



An Advanced Mobile Robot for Floor Cleaning

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ABSTRACT: In this present era, people lead 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. Thus manual work is taken over by robotics nowadays. In this paper, an autonomous robot for floor cleaning application is proposed. It is capable of performing sucking and mopping tasks, obstacle detection, and automatic water spray. Moreover it is also able to work in manual mode. All hardware and software operations are controlled by Atmega 328 microcontroller.

KEYWORDS: LCD, ULTRASONIC SENSOR MODULE, VACUUM CLEANER, ATMEGA 328

I. INTRODUCTION

Robot is an electromechanical machine and used for various purposes in industrial and domestic applications. Robot appliances are entering in the consumer market, since the introduction of iRobot's. Initially the main focus was on having a cleaning device. As the time pass on many improvements were made and more efficient appliances were developed. In early 2010, a new automatic 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 paper, a floor cleaner robot based on ATMEGA328 have been developed. This cleaner robot is an electric home appliance, which works in Automatic mode. Unlike existing floor cleaner robots this is not a vacuum cleaner robot; but it performs sweeping and mopping operation. Detachable mop is used for mopping. It works on multi-power supply i.e., 12V dc supply or single phase AC supply. In the automatic mode, robot performs all operations itself. Our proposed system has the added advantage of displaying the time elapsed during its operation and the proportionate cost so that it can be used for commercial purposes also.

Firstly robot starts, then it moves forward and perform cleaning action. For obstacle detection and to avoid hurdle ultrasonic sensor modules have been used. If any hurdle detected then robot change the lane automatically, does not stop and starts cleaning action. It follows zigzag path. For user convenience automatic water sprayer is attached which automatically sprays water for mopping, therefore no need to attach wet cloth again and again for mopping. Motor driver circuit have been used to drive the motors. Four motors have been used to perform respective operations like to move the robot, for water pump, for cleaner. Relays have been used to drive the water pump and cleaner motor. LM293D IC has been used to drive wheel motor. All the information will be displayed on LCD. All the information displayed on the LCD itself operates the robot.

II. SYSTEM MODEL AND ASSUMPTIONS

The entire system model consists of a Vacuum Cleaner which is used for normal cleaning purpose. The water is supplied by means of a water sprayer. The motors used in this device is a DC motor. Three motors are required for the hardware unit. Two for driving the robot forward and backward and other for vacuum cleaner. The LCD display is used to display relevant messages at the time of starting, ending and to display the time of the completed work and its equivalent cost. A buzzer is connected in order to provide a sound signal after the completion of the cleaning work.

Advanced Floor Cleaning robot is superior to an ordinary vacuum because it is more convenient to use and it can save more time when it works. The whole cleaning process doesn't need a person to control and it reduces the burden on the operation. The noise is smaller than the general vacuum cleaner when it is working. It can purify the air; adsorb harmful substances. Its dust purification rate can reach up to 96%, and the cleaning efficiency can reach up to 99%. Its structure is compact and lightweight, but it can clean up some special space. So it is an environmentally friendly, healthy, intelligent service robot with a good prospect and a wide range of market demand.

Therefore, the development of autonomous intelligent floor cleaning robot not only has a challenge on the research, but also has broad market prospects; it is the integration of key technologies of modern sensors and robotics.

