Arduino Based Cleaner Robot

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***Abstract*— Manual work is taken over the robot technology and many of the related robot appliances are being used extensively also. Here represents the technology that proposed the working of robot for Floor cleaning. Households of today are becoming smarter and more automated. Home automation delivers convenience and creates more time for people. Domestic robots are entering the homes and people's daily lives, but it is yet a relatively new and immature market. However, a growth is predicted and the adoption of domestic robots is evolving. Several robotic vacuum cleaners are available on the market but only few ones implement wet cleaning of floors. The purpose of this project is to design and implement a Vacuum Robot for Autonomous dry and wet cleaning application using mop. Vacuum Cleaner Robot is designed to make cleaning process become easier rather than by using manual vacuum. The main objective of this project is to design and implement a vacuum robot prototype by using Arduino Uno, Motor, Ultrasonic Sensor, and IR Sensor and to achieve the goal of this project. The whole circuitry is connected with 12V battery. Vacuum Robot will have several criteria that are user-friendly.**

Keywords*— *IR sensors , Ultrasonic sensors , Arduino Uno , LCD display

I. INTRODUCTION

The research and development of an autonomous mobile robot and a Manual Phone Application Control prototype able to vacuum cleaning a room or even an entire house is not a trivial challenge. In order to tackle such a task, so that it could be completed in six weeks (the duration of the course), some simplifications and assumptions were made to the designers initial idea of an "ideal" autonomous/manual vacuum cleaner. In this way, some functional requirements that would improve the robot performance were not taking into account due either to their inherent complexity or to their mechanical implications. These robots operate semi- or fully autonomously to perform services useful to the well-being of humans and equipment. With the aim of keeping our robot as simple as possible, while able to perform the initial goals, i.e. an autonomous vacuum cleaner robot able to randomly navigate through a room or a house with the minimum human assistance, the following specifications were found:

- Obstacle avoidance
- Floor avoidance
- Collision Detection
- Dry cleaning
- Wet cleaning
- Status display
- Automatic system

Four motors have been used to perform respected 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 displayed on LCD. These specifications correspond to some of the expected behaviours that will be programmed into the robot. Other behaviours that will increase the overall performance of the robot.

II. METHODOLOGY

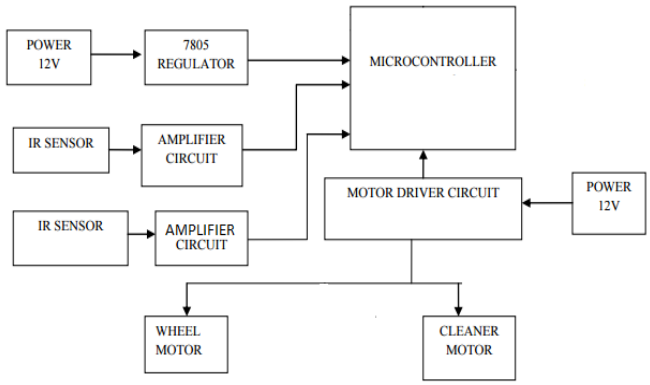

Figure 1

The robot is designed keeping in mind following modules of operation:

- cleaning mechanism directional control with automatic obstacle avoidance
- In time monitoring

The cleaning is inspired from the conventional stages of any wiping or sweeping operation, which are blend with the design and placed in the operational order of working stages.it consist of four dedicated wipers that are attached to the platform. Among them, one of the wipers is cylindrical and the others are flat in geometry. The flat wipers are symmetrically placed at the bottom of the

Platform arranged in 'V' shape so as to ensure efficient cleaning and collection of dust. The roller wipers are placed at the end of the platform using proper links and a driver motor. The cleaning is made efficient using wet wiping system. This system employs a small bottle that carries water in it. This ensures a complete cleaning of the surface. Only the wipers in the front are made wet. This ensures that the wiper from the back remove the water from the surface when sweeping again on the surface.

- Movement

➢ Direction control 40 rpm geared motors provide the necessary forward motion on the floor, powered by 9V batteries and the

directional control is established using a programmable microcontroller ATmega328 IC 32 bit, manually controlled using Radio Frequency transmission. Infra Red sensors are fitted on the edges for obstacle detection.

A. Chassis Construction

Aluminum is selected for the metallic base since it has light weight. The thickness of the chassis is 2mm. The dimensions were decided according to the design requirements considering complexity of construction and and overall weight of the setup. The steps carried out are explained as follows. Two 100mm diameter tiers are fixed in symmetry to balance the center of gravity of the chaise Provision for roller wiper was made by making holes. The thin flat wipers that are 'v' shaped were screwed to the chassis to adjust the height. The roller wiper is placed at the back inside the chassis. The two thin flat wipers are attached to the middle portion of the chassis. These two wipers are attached in a 'v' shape, inclined to each other. The v shape ensures that the dust is transferred to same spot after cleaning, making the duct collection part for floor cleaning very easy. The bumper present at the front collects big particles. The wiper at the front that wets touches the ground lightly to apply water. The next wiper collects dust that is larger in size. The third wiper collects dust smaller than the previous one and so forth. These vipers are provided with a screw attachment such that it allows an advantage of adjusting height as per the surface unevenness. The roller wipers are rotated using 100rpm motors. This cleans the dust along the path that the vehicle moves.

