IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

DESIGN & IMPLEMENTATION OF POWER CIRCUIT FOR MICROCONTROLLER-BASED CEILING VACUUM CLEANER BOT

DR. S.S. Ambekar#1, Astha Dharne#2, Aditi Jumde #3 , Aishwarya Gawande #4 , Megha Ukey #5

[1]Project Guide, [4]B-tech Students, Department of Electrical Engineering

K.D.K College of Engineering, Nagpur, Maharashtra, India

Abstract

This paper focuses on creating a smarter ceiling vacuum cleaner bot by using microcontrollers to manage its power system. Microcontrollers act like the brains of the bot, helping it use energy wisely while cleaning ceilings & coordinating the operation of various components such as motors, and sensors. It also allows us to program clever tricks, like making the bot work harder in dirtier areas. Through real-time monitoring and control, the microcontroller adjusts power consumption based on cleaning requirements. Furthermore, the microcontroller facilitates the implementation of advanced power management algorithms. These algorithms prioritize tasks, allocate resources, and regulate power flow to maximize cleaning effectiveness while minimizing energy consumption. Using microcontrollers can make ceiling vacuum cleaner bots smarter, and make cleaning easier.

Introduction

Imagine a vacuum cleaner that effortlessly cleans your ceiling while you sit back and relax. Our project aims to bring this convenience to life by incorporating microcontrollers into ceiling vacuum cleaner bots. In this introduction, we'll discuss how microcontrollers revolutionize the power system of these bots, making them smarter and more efficient. However, by integrating microcontrollers, we can transform these bots into intelligent machines that adapt their cleaning behavior based on real-time conditions. Microcontrollers serve as the brains of our system, allowing us to manage power usage dynamically. This allows the bot to adapt its cleaning strategy in real time, optimizing energy usage based on factors such as dirt levels, room size, and battery status. In summary, our project harnesses the power of microcontrollers to create a ceiling vacuum cleaner bot that cleans effectively, making household chores easier and more sustainable.

Aim

This project aims to autonomously clean ceilings efficiently and effectively, reducing the need for manual labor and improving cleanliness in hard-to-reach areas. This could be particularly useful in home ceilings where traditional cleaning methods are impractical.

Working

The 12-volt battery is selected. The battery is connected to an R3 resistance of 10 kilo-ohms. R3 resistance one point is connected to the battery and BV (battery voltage) which is indicated on the microcontroller on PIN 9. So we will need to measure the battery voltage also but we can't measure it directly by microcontroller because the battery is 12 volts and the controller is operating on 5 volts because the controller can measure a maximum of 5 volts so for this we are dropping the battery voltage from R3 which is 10 kilo-ohms. We need to send only 10% voltage to PIN 9. R4 is also indicated as Battery voltage which is 1 kilo-ohms. 10% is only needed to send to PIN 9 so the battery is 12 volts which are divided by 10 which is 1.2 volts, The 10:1 divider is taken and by using R3 and R4 we can calculate the battery voltage to the microcontroller. C1 capacitor is taken 1000uF as a filter capacitor. The work of the filter capacitor is that in our circuit inductive load is maximum, motor is a purely inductive load. So when

we turn on-off the motor, the motor electrical interference is generated and if this electrical interference is shared in the circuit it can malfunction. Capacitor C1 bypasses the electrical interference means sending it to the ground and pure 12 volts is provided to the circuit. Circuit microcontroller, Bluetooth, and motor drivers to all 5 volts are given as a signaling command and 12 volts are available from the battery. The 12 volts from the battery need to be converted to the 5 volts so we used U1 7895 regulator IC is taken. If the voltage of the battery is 6 volts – 14.2 volts the Regulator IC will give output constant 5 volts. C2 capacitor is connected to the output of the regulator IC of 470 uF and C2 is the storage capacitor. C2 is used because when the circuit is turned ON the microcontroller, and Bluetooth ultrasonic sensor all will consume 5 volts at the same time because of that the load will come on the IC so the output can be less than 5 volts, and if the output will be less than 5 volts the devices that operate on 5 volts will be inactive, this should not happen so we are storing 5 volts in C2. When the circuit has an accuracy requirement it can consume 5 volts from the C2 capacitor. When we work on the controller there is lots of garbage data available so until the garbage data is clear next processing will not be executed i.e. controller should be initially reset. On PIN 1 C3 capacitor and R1 resistance are connected. From PIN 1 C3 is ground and R3 is connected to the positive of the regulator. R1 and C3 provide power-on reset to the microcontroller. Motor driver 1 and Motor driver 2 there are 4 pins to the input s1, s2, 12 volt, and ground. Both the motor drivers are connected from the 12 volts and the signal provided is rb0, rb1 on microcontroller PIN 21, 22. On Port b 0 and Port b 1 motor driver 1, s1 is connected because the motor driver needs two signals clockwise and anticlockwise to rotate. The right side of the microcontroller consists of PIN 15 (S3) and PIN 16 (S4) and these PIN is connected to motor driver 2 in this project we have made the provision for LCD which will be used for debugging further. We give commands to the bot through a Bluetooth application installed on Android phones. When the microcontroller is on it will check whether there is any command from Bluetooth or not so PINs 6,8,17and 18 of the microcontroller USART pins are used for serial communication and we have to connect the Bluetooth module to this pin only because the default PIN 17 and 18 is TX (transmit data) and RX (receive data) pins. ULN 2003 driver IC is taken.
There are 4 relays of 12V which give motion to the running motor to rotate in clockwise and anticlockwise direction. The 12 V relay on/off decision is taken by the microcontroller. The controller output is 5V. We cannot operate the 12V relay on 5V therefore we used a relay driver U3 which amplifies the signal of 5V from the microcontroller into 12V and thus we operate the relay on 12V. Relay number R5 is used to on/off the vacuum pump. To detect the obstacle we have used an ultrasonic sensor in our project which will detect the obstacle up to 3-4 meters

