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Smart Cleaner Robot

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Contents

1 Acknowledgement

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2 DISCLAIMER

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3 Abstract

The idea of the project is a robot that searches for garbage on the ground, then removes it by suction and cleans its place. This idea came specifically to help people, especially the elderly, who suffer from physical and health problems, as the robot rotates automatically using an algorithm called Wall Following.
When the paths are closed in all directions, the robot goes into a dead end state and then rotates 360 degrees to find an alternative path. In addition, it is controlled via Bluetooth. And based on our observation of huge robots in large factories that do cleaning, these robots are directed by the user to paths at the end of which are designated places for unloading dirt, so we represented these paths using the black line, and the robot can avoid any obstacles on its way to the waste dump area and on Mostly at the other end is one of the workers who unload the dirt from the place designated for the robot, and the robot that we built gives some information that makes it easier for the user, such as the percentage of charge using a sensor, and it also gives the percentage of water in the tank used for cleaning.
When the robot is done, it sends a message to the mobile phone to indicate that it has been completed.

Chapter 1

4 Introduction

4.1 problem statement

Cleaning robots are becoming one of the most popular new home appliances, a trusted little cleaning partner in many households. Unlike the traditional vacuum cleaner, this robot is able to clean your room by navigating across the floor and avoiding obstacles. It also charges itself, all without using human help. The Smart Cleaner Robot uses more advanced technology to solve the issue and is built to automate the cleaning process. The robot is started via the program. The robot navigates using Automatic movement. The Smart cleaner Robot helps to clean the floor surface without the need for human interaction, saving time for the user.

4.2 Scope of work

Basically, the robot that we built on an application on the mobile phone, so that the user chooses the cleaning method that he prefers, so that it contains two basic options for cleaning, which are manual cleaning using Bluetooth, so that the robot's movement is controlled by commands or buttons, or the user chooses the path of automatic cleaning without assistance It is based mainly on the ultrasonic sensor and the servo motor so that the motor moves, and the ultrasonic scans the room and chooses the appropriate path for the robot in order to avoid obstacles that can be encountered.

4.3 Objectives

The following are the project objectives:

1. Automatically recognize and avoid obstacles.
2. Use a fan to suck out the dust particles from the smooth tiles.
3. Showing the battery charge percentage of the robot, as it is transported to the charging point by the black line using IR sensors.
4. Use the app to control the robot using Bluetooth Module.
5. Show the percentage of water remaining in the tank.
6. The robot uses a pump to pump water and then cleans with a roll.

Chapter 2

5 Constraints

1- The problem of the unavailability of the raspberry pi and the camera, as providing them requires a lot of time and a lot of price, so this is the reason why we do not use them.

2- The problem of the aspirator: since the aspirator needed a current of up to 4 amps, and while searching for a solution to the problem, we found that it was necessary to connect the battery with a BMS 3s piece in order to generate the amount of current required for the aspirator.

3- While trying to use the hc-05 Bluetooth, we used the software serial library, and in this case, the robot did not respond at all, so the solution was to use the serial hardware that is in the Arduino mega.

Chapter 3

6 Literature Review

Robots are already an integral part of modern society, making human existence more convenient and comfortable. The floor-cleaning robots are useful in assisting humans in a variety of settings, including homes, hotels, restaurants, workplaces, hospitals, workshops, warehouses, and universities, among others. As a result, they are receiving increased attention in robotics research. Fundamentally, the cleaning abilities of robot cleaners, such as dry vacuum cleaning and floor mopping, have set them apart. Some current devices use laser mapping technology, while others rely on simple obstacle avoidance using infrared or ultrasonic sensors. Each cleaning robot's operations and cleaning system has unique benefits and drawbacks. For example, Some of the robots that use laser mapping are considerably quicker, more energy-efficient, and more expensive. The laser mapping method has a few limitations, including the need for expensive hardware for data processing and the purchase of new cloud-based software.

Due to the random cleaning, obstacle avoidance-based cleaning robots require a lot of time and energy. But less expensive. The cost goes up because countries who don't produce cleaning robots must import them from other nations. to offer a thorough answer to the difficulty of producing robotic cleaner at a reasonable price with local resources. By using local resources and keeping costs low, a cleaning robot that can solve significant manufacturing problems can be constructed. Obstacle avoidance and minimal cost are the foundations on which the Smart Cleaner Robot is developed. The design and development of a Smart Cleaning Robot are presented in this study. The robot can clean the floor periodically without human assistance in both household and commercial settings.

