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Implementation of an Automated Smart Robotic Floor Cleaner

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ABSTRACT: Automation is now being applied to each and every sector. Among this, home automation is a field focusing on making everyday household works simpler and automatic. This robot can perform sweeping and mopping task. The robot is able to avoid obstacles and must be capable of cleaning the room upon user command and is designed for a collision free navigation. The proposed system has two main sections: (I) Mopping Section (II) Vacuum Section. Mopping section consists of a mop attached to the robot which is used for cleaning the floor. It is attached to a small water container from which water is dipped in order to make the mop wet. Vacuum section consists of vacuum pump for sucking the dust particles on the way. All hardware and software operations are controlled by Arduino mega microcontroller. GSM module has been used for wireless communication between Robot and user. An acknowledgment message is sent to the user when the robot starts working and when the mop needs to be replaced. According to the user convenience, mode of cleaning can be selected. i.e., dry cleaning mode or wet cleaning mode. Other than sending commands, the robot can be turned on and off by pressing external switches.

KEYWORDS: GSM, Ultrasonic

I.INTRODUCTION

From the very beginning of human era, cleaning was one of the tedious task. There were many methods for cleaning the premises. But those methods were tedious and needed high effort. It became difficult for the working population to find time for room cleaning. Because of the difficulties, the existed system was not considered as an efficient method. As the technology has advanced, with the help of automation this task was made much more efficient. This paper presents about how the burden of cleaning can drastically be reduced by means of using an automatic floor cleaner capable of accepting user commands via mobile. Main objective of this project is to design and implement a robot by using Arduino Mega, Motor driver L293D, Ultrasonic Sensor, LCD display and thereby controlling the robot through user commands by means of GSM.

II.LITERATURE SURVEY

Earlier sawdust was used to remove water that spilled on the floor. Tea leaves were used to remove the dirt and odor on the carpets. As time passed on, broom sticks and mops were invented. Still it required manpower. The evolvement of vacuum cleaner helps the human to reduce the task of cleaning to an extent by sucking the dust particles. Even though requires the human attention. Later the emergence of room cleaning robot with random cleaning algorithm occurred but the system should monitored by the user and they failed to produce complete cleaning[1].After this smart vacuum cleaner in various platforms emerged, but it isn't much convenient for the user and not provide a particular algorithm[2].Then smart vacuum cleaner using wireless network developed but it is much complex on obstacle detection[3]. Since our requirement is to produce a robot which offers perfect cleaning by mopping and sucking simultaneously. Most of them must be turned ON manually.

III.PROPOSED METHODOLOGY

Our proposed system is able to do the whole cleaning process automatically. The user has to keep the robot on the place where the cleaning has to be done. The robot consists of both mopping and vacuum section. It offers the complete cleaning of the room by following an 'S' path .Self Obstacle avoidance is the leading feature of this system. User is

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capable of governing the system from anywhere within the cellular range. We had incorporated some advancement in GSM technology, SIM 300 for transmission and reception.SIM300 is a Tri-band GSM/GPRS engine that works on frequencies EGSM 900 MHz, DCS 1800 MHz and PCS1900 MHz.SIM300 provides two unbalanced asynchronous serial ports. Autobauding supports baud rate from 1200 bps to 115200 bps .Commands into the robot can be passed as text messages from mobile phones. The robot will be able to receive messages through the GSM module attached to it .Starting and stopping of the robot can be insist by means of messages. Ultrasonic sensors which will record the elapsed time between the sound wave being generated and bounce back wave. The measured distance is compared with pre-defined threshold value so that it can make a decision for its further movement. It will clean the floor by sucking the dust particles as well as by supports wet cleaning along with it. Stop message from user via GSM helps robot to stop its current task. If the robot is in close vicinity with the user, rather than sending commands via text messages, the user can simply turn on and off the robot by pressing the external switches provided on it.