III. BLOCK DIAGRAM AND DESCRIPTION

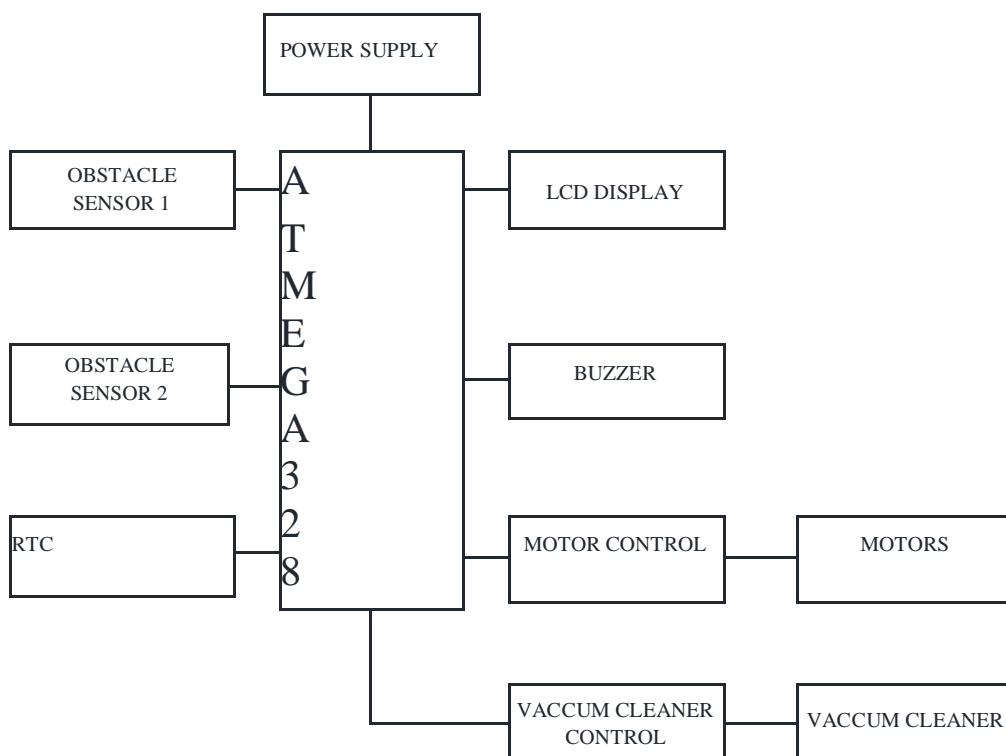


Fig.1 Block Diagram

BLOCK DESCRIPTION:

1. POWER SUPPLY:

Works either on DC or single phase AC supply. A 12V, 7AH Lead acid rechargeable battery is used as the DC supply. Fig 2 shows the battery. The AC supply is provided by using a 230/12V transformer. When working on AC supply the battery is in charging mode.



Fig.2 Battery

2. MICROCONTROLLER:

ATMEGA 328 Microcontroller is used. It is a 28 pin dip with 5v vcc. It is the brain of the equipment and it control whole units of the system. Fig 3 shows the microcontroller.



Fig.3 ATMEGA 328

3. LCD DISPLAY:

A 2*16 line LCD display is used. Fig 4. Shows the LCD. LCD displays the clearance from forward and backward obstacles during its working. After the completion of cleaning operation LCD will display the time taken and its equivalent cost.



Fig.4 LCD

4. ULTRASONIC SENSOR MODULE:

It has a resolution of 0.3cm and the ranging distance is from 2cm to 500cm. It operates from a 5V DC supply and the standby current is less than 2mA. The module transmits an ultrasonic signal, picks up its echo, measures the time

elapsed between the two events and outputs a waveform whose high time is modulated by the measured time which is proportional to the distance.