1. https://www.youtube.com/watch?v=hoY2YxLGV98&t=7s

In the link attached above, one of the products currently on the market that represents a cleaning robot that has similar characteristics to the project that we built so that this product performs automatic cleaning and uses laser sensors to avoid obstacles facing it and also contains a dedicated charging base that charges itself.

2. fybots

https://www.youtube.com/watch?v=AD9FaRwTQAE

In the attached picture below, there is a robot dedicated to cleaning factories, as this this robot has the following characteristics: fybots

1. very best technology, quality, performance and efficiency available on the market
2. 8 movement modes combinable for optimized cleaning, wall, corner areas difficult areas treatment.
3. Pallet, human and obstacles bypass.

Chapter 4

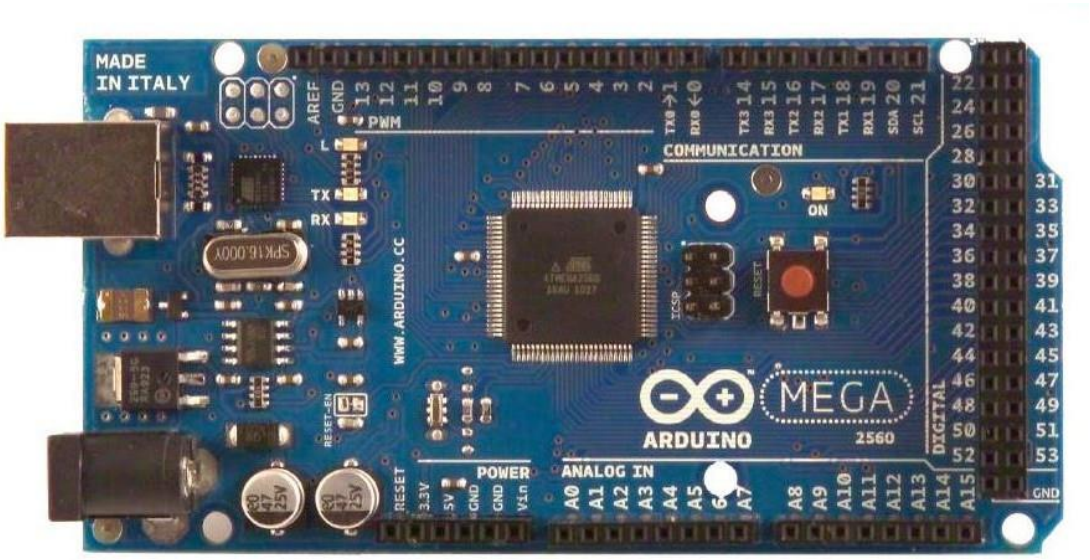
7 Methodology

The purpose of this chapter is to summarize the developments that took place within Smart Cleaner Robot project and put them in a larger scientific and technological context.

7.1 Equipment and Components

7.1.1 Arduino Mega

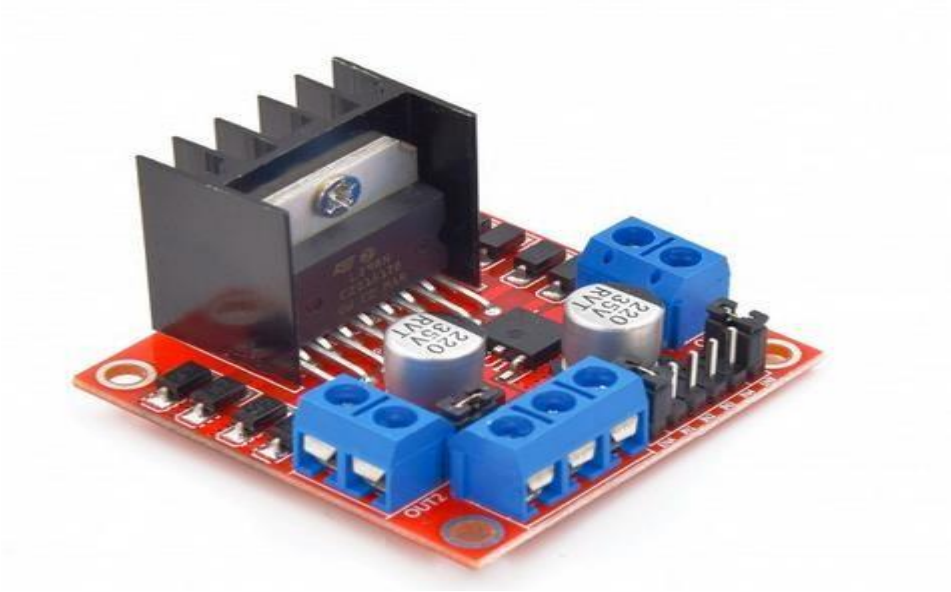
One of the most important components of our project the Arduino is a micro-controller board based on the ATmega2560. It has 54 digital input/output pins, 16 analog inputs, 4 UARTs, It contains everything needed to support the micro-controller