A. BLOCK DIAGRAM

The proposed system consists of Arduino Mega, 3 ultrasonic sensors one on front and the other two in left and right side respectively, two geared DC motors, A motor driver, LCD display, GSM module and a vacuum pump. The Arduino Mega controls all the process to be carried out in the system. Ultrasonic sensors are implemented to calculate the distance between the obstacle and the system. In order to detect the edges and to avoid obstacles, ultrasonic sensors are mounted on front, right and left side. Geared DC motors are which are driven by motor driver (L293D) is used to drive the robot. GSM module is used to transmit the commands through cellular network. Our system can be started and stopped by sending message from mobile phones. Vacuum pump is used to suck out the impurities on the ground. LCD display is used to display the status of the system. It displays the current operation being carried out by the robot.

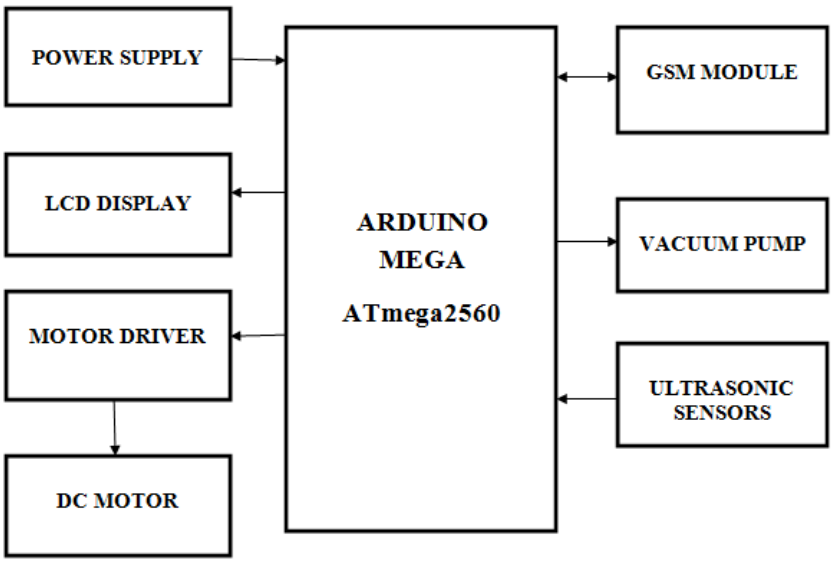

Fig 1 Block diagram of Smart Robotic Floor Cleaner

IV.HARDWARE IMPLEMENTATION

Here an Arduino mega (Atmega2560) is used as the microcontroller. Circuit consist of a GSM module, an ultrasonic sensor, two L293D driver ICs, two motors, a vacuum cleaner and an LCD Display. The ultrasonic sensor 1 trigger and echo pins are connected PWM pins 12 & 13 of Arduino respectively. The trigger and echo pins of Ultrasonic sensor 2 and 3 are connected to pins 22, 23 and 24, 25 of Arduino respectively. The virtual terminal represents the GSM Module. The RXD and TXD of GSM module is connected to TXD and RXD of Arduino. Motor driver IC (L293D) for

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driving the two motors are connected in such a way that the IN1 & IN2 for driving motor 1 and motor 2 are connected to pins 2,3 & pins 4,5 respectively.OUT1 & OUT2 of L293D is connected to motor 1 and OUT3 & OUT4 are connected to motor 2 . LCD is interfaced in such a way that RS,E, D4-D7 of LCD is connected to pins 40,38,36,34,32,30 of Arduino respectively and RW pin is grounded. Vacuum cleaner is connected to IN1 another driver IC, IN2 is grounded. ON switch and OFF switch is connected to pins 46 and 44 of Arduino respectively.

