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A Survey on Realization of a Floor Cleaning Robot.

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ABSTRACT

Service robots are emerging from the laboratory as commercial products. Floor cleaning, is also one of the area where these robots can be deployed. This paper focuses on one such service robot for housekeeping purposes, that can save time, it will run in a predetermined time and get charged when the voltage in the battery is low. This concept is used in the design and integration of a housekeeping robot system and sensor systems to provide a helping hand for cleaning the floor for the user. The robot is a line follower it is equipped with ultrasonic sensors for obstacle avoidance, vacuum pump for sweeping, LCD for showing the status of the process, Voltage sensor for knowing the charge left in the battery. RFID tags for guiding the path of the vehicle

Keywords: Line follower, Ultrasonic sensors, Obstacle avoidance, LCD, Voltage sensor, RFID tags

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INTRODUCTION

In the present day life of human beings have become busy and cleaning of houses is also a time consuming and tiring process and for the older persons who stay in home becomes a health issue as it involves dust it may also lead to allergy. So there is a need for a device which can clean our house without any human efforts.

So for solving this problem we have designed and developed a line follower robot with Arduino MEGA which can clean the house without any human effort. The motor driver circuit is used to control the robot direction. The ultrasonic sensor is used to avoid the obstacles. The IR sensor is used to track follower which operates in straight direction. The sensors are controlled using Arduino MEGA the voltage sensor is used to monitor the voltage of each battery. If the battery voltage is lesser based on the RFID it detects the path and move to the charging station. The RTC is used to activate the robot based on time period. The robot also has a vacuum pump on board for sweeping purpose using crank mechanism. It is also has a pump motor for spraying water on the floor and a roller will be attached to it for mopping purpose. A RTC is used to keep a track of the time as the robot as it will go to the charging station depending upon the input from voltage sensor.

The main idea behind the design of this robot is to make a machine which is able to do mopping and sweeping at the same time. The whole system is mounted on a chaise below which there are wheels which is driven by the motor driver unit controlled by the microcontroller. We are using a vacuum pump which will be used for sweeping purpose and we are using a motor for spraying water in the floor and using slider crank mechanism we will mop the floor. We have used DC motor in this device two for driving the robot forward left and right and other for spraying water. The LCD display is used to display the status of the robot. RTC will use a button cell so that when the device is off the clock will keep on running all the time and it will activate the system when the preset time has arrived. If any obstacle will be detected by the ultrasonic sensor it will stop the motor driver unit. We will place RFID tags in the floor for knowing the voltage or charge left in the batteries, which will be sensed by the voltage sensors present on board. If there is a drop in voltage than a preset voltage than the robot will follow the path back to the charging station.

Xueshan Gao et al. (2007) have designed a floor cleaning robot equipped Swedish wheels. This specialty of this robot is that it can be used in crowded places such as in airports, railway stations. The robot is also fitted with a proximity sensor obstacle avoidance and robot can pivot around without turning. The robot cleaning system includes four cleaners switched by the air-tube switching device when only one cleaner starts to work. The merit of this design idea is to save the power energy and to expect to make the cleaning efficiency up.

Manreet Kaur et al. (2014) have made a robot which has two modes of operation “Automatic” and “Manual”. The robot is able to do sweeping and mopping simultaneously. RF modules is used for wireless communication between remote (manual mode) and robot and having range 50m. This robot is fitted with Infrared sensor for obstacle detection and automatic water sprayer pump. Four motors are used, two for cleaning, one for water pump and one for wheels. Dual relay circuit used to drive the motors one for water pump and another for cleaner. All the information displayed on LCD.

Swati Pawar, et al. (2015) have implemented a human-friendly cleaning robot system for the domestic ubiquitous environment. Though conventional automatic cleaning robots already exist, these robots do not work in sync with humans. These robots cleaning operations often obstruct a person in the home. Therefore, a robot that does not interfere with human activity in the home is required. What indicates human activity most in the home is the usage status of home appliances such as electrical appliances, doors etc. This robot can identify where humans are active by receiving the usage status of home appliances via a network. The usage status of home appliances changes the robot's running pattern and consequently the robot avoids humans and cleans without causing obstruction of home appliances.