It was used in our project to connect the drivers and motors together and give the robot the logic it needed to move. We also connected it to the Ultrasonic Sensor, Relay module, Lcd, HC-05, Water Pump, L298N driver, IR sensor, Suction, and power supply.

7.1.2 L298N Driver

The L298N is a dual H-Bridge motor driver which allows speed anddirection control of two DC motors at the same time.



We used two of the L298N in order to control all four of our DC motorswhich will be used to drive the robot around.

7.1.3 DC Motor

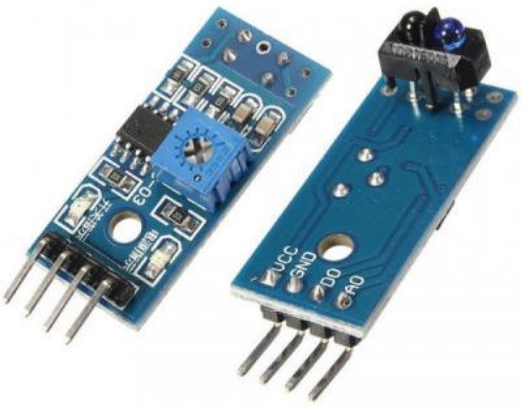
The driving power of our project when connected with the L298N driverwe can control the movement of the robot. Each one of the four motors was connected to a wheel that allows the robot to move smoothly.

7.1.4 Rubber Wheel

This type of wheel was used because it bears heavy loads and was connected to a DC motor to move the robot.

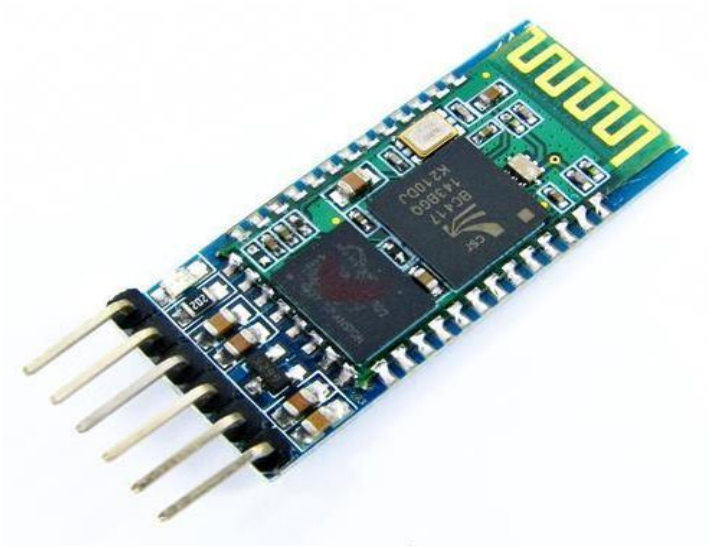
7.1.5 TCRT5000 IR sensor

ideal for detecting white/black lines which we will be using in our project this component uses IR to detect whenever a black line is present in front of the robot.



7.1.6 Bluetooth Module HC-05

HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration. It has range up to <100m uses serial communication to communicate with devices serial port.



7.1.7 Water Pump

Connected to our tank with a hose so that the robot can pump water onto the roller, so the roller cleans the floor while the robot is moving.

7.1.8 Single Cell Lithium-ion Batteries

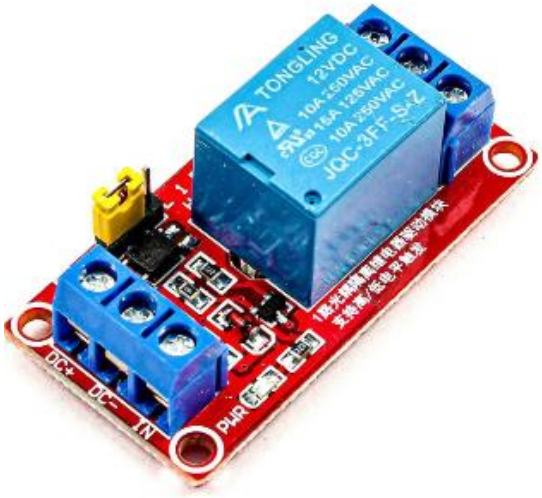
Arguably our main power supply on our project, we've used three of these in order to power our engines, motors and most of the components we mentioned before.