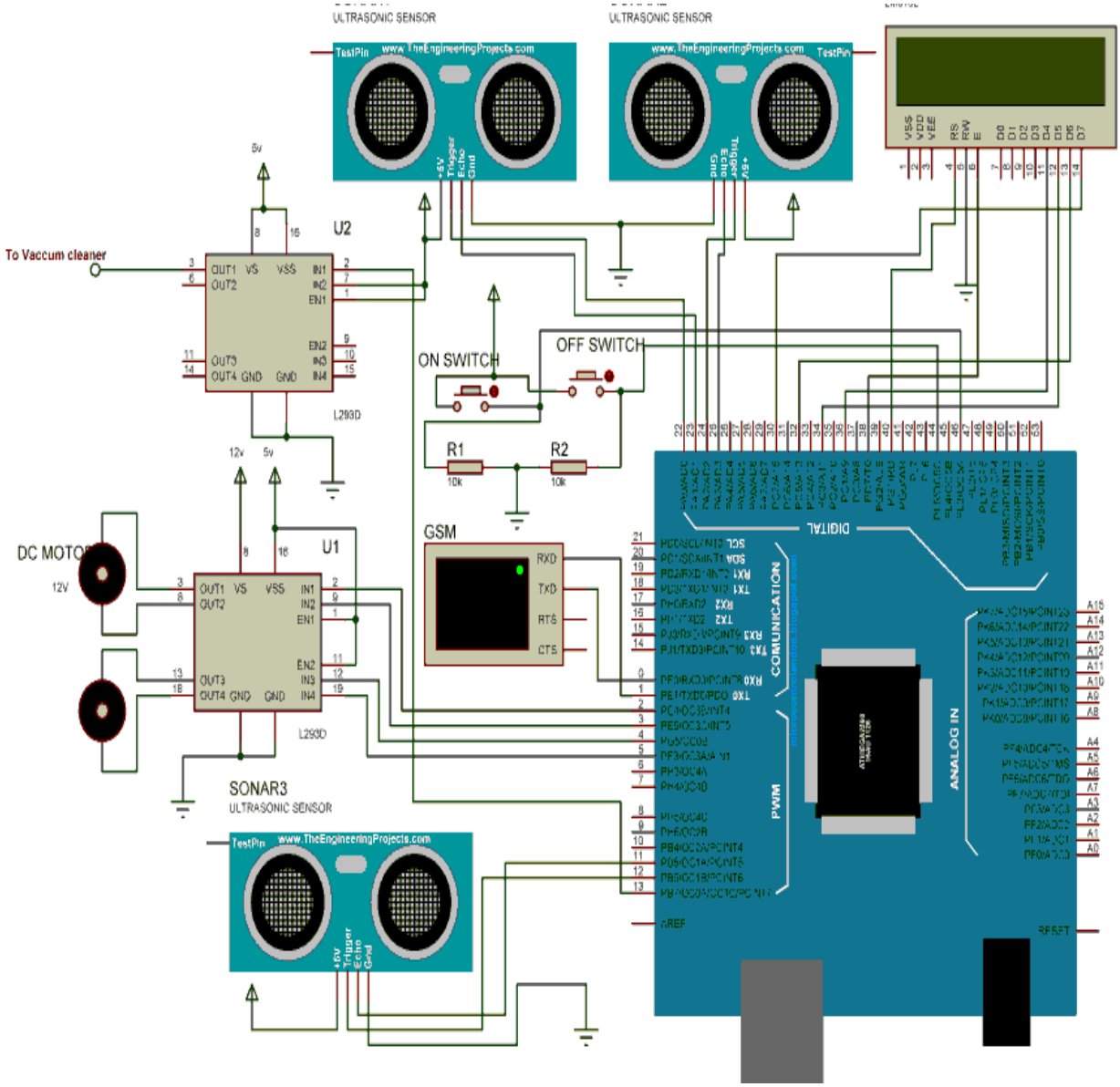

Fig 2 Schematic diagram of Smart Robotic Floor Cleaner

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A.FLOWCHART

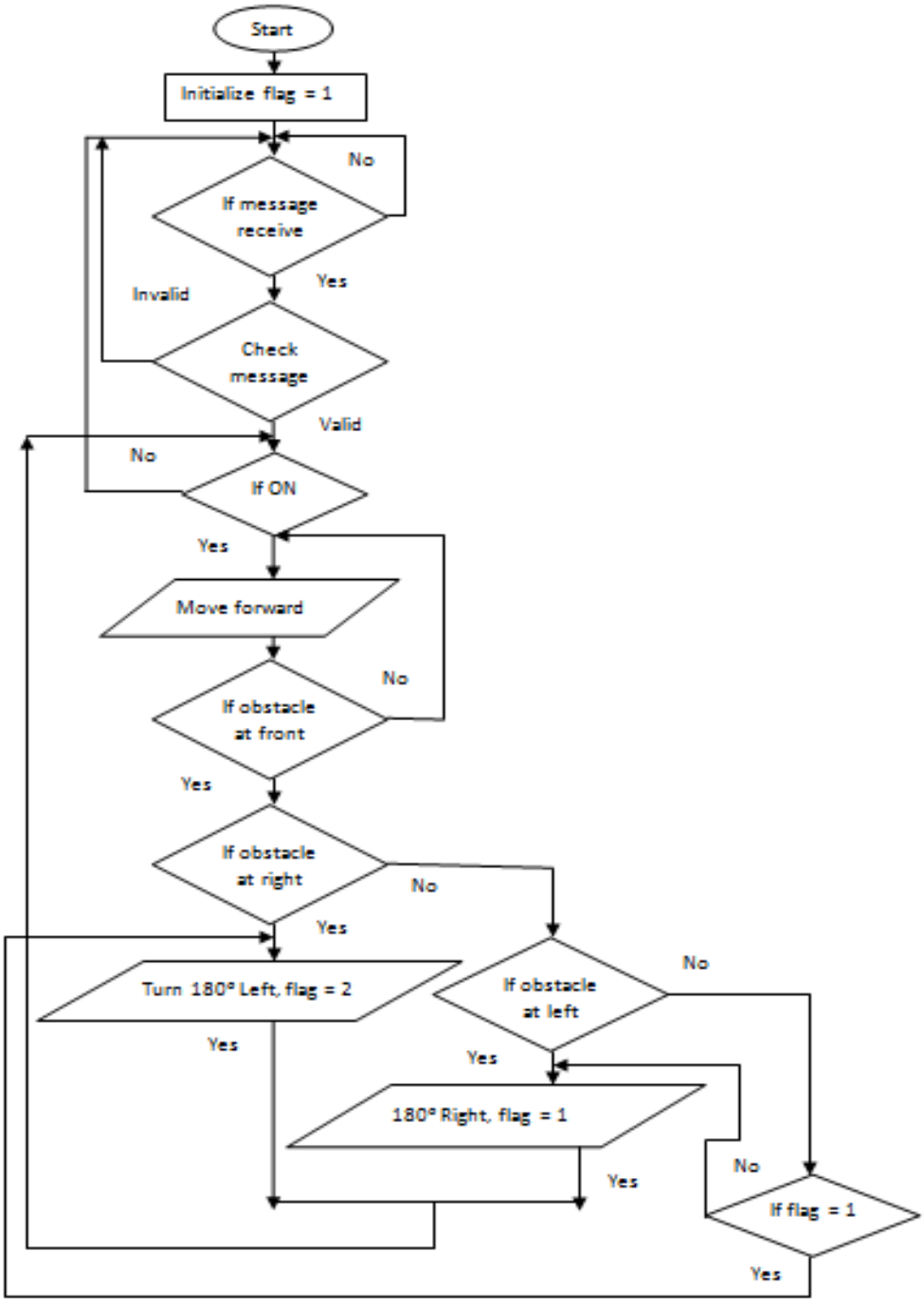

Fig 3 Flow chart

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Initially the flag is set as one. The robot will be in idle condition and will be waiting for the message from the user. The commands are preset on the program. When a valid message is received, it turns on the robot and moves forward. When a single obstacle is being detected at the front ultrasonic sensor, the robot is rotated 180° left and flag is incremented to 2. Then the cycle repeats and on detecting next obstacle the robot rotates 180° right to maintain the 'S' path. On detecting more than one obstacles i.e., if an edge is being detected at left, the robot is turned 180° right and similarly if the edge is detected at right, the robot is turned 180° left and continues the 'S' path. The cycle is repeated until a valid stop message is received. Also an acknowledgement message is sent back to the user when the machine is started and when the mope needs to be replaced. The robot can be turned ON/OFF manually by pressing external switches mounted on it. An acknowledgment message is sent to user when the system starts, when the mop needs to be replaced and when the system is turned off.

