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Smart Floor Mopping BOT

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Abstract **Cleanliness is next to godliness. Cleaning is important work at every place. Sometimes the work may be simple or it may be tedious. Nowadays automation plays vital role in day-today life. So, to reduce efforts in household chores we are proposing a "Smart Floor Cleaning Bot". It is compact system which would eliminate the time and human efforts required in floor cleaning. This bot by using intelligence would detect the obstacles and clean the floor in optimized way. Our main aim is to design low-cost bot which can be used for doing daily chores. It will help people to spend this time in other activities and direct their energy to do something productive. Arduino Uno is the main component to control the mopping robot. An ultrasonic sensor which transmits the ultrasonic waves from its sensor head and again receives the echo waves and sends its output to the Arduino Uno. The ultrasonic sensor is connected with the servomotor, which helps within the rotation of ultrasonic sensor. The ultrasonic sensor measures the space between the robot and therefore the obstacle ahead of it. The Arduino will stop the robot immediately and proceed with further algorithm. The moping operation will be started or stopped at any point of your time as per the need. The moping brush is actuated by the DC motor fixed below the chassis. A robot which is capable of efficient moping of the floor of a given room is the main aim of the robot. It is aimed to make the robot economic and feasible for the economic class society.**

Keywords—Automation, Cleanliness, Cleaning bot, Daily Chores, Intelligence.

I. INTRODUCTION

Nowadays, people lead a busy life. People living in urban have very busy schedule. Hence, people always tend to look for ways to save time. As the number of women in the workforce is increasing it becomes hard for them to handle home as well as the job together. So, they have to pay someone else to do household chores. The same task can be done by a machine and it saves lot of money and time. So to clean every corner of floor, the bot can be design to do cleaning work automatically. The cleaning scrubber is attached to the bot which will rotate continuously with the help of the motor. The scrubber can be designed to clean any type of floor.

In the today's market, there are various types of floor cleaning robots are available. The main issue with these robots is that they are expensive. They usually cost above twenty thousand as advanced sensors are used. Hence, most of the population of our country cannot afford this expensive robot just for cleaning. People are willing to buy if the cleaning bot is affordable. So, many researchers are trying to make the bot cost-effective for the masses. But, with the less cost the accuracy should not be compromised by huge margin. It is a challenge for researchers to make the bot not only cost-effective but accurate as well.

The main objective is to make low cost bot. The bot should reduce the time, effort, manpower and water needed for cleaning the floor.The bot should be autonomous and it should clean the floor without any human intervention with maximum efficiency.

The Arduino Uno is being used as microcontroller for the bot. It takes the input from the various sensors and based on the algorithm, controls the movement of the robot. It is four wheel drive bot. The motors are controlled by the LN219 motor controller. The motor controller controls the direction as well as the speed of the four motors. The bot is powered by 12V a Li-ion battery which gives the battery backup of about 3-4 hours. The onboard charging circuit is also installed in the bot so, it can be charged using 12V charging adapter. The use of three ultrasonic sensors for the object detection increases the cleaning efficiency. One of the ultrasonic sensor is mounted on servo motor which rotates the sensor in left and right direction to detect any kind of obstacles. Thus this bot is efficient and can cover maximum region.

II. LITERATURE REVIEW

After going through several research papers, it is observed that there was no low cost fully-fledged autonomous floor cleaning robot. Many papers mentioned Raspberry pie as the primary microcontroller which

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increases the cost of the robot. Also, it is quite unnecessary if using sensor like ultrasonic for object detection. The cleaning robots are controlled using Bluetooth, remote control which themselves suggest that the robots are not autonomous. One of the research paper emphasis on the use of IOT to control the mopping and cleaning of the floor but the movement of the robot is controlled using Bluetooth. However, the use of IOT for the above-mentioned purpose is not necessary. Some Robots are controlled using Arduino. All of them used different algorithms and techniques for controlling the robot.

III. METHODOLOGY

Arduino is the brain of this smart floor cleaning bot. Power supply is used to fed arduino, motor driver and sensor. Motors receive voltage through motor driver. Initially after turning on the bot, it moves in linear motion and at the same time mop rotates to clean the floor. The mop is driven by high rpm motor and dripping system is used to clean the floor efficiently. Ultrasonic sensor plays important role to clean floor efficiently without any human interference.

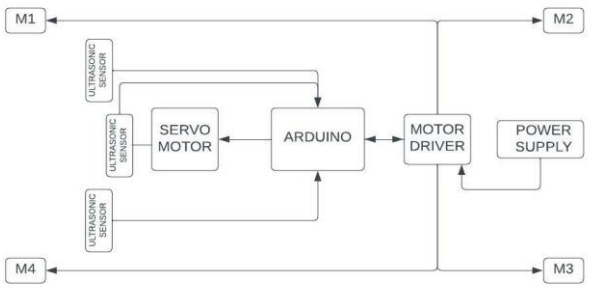

Fig. 1 Block Diagram

Here three ultrasonic sensors are used for the object detection. The main ultrasonic sensor is mounted on the servomotor and the other two are mounted on the chassis of the bot. If the object is detected by any of three ultrasonic sensor the bot will stop and the ultrasonic sensor mounted on the servomotor will look in left and right direction to detect object present in the path. Based on the algorithm, the bot will take the required decision. Depending upon the signal received from ultrasonic sensor, the arduino will decide the path. The motor driver receives the signal depending on the decisions taken by the arduino and the same signals are given to motors to change the path and clean the required floor efficiently.