We connected 3 batteries inside a battery case the we glued on top of thebody of the robot.

7.1.9 Relay Module

This is a single channel opt coupler isolated relay module that uses high quality original relays. The open interface maximum load is usually: AC 250V/10A, DC 30V/10A.
Features
Channel: 1 channel
Control voltage: 5V, 12V, 24V
Working current: 190mA
Trigger current: 3mA~5mA
Low level trigger voltage: 0V~1.5V
High level trigger voltage: 3V~5V
Output voltage: 250Vac, 30VDC
Output current: 10A

This piece was used to connect a 5V water pump to the Arduino and control it



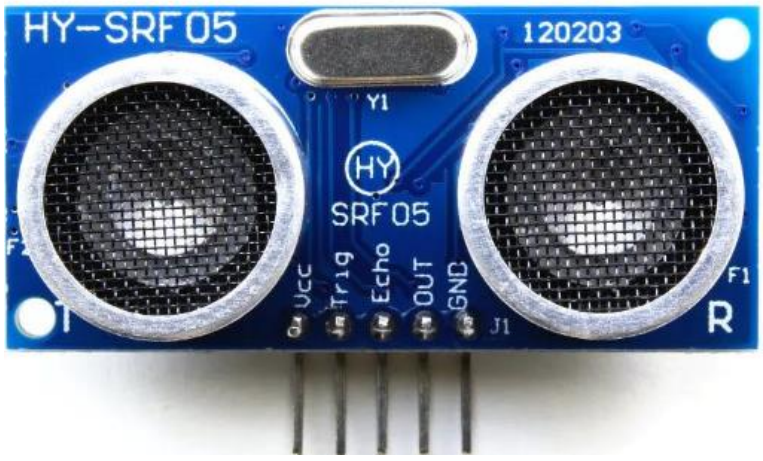
7.1.10 Servo Motor

The servo motor was used to move the ultrasonic so that the scanning works to move the robot.

The rotation angle of the servo motor is controlled by applying a PWM signal to it.

7.1.11 Ultrasonic Sensor

Ultrasonic is used to measure the distances around it in order to order the robot to move and move away from the obstacles it encounters.



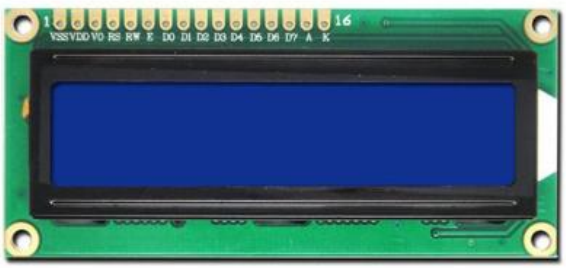
7.1.12 Voltage Sensor

Voltage Detection Sensor Module 25V module is based on the principle of resistive voltage divider design, it can make the red terminal connector input voltage to 5 times smaller. Arduino analog input voltages up to 5 v. The voltage detection module input voltage not greater than 5Vx5=25V (if using 3.3V systems, input voltage not greater than 3.3Vx5=16.5V).

It was used to measure the percentage of battery charge and print it on the LCD.

7.1.13 LCD 16*2

It was used to display the percentage of battery charge as well as the percentage of water in the tank.



7.1.14 8 Pole Lever Connector

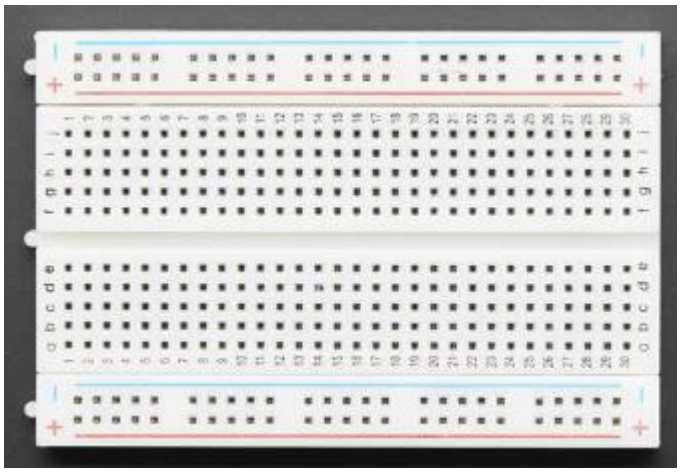
It was used as an assembly point, so any piece that needed 12 volts and ground would be plugged into the lever.