B. IR Sensors:

The IR sensors are used for the obstacle detection. These are sent as the input values for the Arduino microcontroller board along with the push button signals received from the RF transmission. The IR sensors works according to the following:

- The IR sensors emit IR rays continuously in a line.
- The rays transmitter and detector are present in the same board.
- Once any object comes as an obstacle, the IR rays are reflected back to the source
- These rays are detected and an output signal Is sent.
- This signal is sent to the arduino board for further processing Infrared radiation is the portion of electromagnetic spectrum having wavelengths longer than visible light wavelengths, but smaller than microwaves, i.e., the region roughly from 0.75µm to 1000 µm is the infrared region. Infrared waves are invisible to human eyes. The wavelength region of 0.75µm to 3 µm is called near infrared, the region from 3 µm to 6 µm is called mid infrared and the region higher than 6 µm is called far infrared.

Figure 2

The wireless sensors involve the following components and steps:

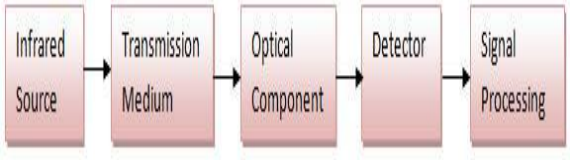

Figure 3

- Infrared Source All objects above 0 K radiate infrared energy and hence are infrared sources. Infrared sources also include blackbody radiators, tungsten lamps, silicon carbide, and various others.
- Transmission Medium Three main types of transmission medium used for Infrared transmission are vacuum, the atmosphere, and optical fibers. Due to absorption by molecules of water carbon dioxide, ozone, etc. the atmosphere highly attenuates most IR wavelengths leaving some important IR windows in the electromagnetic spectrum; these are primarily utilized by thermal imaging/ remote sensing applications.
- Optical components Often optical components are required to converge or focus infrared radiations, to limit spectral response, etc. To converge /focus radiations, optical lenses made of quartz, CaF2, Ge and Si, polyethylene Fresnel lenses, and mirrors made of Al, Au or a similar material are used. For limiting spectral responses, band pass filters are used. Choppers are used to pass/ interrupt the IR beams.
- Infrared detectors Wavelength region or temperature to be measured, response time, cooling mechanism, active area, number of elements, package, linearity, stability, temperature characteristics, etc. are important parameters which need attention while selecting IR detectors.
- Signal Processing Since detector outputs are typically very small, preamplifiers with associated circuitry are used to further process the received signals.

C. Arduino UNO Board

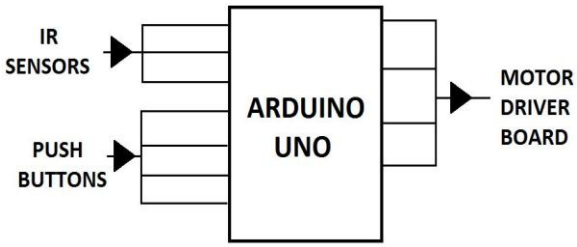

Figure 4

This is the micro controller that controls the action of the entire motion control of the cleaning system. This controller decides the way in which the entire set up should turn depending on the presence of the obstacles.

The arduino board has the following steps:

- The controller receives inputs from the IR sensors and the Push button signals.
- The signals are analyzed .
- A program is already fed into the Arduino board IC to perform a certain task.
- For example, if the input signal is received as 0111, then the chassis is destined to do forward movement. So signals are sent out to the driver board accordingly.
- In case of the IR sensors, the signals when received are supposed to stop the motor. Thus no supply signal is given to the motor.
- The program is fed into the arduino board through software specially designed for this board.
- The software is ARDUINO IDE that can be installed in any system with its basic configuration.
- The output from this goes to the motor driver board.
- The processor uses here is ATMEGA 328D. The main function of this processor is to decode the information received from the pushbuttons and the IR sensors and send the signals to the motor driver board for actuation of the motors. The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, 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. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.

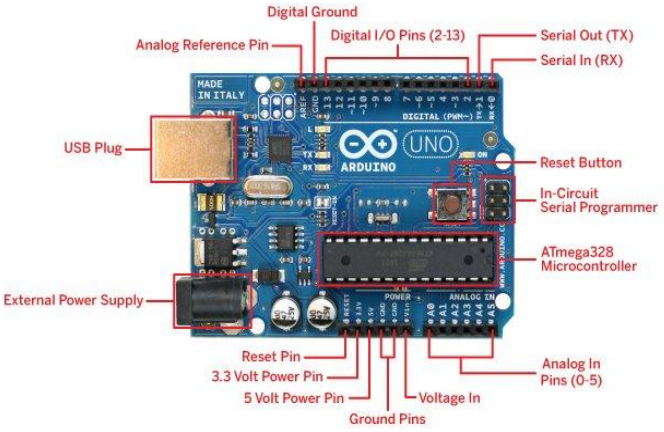

Figure 5

D.Motor Driver Board:

