



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 7, July 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.569

 9940 572 462

 6381 907 438

 ijirset@gmail.com

 www.ijirset.com

House Cleaning Robot Using Arduino

Prof. Swapnil A. Namekar¹, Satyam Kumar², Harsh Verma³, Ravi Mishra⁴

Associate Professor, Department of Electrical Engineering, BV(DU)COE, Pune, Maharashtra, India¹

U.G. Student, Department of Electrical Engineering, BV(DU)COE, Pune, Maharashtra, India^{2,3,4}

ABSTRACT: The advancement in robot technology is seeking more concentration on analysis which makes the life of humankind convenient. This paper introduces the simulation, development, and design of the model House Cleaning Robot^[1] adopting IEEE Standard 1621 (- for User Interface Elements in Power Control of Electronic Devices interact in work/home lives)^[2]. Here the term robot is operated in both mode autonomous along with manual with features like picking dirt and disinfecting the area by UV (ultraviolet) light. This project can be very helpful in developing the lifestyle of humankind.

KEYWORDS: Housing cleaning robot, User Interface, dirt picker, UV

I. INTRODUCTION

In the modern generation, House Cleaning Robots have gained a lot of popularity in the field of robotics research. Due to their vast usage in assisting humans in floor cleaning applications at home, hotels, restaurants, offices, hospitals, workshops^[3]. The advantages of the operating mechanism are less time-consuming and energy-efficient but on the other hand, it can be less energy efficient due to the random cleaning process. The main objective of this work is to provide an optimum solution to the problem of manufacturing robotic cleaners utilizing local resources while keeping their low costs.

In this work, "House Cleaning Robot" has been designed for consumer/office environments and each component under IEEE Standards. The proposed design is being operated in dual modes. In one of the modes, the robot is fully autonomous and makes decisions based on IR proximity sensors' outputs, ultrasonic sensors after being processed by Arduino controller and by the H-bridge driving circuitry, the actuators, that is 2 DC encoder motors, are controlled. In manual mode, the robot can also be used to clean a specific area of a room by controlling it manually from mobile with a mobile application via Bluetooth connectivity.

II. MECHANICAL DESIGN

The mechanical design of the robot containing chassis design, UV, Vacuum cleaning, and Dirt disposal mechanism. Electronic circuitry involves a motor controller, vacuum cleaner controller, and safety circuit for power supply to sensors, Arduino controller, and the precautionary circuit is explained in the upcoming Section.

The mechanical body consists of four parts i.e. chassis, UV, vacuum cleaning, and dirt disposal mechanism. Combination all these four parts makes a complete prototype for testing,

A. Chassis

^[6]The base of the body comprises of MDF sheet, 2 encoder motors along with the Caster Wheel having O-rings' rubber on them for avoiding friction, two ball casters of adjustable height having frictionless steel balls, Aluminium angular brackets, and Aluminium holders for two lead-acid batteries of 12V and 1.2Amp rating. These motors are independently powered and mounted diagonally, and two ball casters are placed at another diagonal of the MDF sheet so that motors can move along its axis easily and more weight as compared to the chain mechanism. The cleaning robot includes a DC geared motor, sprockets for moving chain from geared motor to rotating brush, and two aluminum rods for supporting vacuum cleaner mechanism and dirt compartment. This DC geared motor fitted on one side of the MDF sheet with an aluminum holder and sprockets installed with it which have been fitted into the shaft of the motor. All desired components are installed on the lower side of the MDF sheet so that center of gravity should be lower, and the robot would be stable.

B. UV

The invisible radiation wavelength ranging from 100nm to 400nm. In four separate regions, UV light is categorized:

- 100 nm to 200 nm
- Only propagate in a vacuum (far UV)
- 200 nm to 280 nm
- Useful for disinfection and sensing (UVC)
- 280 nm to 315 nm
- Useful for medical applications (UVB)
- 315 nm to 400 nm
- Useful for printing, curing, etc. (UVA)

The Sun generates most of the natural UV light nearly 10 percent of sunlight and in that 3 to 4 percent penetrates the atmosphere to reach the ground. Out of that 95 percent is UVA and 5 percent is UVB.

No measurable UVC from the sun reaches the earth's surface. Because of the spectral sensitivity of DNA, only the UVC region have the property for significant germicidal properties.

[8]HOW DOES UVC DISINFECTION WORK?

When biological organisms are exposed to deep UV light in the range of 200 nm to 300 nm, they are absorbed by DNA, RNA, and proteins. Absorption by proteins leads to the rupture of the cell walls and the death of the organism. Absorption by DNA or RNA (specifically by thymine bases) is known to cause the inactivation of the DNA or RNA double helix strands through the formation of thymine dimers. If enough of these dimers are created in DNA, the DNA replication process is disrupted, and the cell cannot replicate. In this process, UVC disinfection works and we are using it in our project.