7.1.15 Aspirator

The Aspirator is used to suction dirt and clean smooth tiles

7.1.16 Breadboard

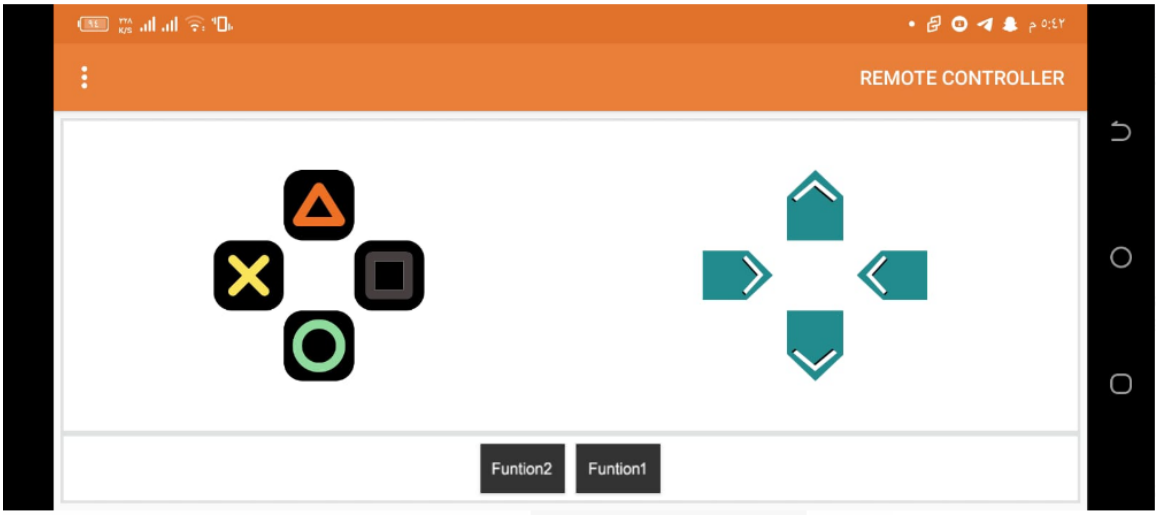
It was used for bits that need VCC and GND.