- ❖ Motors cannot be operated directly from the signal obtained from the controller.
- ❖ This is because the power obtained from the controller is very small.
- ❖ It is only about 5 volts.
- ❖ But the motors require 12 volts for their operation.
- ❖ So the motor driver board acts as the intermediate component.
- ❖ L293 is the ic used in this driver board
- ❖ For this to work the inputs and outputs of are specified in the form of a block diagram as shown:

The motor driver board contains an IC that converts the input given to the board to pulses that operate the motors. The input for this board is obtained from the Arduino Uno board and the output is given to the motors. The electrical signals are given to the motors. The motors must have opposite electrical signals in their poles to enable their running. For example, to run the first motor, a low signal has to be given to one pole and high signal to the other pole.

E. Motors:

Motors are the primary actuators for any system. They move the entire vehicle in the desired direction. The motors have two poles that have to be given supply to rotate it. Among the two poles, one has to get the required power supply while the other gets the ground. Due to opposite charges given to them, the core starts rotating in the desired directing giving the output. This is the basic operation for any motor. The motors for durability and usability in their system is what we are basing our data on. These motors can be run at their max power since our system will have a battery which can provide the system with 24V of power. Desired motion like and left turns can be achieved by powering the poles accordingly. Due to our design objectives to produce better suction power and a better cleaning effort all together, the team decided to choose one motor for the whole design to keep cost down while improving performance. The various parts that require motor and their specifications are as follows.

TABLE I

PART NAME	VOLTAGE NEEDED	RPM	MOTOR NEEDED
TYRES	12	40	2
ROLLER WIPERS	12	100	1

Geared motors are used for the application here. A gear motor is a device which allows low-horsepower motors to drive a great deal of force on an object with low speed. It consists of a reduction gear train and an electric motor, which both come fully integrated into an easily mountable and configurable system. The benefit of using gear motors is that they simplify the design and manufacturing of power tools and machines which require high torque, or moment of force, at low shaft speeds or at low revolutions per minute speeds.

The system needs motors to power the rollers for cleaning and the wheels for motion. In the design, one motor is used to rotate the wheel base and one motor is used to rotate the wheels. The third motor is used to delivery power to the four brushes throughout the system. Here, we have decided to use one type of motor throughout the design. Since the system will be powered by a 24V battery, we decided to use the fastest spinning motor out of the researched.

Motor Driver Board:

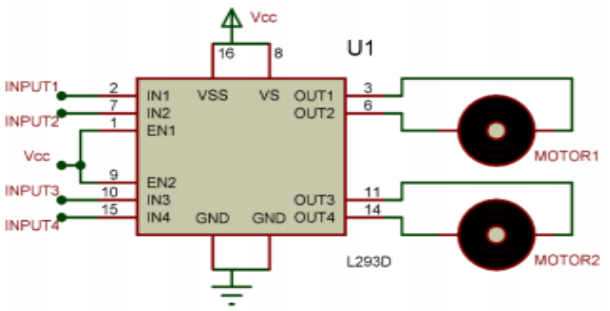

Figure 6

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III. CLEANING SYSTEM

1) flat sponge wiper (stage 1. Wetting)
2) flat wiper hardened sponge (stage 2: larger duct collection)
3) flat wiper hardened sponge
4) finer duct collection
5) roller wiper (stage 3: mopping and finishing)

IV. APPLICATIONS

- Cleaning the wet and dry floors
- A floor cleaning assistant at home and offices
- Can clean the inaccessible areas like underneath of sofas bed and table.
- Small particles and can be picked up efficiently.

V. LIMITATIONS

- Suitable only for flat surfaces.
- Semi automated.

VI. FUTURE SCOPE

The model that is present in the report above can be optimizedas much as possible. The recommended additions are:

- The chassis can be built on a PVC polymer. This will reduce the overall weight of the system
- The suction part can be automated using Programmable Logic Control for the sequence of operation
- The setup can be fully automated without manual interventions
- The dust can be collected using vacuum removal
- Image processing technique can b implied to analyses the surface cleaning efficiency using a high quality on board camera
- Germ less cleaning using UV exposure installed on the vehicle.

VII. CONCLUSIONS

This research facilitates efficient floor cleaning with sweeping and mopping operations. This robot works in two modes automatic and manual for user convenience. This proposed work provides the hurdle detection in case of any obstacle that comes in its way. The obstacle detection range is 1ft. RF modules provide wireless communication between remote and robot and their range is 50m.

A mechanical setup is designed with the synergies of pneumatics and electronics to provide efficient cleaning system both at ground and as well as window levels.

This contemporary design helps to overcome the limitations of the existing technologies and surpass them in terms of robot capability, modularity and payload. These components determine how well the dirt is collected. As of now, we feel that by adding brushes and increasing the motor size will do the job. Instead of the one brush underneath Roomba, we will be using two brushes to maximize cleaning on each side of the robot.

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