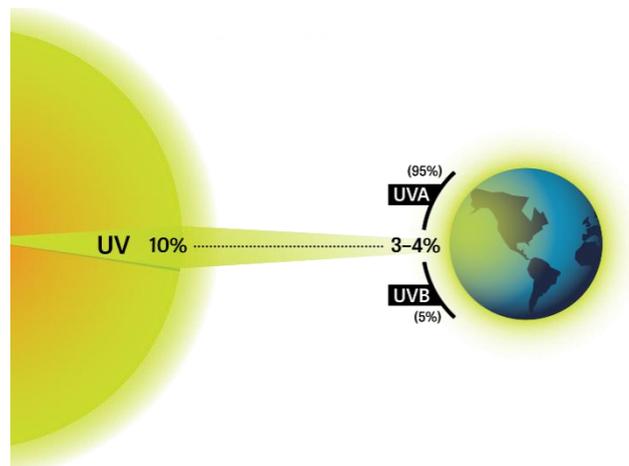


Fig. 1 UV ray[7]

C. VACUUM CLEANING AND DIRT DISPOSAL

Vacuum cleaner and dirt disposal mechanism having vacuum motor, propeller, steel holders for fixing the motor, filter mounted on two steel rods, aluminum alloy sheet, steel sheet, servo motor, aluminum brackets, and aluminum strips. A propeller mounted on a vacuum motor fixed by steel holders and filters are placed inside of aluminum alloy. The steel sheet has been melded in such a shape that it gives a shape of a robot. Aluminum alloy is also melded into a shape just like a steel sheet but of bigger size. Both sheets are attached results in the narrow tunnel from the front side and the broad compartment on the backside. The tunnel is necessary for better suction of the dirt compartment is used. At the very last end of both sheets, an aluminum strip is controlled by a servo motor installed at the upside of aluminum alloy right behind the vacuum cleaner to dispose of dirt. The vacuum Cleaner holder is spot welded on the inner side to support 18.1V, 5AhLiPo battery.

III. ELECTRONIC CIRCUITRY

Circuits are designed and simulated in Fritzing software. After the improvement of values for components, circuits were equipped on PCB. There are five main circuits including three batteries being used in this project and all these circuits are designed, analyzed, and then procured under IEEE Standard 1621. An explanation of all these circuits is given below:

A. MOTOR CONTROLLERS^[5]

Motor controllers are interfaced with L293D Motor Driver IC with Arduino, which is used for driving motors in both directions that are clockwise and counterclockwise with a current rating of 15A. This controller comprises two parts. The first part is to control the speed of motors while the second part is for controlling the rotation direction of motors. Pulse width modulation (PWM) is used to control motor speed. PWM is a technique used to average the value of the input voltage which is adjusted by giving a series of ON-OFF pulses. This average voltage is proportional to the width of the pulses known as the Duty Cycle. The higher the duty cycle, the greater the average voltage being applied to the dc motor (High Speed), and the lower the duty cycle, the less the average voltage being applied to the dc motor (Low Speed). PWM is directly given to the motor from L293D IC using PINs 1 and 9 where pin1(ENA) is for ON and pin2(ENB) is for OFF. Usually, the DC motor's rotating direction is controlled by changing the polarity of its input voltage supply and for this H-Bridge circuit is used and it contains four switches like concept having two switches close at the same time which reverses the polarity of the voltage applied to the motor. This causes a change in the rotating direction of the motor. All these four switches are controlled by Arduino via code.

B. VACUUM CLEANING CONTROLLER

This circuit is used for controlling vacuum cleaners having one transistor, one relay, one diode, and two batteries. One Lead-acid battery of 12V and 1.2Ah ratings are for power controlling (ON/OFF) of the vacuum cleaner by energizing the coil of a relay having diode in a flyback position while one LIPO battery of 18V and 5Ah is used for supplying power to vacuum cleaner with different ground terminals to avoid short circuit currents. The signal from the Arduino controller is given to transistor BJT 2N2222 which energizes relay and relay switches. After switching relay will allow an 18V power supply through it and turns on the vacuum cleaner through an ON/ OFF switch. This circuit is properly insulated to provide safety since currents may exceed 7A.

C. BRUSHING MOTOR CONTROLLER

The circuit consists of two transistors. One transistor takes signals from the Arduino controller and drives the other transistor. The transistor takes a signal from BJT 2N2222 and the other one is TIP-122. The circuit of the motor controller works on a 12V DC supply connected through a switch and fuse. Two transistors are used but transistor TIP-122 has a high current rating and cannot be activated by Arduino directly. Transistor BJT 2N2222 is not used only because the current of the brush motor is much high and BJT will not provide the necessary current. The combination of these two-transistor gives a successful circuit to drive the brush motor.