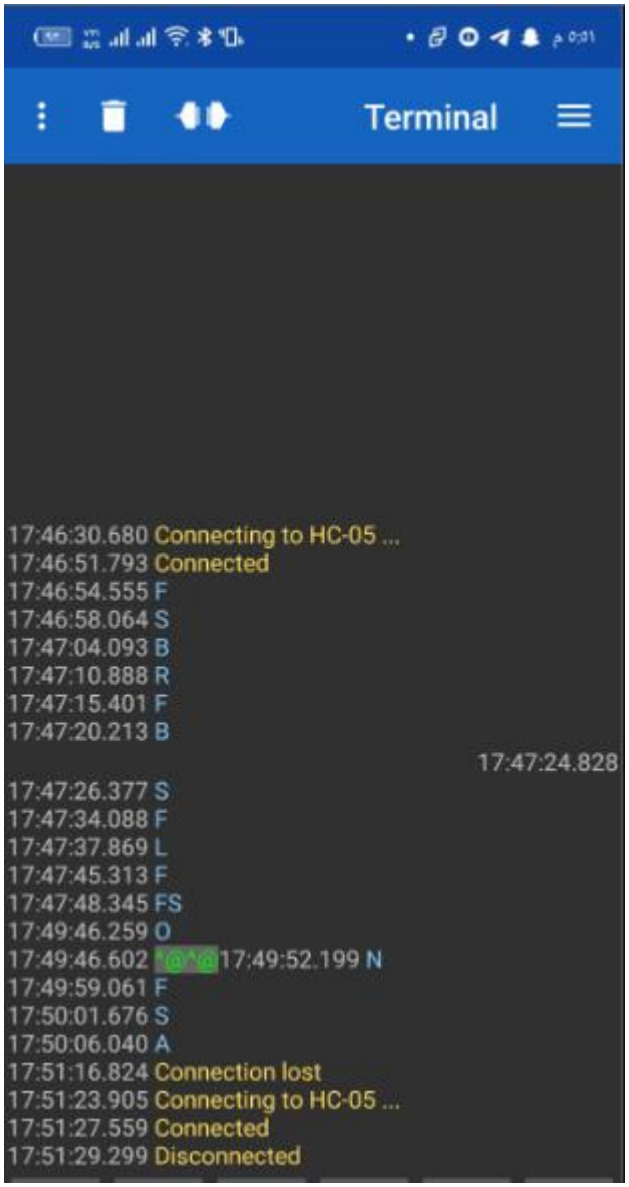
7.2 Implementation

The hardware components of robot and application are Integrated using a microcontroller.
The robot is made Automatic achieves the main purpose of cleaning, The robot test showed the functions that the user can to take a look at it during operation and it helps the user by referring to it battery level by displaying the charge percentage on the LCD so that the user can recharge as required.
Microcontrollers are used to integrate and control everything three ultrasonic sensors, motor driver, voltage sensor, Bluetooth module, VCC and GND for all sensors.
Breadboard is commonly used for battery supply.

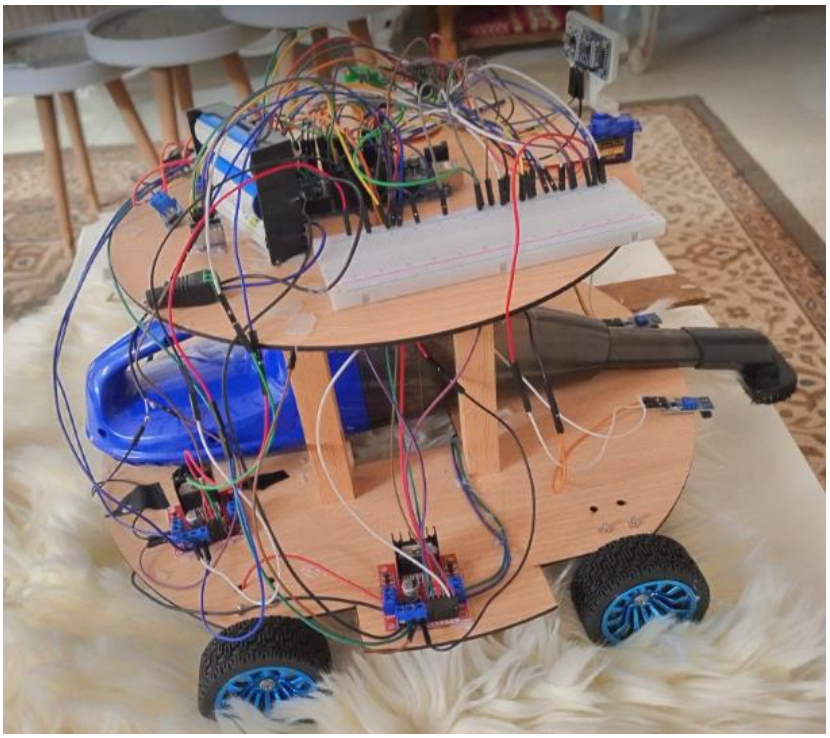
The Smart Cleaner Robot is initiated by following steps:
1 . Firstly, We have 3 modes, the Bluetooth mod, the Autonomous mod, and the black line mod.
2 . The mobile phone communicates with the Bluetooth module so that the robot can be controlled manually or automatically via the command using a Serial Bluetooth Terminal program and using Bluetooth Controller to move the robot in all directions.
Using Bluetooth Controller program:
We can use the buttons to control the direction of the robot's movement, left and right, forward and backward**.**
X: to stop movement of robot.
Triangle: to start pumping water.
O: to stop pump water.