V.RESULTS AND DISCUSSIONS

A. PERFORMANCE ANALYSIS

We had evaluated main three tasks
1) Cleaning time
2) Obstacle detection
3) Calibration

1) Cleaning time
The path followed by the robot is in "S" shape, and it gives best result for cleaning cycle with less time. The average speed of the robot was 0.60 m2 per second. The proposed system is capable of cleaning 3.85m × 2.67m room within 874.15 sec or 15 Min.

2) Obstacle detection
Due to the limitations of ultrasonic sensor, there are possibilities for minute errors, but it is negligible and comfortable for the operation of robot. Similarly, S shape path make it smooth cleaning without any leftover space other than the obstacle area.

3) Calibration
Most difficult task while doing the project was the calibration process. The major shortcoming of the system was the varying calibration according to the various terrain in which the system is placed. Calibration is done based on the angle of rotation of the wheel by keeping a wheel stationary, i.e., 180 degree.

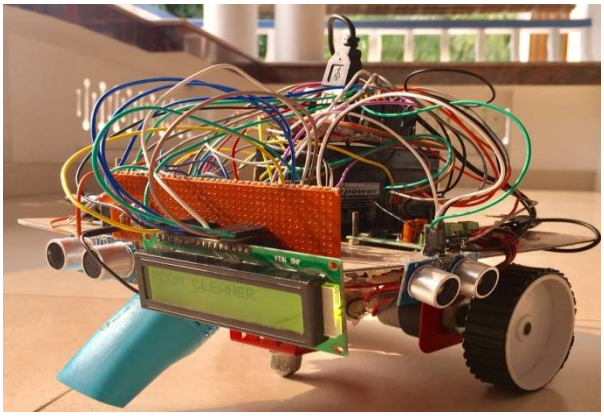

Fig 4 Working model of smart robotic floor cleaner

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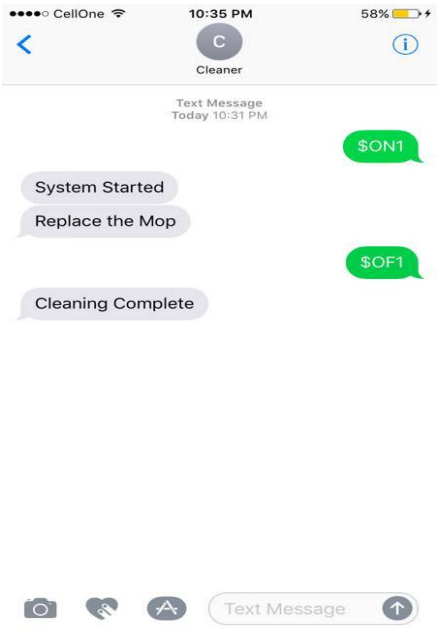

Fig 5 Sending commands from Mobile and Acknowledgement messages from the smart robotic floor cleaner

VI.CONCLUSION

In our project we introduced an automatic floor cleaning robot capable of performing both vacuum and mopping .It follows an 'S' path in order to assure complete and perfect cleaning. The use of passive IR sensors is replaced with ultrasonic sensor and is the major feature of this robot. GSM module helps to enhance its performance by proper communication between user and robot. Moreover in certain scenario, it is necessary for the robot to run more than once through the floor to ensure complete cleaning. Also future researches and updates can be ensured to keep the robot developed by more efficient path routing method and research on using other sensors for detecting waste and obstacles can be able to bring more improvising too. Also, automatic charging process using wireless can be implemented as well as the advancement in speed change mechanism.

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