Uman Khalid et al. (2015) have presents the design, development and fabrication of prototype Smart Floor Cleaning Robot using IEEE Standard 1621 .The robot operates in autonomous mode as well as in manual mode along with additional features like scheduling for specific time and bag less dirt container with auto-dirt disposal mechanism.

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Manya Jain et al. (2017) have focus is to build and program it in such a way, that it can move around freely and clean a specific area by the vacuuming process. Brushes are attached at its side in order to collect the dust while moving. It uses Ultrasonic sensors to detect the obstacles and hence change its direction while moving and also preventing the cleaner to fall from height

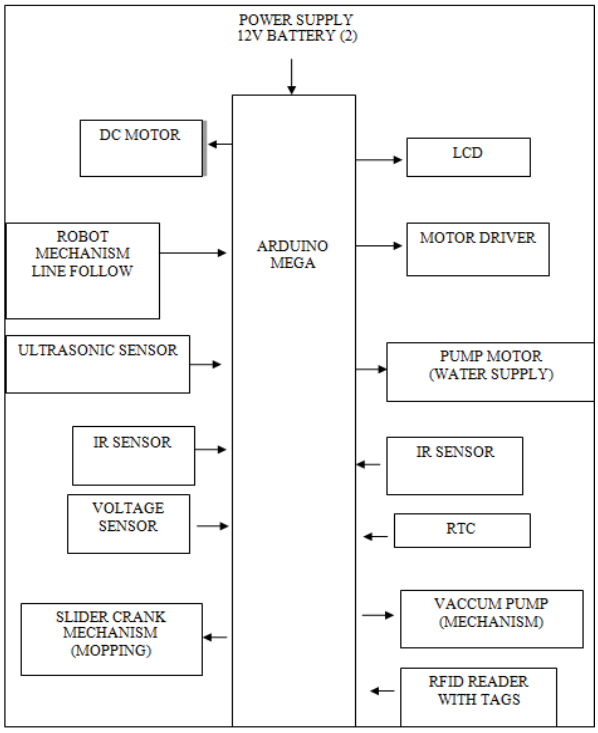
Sonali S et al. (2017) have implements the cleaning of floor in an automatic way which reduces the man power requirement. For this purpose we have design and fabricate an automatic floor cleaning robot. This work is to develop and modernized process for cleaning the floor with wet; hence it is widely used in house, hospitals, shops, office, etc.

Proposed Diagram For Floor Cleaning Robot

Arduino mega the microcontroller is the main heart of the robot which does the main processing part of the robot. It takes the input from the IR and the ultrasonic sensors and gives the command to the motor driver circuit. It runs on the Arduino software which is a free software. The coding is similar to C and C++ program which is compiled and dumped into the CPU of the microcontroller. The microcontroller works according to the conditions which are present in the program. The conditions depends upon the input received from the sensors. The microcontroller gives instructions to the Dc motors for moving.

A. Ultrasonic sensor

The obstacle detection is primary requirement of this autonomous robot.The robot gets the information from surrounding area through ultrasonic sensors mounted on the robot.. Ultrasonic sensor is most suitable for obstacle detection and it is of low cost and has high ranging capability.The ultrasonic sensor is attached in front of the robot.The ultrasonic sensor is attached in front of the robot.When the robot is going in a path the transmitter of the sensor transmits a ultrasonic waves which bounces back when any obstacle is there on the path and the robot is paused till the obstacle is cleared from the path. The microcontroller controls the movement of the robot based on the inputs recived from the Ultrasonic sensor.