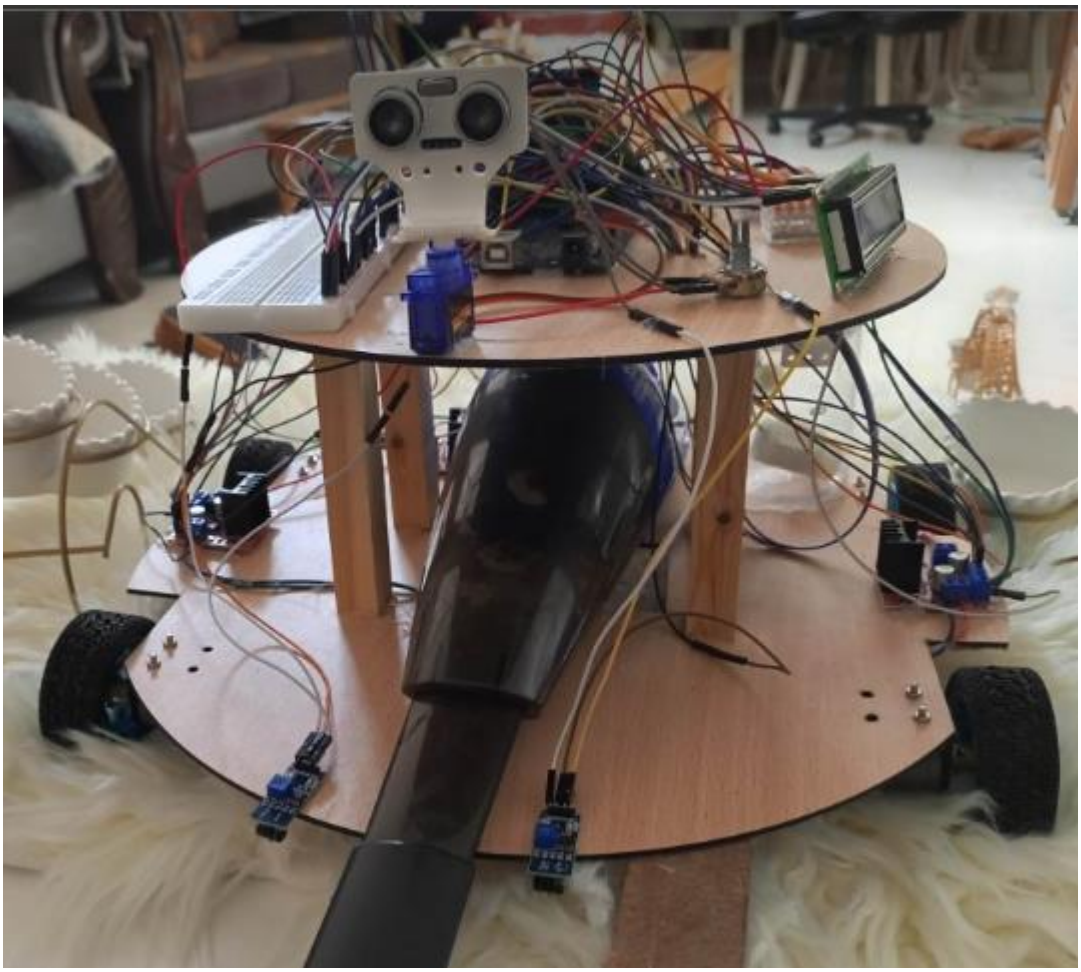
- The picture below shows how the phone communicates with Bluetooth (Serial Bluetooth Terminal program) and moves the robot in both modes(autominous mode and manual mode) by typing the following commands.
  1. **F**: Move the robot Forward.
  2. **B**: Move the robot Backward.
  3. **R**: Move the robot to Right.
  4. **L**: Move the robot to Left.
  5. **A**: Move the robot in Autonomous form.
  6. **O**: Turn-on the water pump.
  7. **N**: Turnoff the water pump.



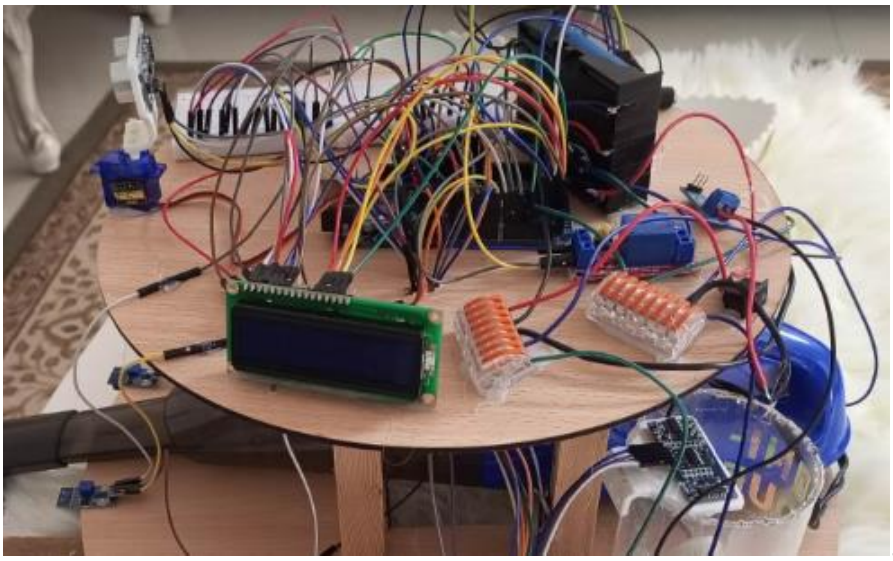
2 . The robot is powered by sensors and motor driver. The bottom picture appears Top view and front view of the robot. Started navigation according to program logic.