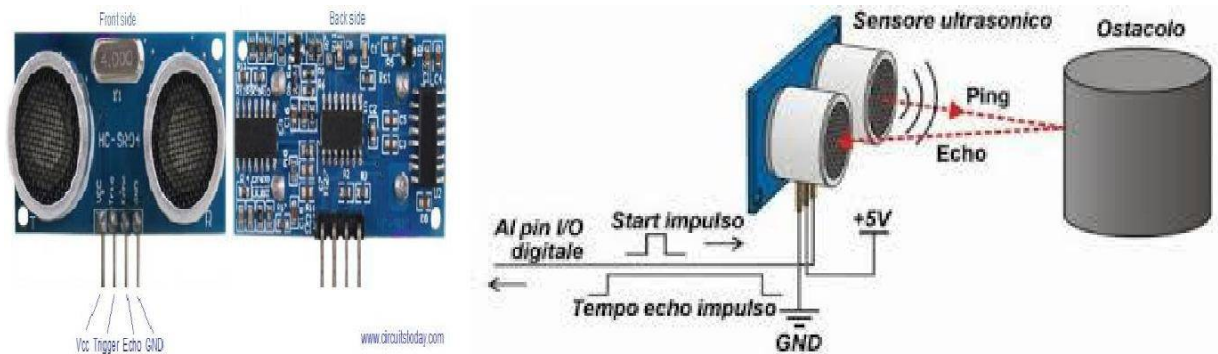


Fig.5 Ultrasonic Module

The ultrasonic module emits ultrasonic sound energy into an area of interest, and this further reacts to a change in the reflected energy pattern. Either a quartz crystal or ceramic resonator may be used to drive the device from an external clock source.

5. BUZZER:

The buzzer is a device which is used to produce a sound signal which indicates the completion of a particular task. The buzzer used in this device is a 5V buzzer.



Fig.6 Buzzer

6. REAL TIME CLOCK (RTC):

RTC is a computer clock that keeps track of the current time .RTC IC's measure time, even when the power of the main device is off. RTC draw power from an auxiliary battery.

7. MOTOR DRIVER CIRCUIT:

A motor driver is used to control the two geared DC motors. It can make a motor rotate in either clockwise direction or in anti-clockwise direction according to the control inputs given to it by the microcontroller.

8. VACUUM CLEANER:

Consists of an intake port, an exhaust port, an electric motor, a fan, a filter and a dust compartment. Particles are being suctioned due to the pressure difference created by the motor.

IV. FLOWCHART

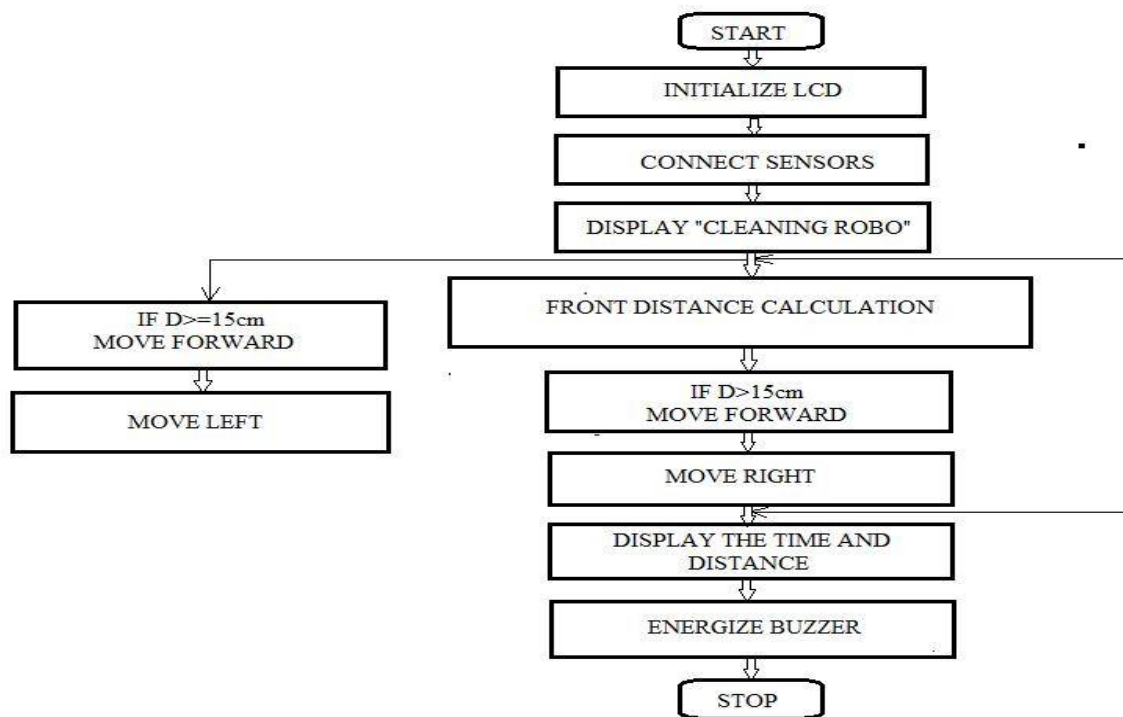


Fig.7 Flow Chart

The flow chart of the hardware unit is shown above in fig 7. Firstly we have to initialize the LCD unit and when the device is on, it initially displays “CLEANING ROBO”. The devices consist of two sensors units basically sensor1 and sensor2.