Block Diagram

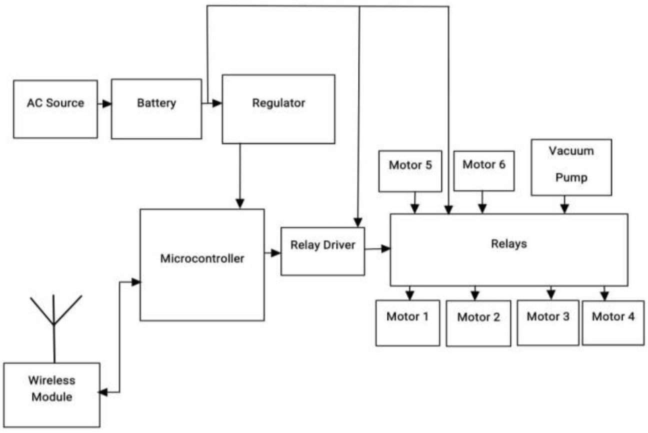

Fig1:- Block Diagram of Microcontroller based vacuum ceiling cleaner

Here is an explanation of the components listed in the block diagram:

1. Microcontroller: This is the central processing unit that controls and coordinates the operation of the entire system. It processes input signals and generates output signals to control other components.

2. Relay Driver: A relay driver is used to control the operation of relays. It amplifies the control signal from the microcontroller to switch the relays on or off.

3. Relays: Relays are electrically operated switches that are controlled by the relay driver. They are used to control the operation of various devices such as motors and pumps.

4. Motor 1-6: These are the motors that are controlled by the relays. Each motor performs a specific function in the system.

5. Vacuum Pump: The vacuum pump creates a vacuum in a specific area or system. It is used for various applications such as suction or pressure control.

6. Wireless Module: The wireless module enables communication between the system and external devices wirelessly. It can be used for remote monitoring or control.

7. Regulator: The regulator regulates the voltage or current in the system to ensure the stable operation of the components.

8. Battery: The battery provides power to the system when an AC source is unavailable. It stores electrical energy for later use.

9. AC Source: The AC source supplies power to the system when connected. It is used to power the components and charge the battery if present.

The block diagram provided in Fig.1, illustrates a system architecture comprising a microcontroller, relay driver, relays, motors (Motor 1-6), vacuum pump, wireless module, regulator, battery, and AC source. The system's operation begins with the microcontroller receiving input signals, processing them, and generating output signals to control the relay driver. The relay driver, in turn, amplifies these signals to switch the relays on or off. The relays control the power supply to the motors based on the microcontroller's commands, enabling the activation of specific motor functions. In Fig.1 Additionally, the vacuum pump may be activated or deactivated as needed, creating a vacuum for system operations. The wireless module facilitates communication with external devices wirelessly, allowing for remote monitoring or control. The regulator ensures stable voltage or current levels for proper component operation, while the battery provides backup power when the AC source is unavailable. The AC source powers the system and charges the battery when connected, ensuring continuous operation of the components. This integrated system architecture enables coordinated functionality, with the microcontroller as the central control unit orchestrating the operation of various elements to achieve the system's intended tasks efficiently.

Conclusion

Its power effectively keeps users safe and works consistently without issues. A well-designed power system ensures the bot can perform its tasks effectively and last for a long time. In conclusion, the power system of the microcontroller-based ceiling vacuum cleaner bot is crucial for its efficient operation, safety, and reliability

References

1. The microcontroller idea. Book Madison Lakeview Research U.S. - 1997.

2. Hall, D. V. Microcontroller and interfacing, and hardware (pp 278-279), McGraw Hill - 2004

3. Bhattacharya SK, Basic Electrical and Electronics Engineering, Pearson Education - 2012

4. Design and implementation of a microcontroller-based controller for the direction and speed of a robot - 2016

5. Microcontroller bot theory and applications, McGraw Hill Education - 1 July 2017