B. Infrared sensor

IR sensor is used for detecting direction there are two IR sensors present on board for left and right direction. The transmitter of the sensor emits Infrared light which spreads around its surroundings and the receiver detects it when it bounces back. If no object is detected then the IR light continues forever and no reading is recorded. However, if an object is nearby then the IR light will be reflected and some of it will hit the detector. The detector is able to detect the angle that the IR light arrived back at and thus can determine the distance to the object. The detection is almost precise but the sunlight during the day is a problem too.

C. Voltage sensor

The voltage sensor is used to measure the potential difference between the input terminal and the output ter. The voltage sensor here will make the robot go back to its charging station as soon as it realises that the voltage is low and the robot will not be able to carry on its work. The voltage sensor actually plays a very important role in the case of automatic charging.

D. Line Follow Mechanism

The line follow is a mechanism which the robot traces a line and follows that until the end. The line is the path of the robot it is usually a black line .The path is always pre-determined by the user.

E. LCD

The LCD used in this robot is a 16X2 LCD. It will display all the functions that are processed by the robot. If the robot moves forward, the LCD will display (FORWARD);if the robot has low voltage ,then the LCD will display (LOW VOLT) etc. Basically the LCD is being used for displaying the status of the robot.

F. Radio-frequency identification

Radio-frequency identification (RFID) tracks down its tags with the help of electromagnetic fields produced by it. Generally the tags are attached to the devices and they store information electronically. They are available in two types Passive tags and Active tags .The passive one's collect energy from a nearby RFID reader's by interrogating radio wave whereas the active one's have their own power source eg BATTERY and it is able to operate hundreds of meters from the RFID reader. In our robot, the reader will be placed on the robot and the RFID tags will be placed on the path which will be followed by the robot. It will be mainly helpful for the robot for moving to charging station.

Performance Analysis Inference

When the robot starts it will first check for the time which is already set in the microcontroller than it will check for the voltage. If both the motors are on than the robot will move forward if the left motor is on than the robot will move right and if the right motor is on than the robot will move towards left . Every time the robot moves it will check for voltage i.e the amount of charge left in the battery.

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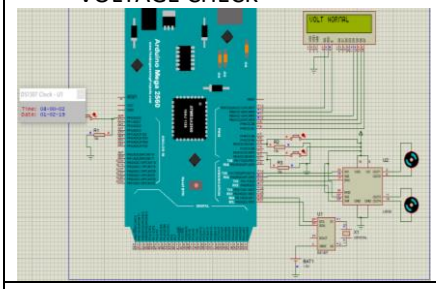
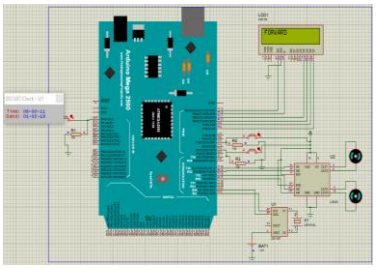
PERFORMANCE ANALYSIS

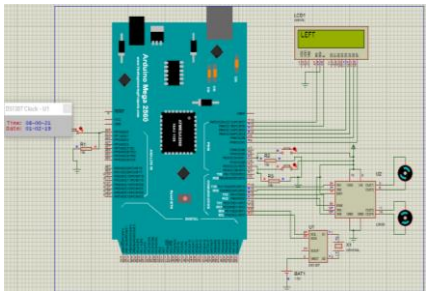
VOLTAGE CHECK



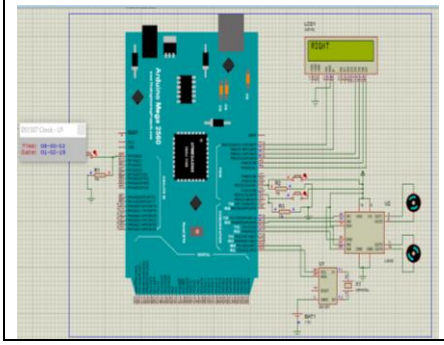
FORWARD MOVEMENT



LEFT MOVEMENT



RIGHT MOVEMENT



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 labor 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 auto charging 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.

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