Consider the robot is cleaning a room and it is being placed at one of the corners. When the device starts the operation, the sensor1 which is connected in the front side of the device senses the obstacle in-front of it. If there is no obstacle within the 15 cm in-front of it, the device starts moving forward and at the same time starts the cleaning with the help of a vacuum cleaner connected to the robot. It keeps on moving forward until the obstacle is within the specified distance (15cm). Now consider the corner of the room is on left side, hence the robot has to move right. After moving right, sensor 2 connected in the backside is actuated and the same calculations is being done and move forward with respect to sensor2. This cycle repeats until whole cleaning of the room is completed. When the corner is in the right side, robot need to move to the left side.

After the completion of the work, the total time of the work and the cost of cleaning is being displayed in the LCD display. The buzzer produces a sound signal as indication of the completion of the work and finally stops.

V. WORKING

The Advanced floor cleaning robot works in automatic mode. When the power button is switched on the power LED glows and the hardware starts working. It proceeds the work sensing the corners using the ultrasonic sensors. Now with the help of the ultrasonic sensor connected in the front part of the robot, the sensor measures the distance to the front obstacle. If the distance is greater than 15cm, robot starts moving forward. The dc motors connected across the wheel controls the motion of robot. At the same time the third motor with the help of relay circuit, controls the vacuum cleaner in such a way that the maximum amount of dust is being sucked .This process continues till the next corner is being detected. If the distance between the corner and the robot becomes less than 15cm, the sensor senses the obstacle and the hardware stops. According to the side of corner, the hardware decides to mover right or left.

Consider that the robot need to move right. A wheel turning mechanism is being provided to turn the robot to move right side. Now the sensor connected in the back side checks the distance between the obstacles and if the distance is greater than 15cm, the robot moves backwards and this process continues till the whole area is being completed. After the completion of work, a buzzer is activated which produce a beep sound as an alert to the operator. The time of work and its corresponding amount or cost is being displayed in the LCD display. This is the most advanced updation that has been added from our side as comparing with the existing systems.