D. POWER SUPPLY TO SENSORS

All sensors are used at 5V, but batteries are of 12V and 18V. Regulator IC 7805 is used for converting 12V to 5V with the current in the milliamperes range. Capacitors are also used for voltage regulation and if there is some impulse that can disconnect power to sensors then these capacitors will act as a source for maintaining a connection to sensors. In case of a disconnected state of power supply to sensors, White LED glows labeled as disconnected owing to a section: 3.1.14 of IEEE Standard 1621.

E. PRECAUTIONARY CIRCUIT

This circuit consisting of bridge rectifiers, relays, transistors, diodes, fuses, a Positive voltage adjustable regulator, LEDs, terminal blocks, and slim headers. This circuit consists of three parts. One is for motor battery safety and regulation of voltage, the second for circuit battery voltage safety, and the third is for controlling motor battery through circuit battery and giving power to Arduino controller. In the first part, we are consisting, one relay with diode in

flyback mode, one transistor, one fuse, terminal blocks, one regulator, and a variable resistor are used. The bridge rectifier is used to keep the supply voltage positive and secure the circuits if the battery terminals are connected in a positive or negative direction. The Signal from the Arduino controller is given to the transistor BJT 2N2222 which energizes the relay and the relay will allow motor voltage to go to fuse from rectifier and then it will go to regulator input. LM338k is used which is a positive adjustable voltage regulator having a rating of 15A and can regulate voltage from 12V to 6V. After adjusting the voltage at 12V output will be shorted with terminal block and that block is now used for battery output both for encoder motors and brush motor. For more safety, fuse holders are used so that if there is any short circuiting occurs then it will not harm other components and the fuse can easily be changed. Fuse is used of 10A rating as stall current for encoder motor is 7A and for brush motor stall current is 5A. LED along with resistor is placed just after regulator so that to ensure whether the voltage is reaching to an output terminal or not. Fuse is used of 2A because no component drew more than 800 mA current. 7805 regulators are also used for giving power to Arduino through the slim header. The signal from Arduino given to transistor BJT 2N2222 energizes the relay connected to the motor battery circuit.

IV. DISCUSSION ABOUT ROBOT OPERATION

The objective of this project is to make a vacuum cleaning robot that is fully autonomous, and manual featured with a user-friendly interface. The vacuum cleaner can clean and disinfect with UV. The robot named House Cleaning Robot has variable speed and power efficiency. It can be used in autonomous and manual modes as the user's input. Customers are provided with a user-friendly interface to operate the robot without any difficulty. House Cleaning Robot most importantly consumes extremely low energy which is 90W and take lead from the competitors. And it has a safety circuit that rectifies different poles and restricts high voltage to affect the circuitry. This robot can't do wet cleaning. These two functions can be included in future enhancements of this robot. The evaluation shows that our product is reliable and cost-effective. It works with less energy consumption. The results showed that users from the university found no difficulty in using the product. Its results also showed that this product is user-friendly in both modes.

V. CONCLUSION

This paper shows the implementation of IEEE Standard 1621 IEEE Standard for User Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments in terms of the smart floor cleaning robot. This paper shows a better and simple approach to provide an overview of the design of a simple robotic cleaners control design using gadgets and instruments. This robot (House Cleaning Robot) is specially made based on modern technology. It has all the features which are required for a vacuum cleaner. It can work automatically and manually. It has the feature UV disinfectant. House Cleaning Robot has many moderators who are selling the same product at high prices. This is the first locally manufactured smart vacuum cleaner with all features up to the standards of IEEE. The target audience with all the features in the middle and upper-class families. It can also be used in industries where cleaning with the help of humans is toxic, vacuum cleaners can easily be used.

REFERENCES

- [1] Winbot Window-Washing Robot: Like Roomba, but for Glass Windows, Time Magazine
- [2] IEEE Standard for User Interface Elements in Power Control of Electronic Devices employed in Office/Consumer Environments, IEEE Standard 1621, 2004 (R2009).
- [3] Editor, (Ed.). By Alyssa Pagano, Location: <https://spectrum.ieee.org/video/robotics/home-robots/kuri-robot-brings-autonomous-video-to-a-home-near-you>
- [4] Joseph L. Jones, Newton E. Mack, David M. Nugent, Paul E. Sandin, "Autonomous floor-cleaning robot," U.S. Patent 6883201B2, April 6, 2005.
- [5] Location: <https://lastminuteengineers.com/l293d-dc-motor-arduino-tutorial/>
- [6] Location: <https://circuitdigest.com/microcontroller-projects/build-your-own-arduino-based-smart-vacuum-cleaning-robot-for-automatic-floor-cleaning>
- [7] Picture, Location: uv_sunlight_3-ece1190d.png (1920×1359) (klaran.com)
- [8] Editor, (Ed.). Klaran, Location: [What is UVC? Ultraviolet Light - Klaran](#)



**Impact Factor:
7.569**



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details