IV. HARDWARE IMPLEMENTATION

A circuit diagram is simplified representation of electrical components using the standard symbols. It shows relative position of all the components and their connections to one another. It is used to show the visual representation of the circuit. The circuit diagram shown below is build and tested using proteus design suite tool.

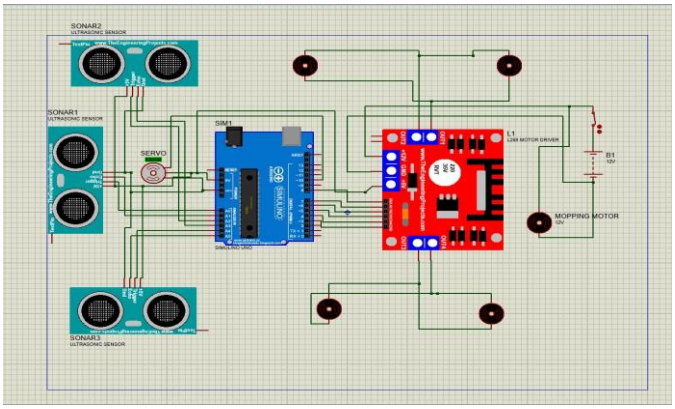

Fig. 2. Circuit Diagram

Hardware specifications are technical description and capabilities of the component. Hardware specification plays important role in designing the product which is highly efficient. Components selected must satisfy the the requirement of bot. The µC based on the ATmega328 is used. It has 14 digital input/output pins of which 6 can be used as PWM outputs, 6 analog inputs, a16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. Here, arduino is the main component which drives the other components. It is responsible for processing the information received from various sensors and actuators.

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit. Here ultrasonic sensor is used for obstacle detection. Three ultrasonic sensors are used. One of the sensors is mounted on servo motor and the other two are placed at the front corners of the chassis.

The L298N Motor Driver Module is a high power motor driver module for driving DC and Stepper Motors. This module consists of an L298 motor driver IC and a 78M05 5V regulator. L298N Module can control up to 4 DC motors, or 2 DC motors with directional and speed control. Here the motor driver is responsible to take various actions depending upon the signal it receives from the arduino. It is responsible to provide sufficient amount of current to the motor. It is also used for speed control of the motors.

Four 12 V DC motor connected to wheels for rotation. The 150 RPM single shaft motor gives good torque and rpm at lower operating voltages, which is the biggest advantage of these motors. The Dc motors drive the system

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over the desired area to carry out the cleaning action. One additional high rpm motor is used to rotate the mop to perform the cleaning action.

The ultrasonic sensor is used to calculate the distance. The ultrasonic sensor is mounted on servo motor which rotates in particular angle to help ultrasonic sensor to calculate distance in different direction.

In 3S 10A 12V 18650 is the Lithium Battery Charger Board Protection Module, 3S stands for 3 batteries or polymer lithium battery series combination. With 10.8V rated voltage for polymer battery, 11.1V 18650 or 3.7V lithium battery rated voltage and 12.6V lithium battery can be charged. And discharge 10A (referring to the maximum discharge current limit) Lithium battery protection board it also comes with over-charge, over-discharge, over-current, short circuit protection. The BMS module is used for charging the cells.

V. Software Implementation

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board. The Arduino Integrated Development Environment is a cross-platform application that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards.

Arduino IDE is used to write the code for the bot. It is necessary to import library called as New Ping which is required for working of ultrasonic sensor. Initially, the functionality of all the sensors are individually tested by using IDE.

Initially the bot moves in linear direction. The ultrasonic sensors are continuously monitoring the surroundings to check whether the object is present in the predefined range. When the object is detected the bot moves in backward direction and stop for the delay which is defined in the code. During this delay the ultrasonic sensor mounted on the servo motor checks the distance on both left and right hand side. The direction where distance is maximum is chosen for further motion. As ultrasonic sensor is present at considerable height hence it cannot detect object at the bottom and the front edges of the bot. To overcome this, two additional ultrasonic sensor are used. One sensor is mounted at right and other at left corner. Even if the object is detected by either of these sensors, the flow chart from the decision box is executed in the same way. Figure 3 shows the flow diagram of bot.

