and dries it, acting like a mop, while the remaining wipers remove the dirt off the floor (Figs(4-5)).

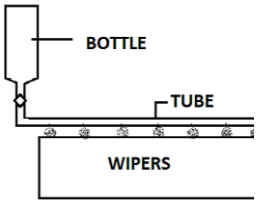

Fig.4 Analysis of a floor cleaning Robot 1

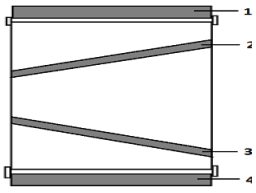

Fig.5 Longitudinal cleaning system of a robot

The regions for cleaning the floor are given below:
1: Wetting
2: Collection of higher-size dust
3: Finer dust collection
6.1 Mopping and finally finishing
The four wipers mounted at the bottom act as the cleaning mechanism. Three of them are flat, while the other is a roller wiper. At the base of the platform, there are symmetrically arranged flat wipers. They are arranged in a "V" form to make sure that the wiper picks up dirt and water as it passes over the walls in all directions. The roller wiper is positioned at the end of the platform using the correct linkages, and it is powered by a motor that operates at a higher rate in a direction that is counter to the propagation of the vehicle. The center wipers are attached by a screw that may be adjusted and taken out as required. Analysis done in ANSYS is shown in Fig.6.

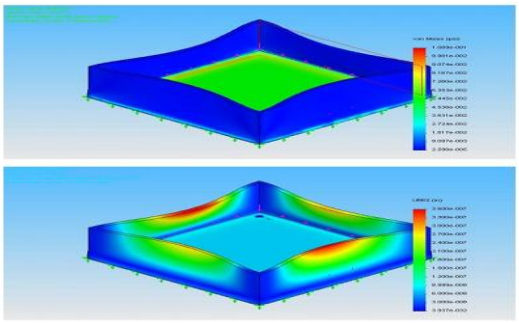

Fig.6 Analysis of a chassis and stress acted on it

VIII CONCLUSION

Hence, we have designed, analyze, and developed an automated floor-cleaning machine by using solar panels. Certain modifications must be made to make it more efficient and more suitable for conventional usage. We have incorporated only the dry-cleaning mechanism. With suitable accessories and design, a wet cleaning mechanism can also be implemented. For even more effective suction, a blower fan with higher power/rpm or multiple blower fans can be used. Since the model is reprogrammable, the navigation algorithm can be modified any number of times and fed to the Arduino board. This Arduino board and the motors are the main components involved in navigation. However, if other such algorithms seem more effective, they can be implemented and tested individually and the most effective one can be used. More advanced navigation systems such as 360° scanning of the given area thereby identifying the dust particles present at random places and removing them specifically rather than scanning the entire area are being used. Thus, we have overcome the difficulties faced by the different robots and the analysis is carried out based on the design and orientation of the robot. The wet cleaning of a robot can also be implemented as it will cost more compared to dry cleaning and mopping. The more advanced 360° scanning robot will tend to more amount when compared with our robot.

REFERENCES

. [1] Chaomin Luo & Simon X. Yang Deborah A. Stacey: "Real-time Path Planning with Deadlock Avoidance of Cleaning Robot", Proceedings of the 2003 IEEE International Conference on Robotics & Automation Taipei, Taiwan, September 14-19. 2003

[2] Chih-Hao Chen and Kai-Tai Song: "Complete Coverage Motion Control of a Cleaning Robot Using Infrared Sensors", Proceedings of the 2005 IEEE International Conference on Mechatronics July 10-\2, 2005, Taipei, Taiwan

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

[4] Zelun Li and Zhicheng Huang "Design Of A Type Of Cleaning Robot With Ultrasonic", Journal of Theoretical and Applied Information Technology 47(2013) 1138-1142

[5] Ryo Kurazume and Shigeo Hirose "Development of a Cleaning Robot System with Cooperative Positioning System" Autonomous Robots, 9(2000)237-246

[6]. Design and Development of Automated Floor Cleaning System for Domestic Purpose, Vaibhavi Rewatkar, Sachin T. Bagde, Int. Jl. for Scientific Research & Development| 3(2015) 1989-91