VI. SIMULATION RESULT

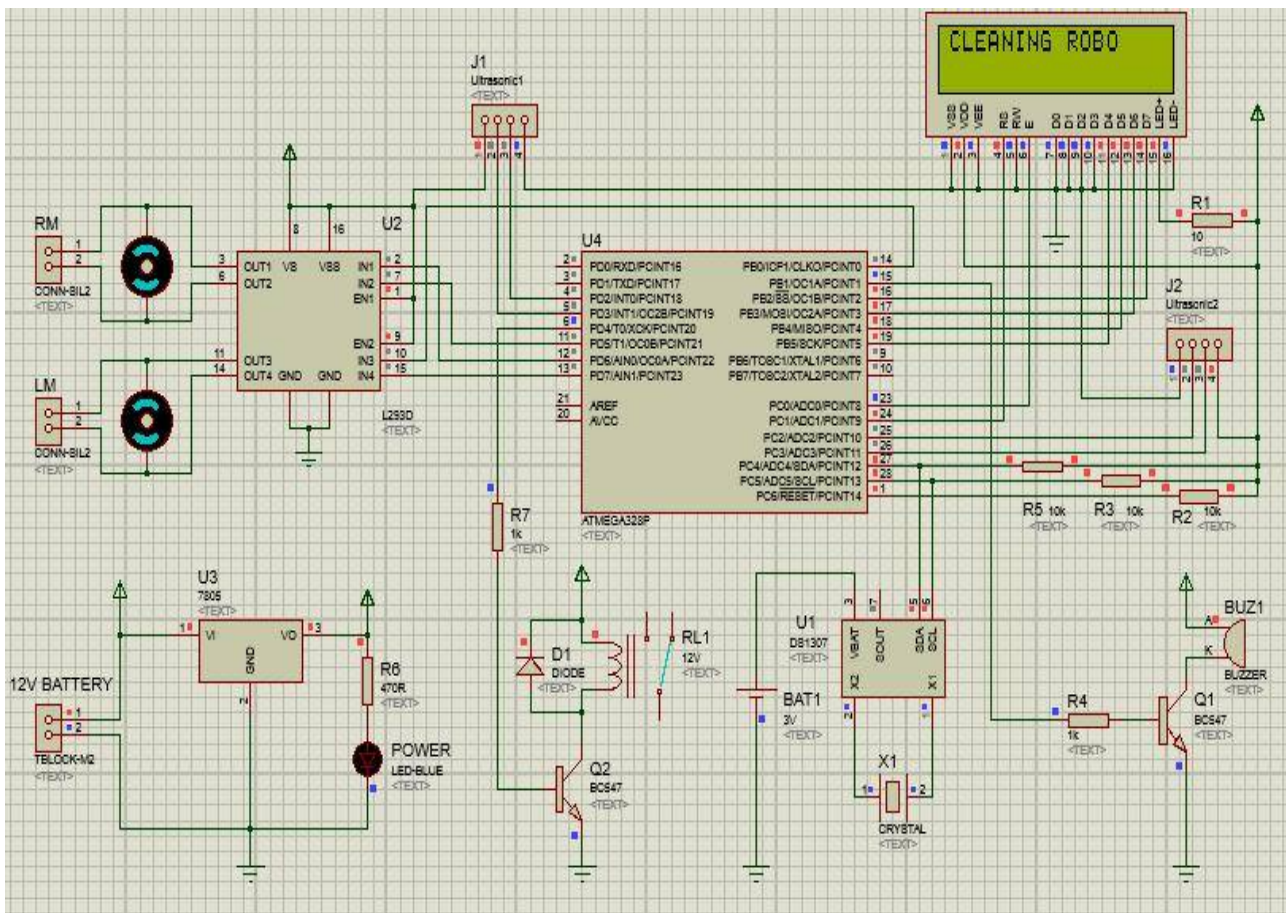


Fig.8 Simulation



The schematic circuit diagram which is used for the simulation is shown in fig 8. The LCD display used is (16 x 2) type LCD display with alphanumeric displays. The ultrasonic sensors are represented by J1 and J2. The microcontroller unit used is ATMEGA328. It's a 40 pin IC and supply used is 5V. The RLC (Real Time Clock) is connected to calculate the time elapsed during the operation, a separate 3V Battery is used for it. The motor control circuit controls the rotation of left and right geared DC motors which helps in the movement of the robot.

A 12V supply is provided, required voltage conversion is done by voltage regulator IC 7805 and is given to each devices connected in the circuit. The core part of the circuit is ATMEGA 328. A relay circuit is used to control the working of the vacuum cleaner. When the power is switched on, the message “**CLEANING ROBO**” is displayed in the LCD display.

VII.CONCLUSION

This paper facilitates efficient floor cleaning ROBOT with suction, sweeping and mopping operations. This robot works in automatic mode. This proposed work also provides the hurdle detection in case of any obstacle that comes in its way. The obstacle detection range is 15 cm. If there is hurdle in the way of robot, it sends the information to the microcontroller, which gets displayed on the LCD. Then the microcontroller will change the direction of the robot by providing necessary signals to the motor control unit. An automatic water sprayer is attached which sprays water for mopping purpose for the convenience of user. It reduces the labour cost and saves time and also provides efficient cleaning. In automatic mode, the robot operates autonomously. The operations such as sweeping, mopping and changing the path in case of hurdle are performed automatically. Moreover, there are still new ideas to improve the developed system and to add new functionality to it. When cleaning a large area the usage of a single unit is not found to be an efficient one. Therefore we may use a number of robots at a time which can be controlled linearly and continuously by an android application. A GSM module can be used to send message that, the robot has done the cleaning task. Further, the robot can be made to move randomly in any direction and its speed can be controlled.

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