3 . The robot moves using ultrasonic waves that are used to measure the distances around it, and when the robot approaches barriers and obstacles, it moves away from them and goes to other places.



4 . During the suction and cleaning process, the robot pumps water from the tank onto the roller using a water pump. During pumping, the amount of water remaining in the tank is measured and shown on the LCD.

 .

5 . During the cleaning process, the battery charge percentage is measured and displayed on the LCD. When the charge rate reaches 40%, the robot sends an alert that it needs to be charged.

Mode3: Using black line.

6 . During the cleaning process, the percentage of battery charge is measured and displayed on the LCD screen. When the charge rate reaches 40%, the robot sends an alert that it needs to be charged, so the user directs it to the beginning of the black line by manually moving it via Bluetooth. Upon reaching the black line, the robot will move automatically by means of infrared sensors, and during the movement there will be a stopping point when the two sensors are above a black area, and thus there will be a charging point, so the robot will be recharged to continue cleaning after that.

Chapter 5

8 Results and Discussion

In the end, We can say that we have made a project that provides multiple features that can help employee everywhere in their work. These features are:

1. Automatically recognize and avoid obstacles.
2. Use a fan to suck out the dust particles from the smooth tiles.
3. Showing the battery charge percentage of the robot, as it is transported to the charging point by the black line using IR sensors.
4. Use the app to control the robot using Bluetooth Module.
5. Show the percentage of water remaining in the tank.
6. The robot uses a pump to pump water and then cleans with a roll.

Chapter 6

9 Conclusions and Future Work

9.1 Conclusion

The created bot is fully functional and follows logical navigation rules. It is turned on in order to more effectively clean dry dust particles. Robots are wireless devices, and therefore they can move around a vast area. Plus, less human interaction means less human labor. The robot can be upgraded with additional features to improve cleaning, including self-charging, self-dusting, and the ability to detect a whole room using the wall following algorithm.

9.2 Future Work

When deployed in addition to human workers, cleaning robots eliminate the need for people to engage in mindless, repetitive tasks, freeing them up to concentrate on more difficult, thought-intensive tasks that robots cannot complete (at least, not yet).
Due to the inherent constraints in human productivity a person can only mop a certain amount of square feet per hour robots bring cleaning to a new level of efficiency that humans are unable to achieve. Robotic cleaning may be the way of the future, doing away with the need for window washers to dangle perilously from ten-story buildings, service sheets on the inside of bathroom doors, and the requirement for human cleaners to do time-consuming tasks every day.
Robots are very new to the cleaning sector, and our understanding of the implications of their use is still in its infancy. While there are advantages and disadvantages to using robots for cleaning, one thing is certain: as robots continue to advance, so will the range of their applications. Although the future is uncertain, one thing is certain: cleaning may never be the same. Here is an example of where cleaning bots are currently applied:

- **Floor Cleaning Robots**
  Floor cleaning robots are simple to use, affordable, and offer a useful service, especially when used on big tile or stone floors. The cleaning machine applies a detergent solution to the floor, then scrapes it in. The dirty solution is then vacuumed out, filtered, and put back in the tank holding the cleaning solution. Robots that clean floors are particularly well suited for high-traffic locations like malls, airline terminals, and other locations that see significant wear and tear.

10 References

- https://docs.arduino.cc/hardware/mega-2560 (**Arduino Documentation**).
- https://www.youtube.com/watch?v=VV7J_7brgcw (**Arduino Course**).
- https://ozeki.hu/p_3083-upload-source-code-to-arduino.html (**For connection**).
- https://ar-ar.facebook.com/technolab.electronics/ (**For purchase the pieces**) .
- https://www.diva-portal.org/smash/get/diva2:1373823/FULLTEXT01.pdf (**To use datasheet for pieces**).