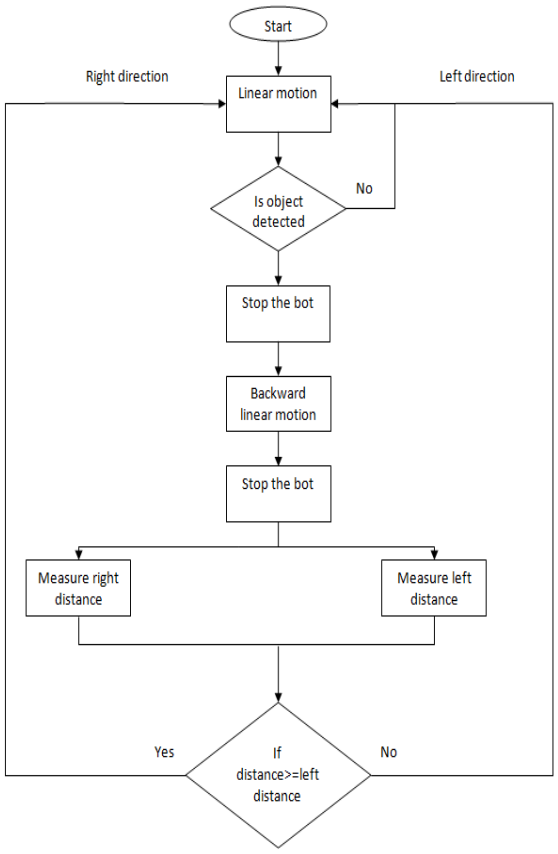

Fig. 3. Flow Diagram

VI. Results And Discussion

The development of the robot started with the design of a simple and most effective chassis for the robot which is a very important part as it has to carry all the weight on the robot. The electronics part where, the type of motor and its specification is used to run the bot, the sensors to be used, the microcontroller, the motor drivers, the wheels and other electronic components to be used on the robot are decided. Further, the assembling of the components is done and finally testing and calibrating the device.

Initially, the circuit is implemented on breadboard to check whether all parts are working properly to get the desired result.

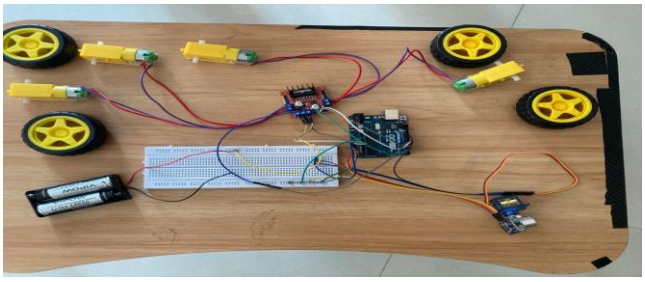

Fig. 4. Breadboard Implementation

After this stage, the prototype of bot is prepared using cardboard. In this prototype, only one ultrasonic sensor is used to monitor the movement of bot under various conditions like empty room, messy room etc.

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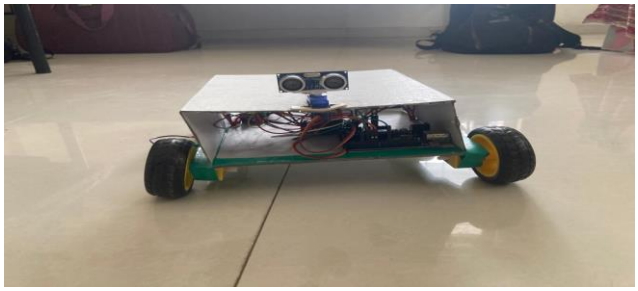

Fig. 5. Testing Stage one

This prototype had few blind spots as ultrasonic sensor is mounted on the considerable height. Hence it is not feasible to detect obstacles present at the bottom. Whenever bot goes through such kind of situation it was stuck in that position and it could not trace the further path.

To overcome this problem, it is necessary to use more sensor. The use IR sensor is not feasible because it could not detect the object in presence of the sunlight. Hence, ultrasonic sensors can be the solution. Two ultrasonic sensors are placed on the front left and right corner with height lower than the ultrasonic sensor mounted on servo motor.

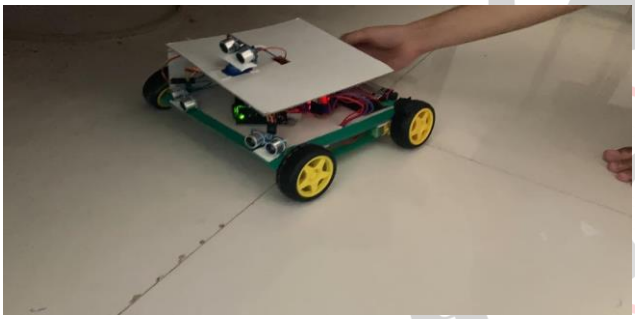

Fig. 6. Testing Stage Two

Now, the desired result is available using this prototype. The blind spots are removed and it could detect all types of objects. Now, the bot could clean the maximum area and the efficiency is increased. But still there are few limitations with are model. First is that it could not reach few parts of the room though it covered significant area. The second one is it has only mopping function.

VII. Conclusion

An autonomous and wireless bot is designed which can mop and clean the floor without human intervention. Since the bot is incorporated with different devices like Dc motors, ultrasonic sensors, so it is easy to handle and saves time. With simple algorithm and program, the bot is able to mop the maximum area of the floor as well as finds its way in and out of the small corners.

All the components used will adhere to the function of mopping and will be as affordable as possible which can be used by common man as well. As the use of water is less thus water is saved in mopping the floor. Also, the device cleans the room with a single switch of button.

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