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Design & Implementation of C-19 Arduino Robot

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Abstract - *Over recent years, the requirement of robots in tech industry and the way Automation & Robot industry is been revolutionized , is irresistable .Robotic technology has increased appreciably in past couple of years. Such innovations were only a dream for some people a couple of years back. But in this rapid moving world, now there is a need of robot such as Robot that can interact and co-exist with them And hence the door to Robotics and Automation is through Computer Science Engineering only. Artificial Intelligence and Machine Learning both requires a System to being implemented, which is in the form of a Robot. & being a computer science engineer, one have to be complete with the knowledge of both hardware & software. In current scenario, we suffered Global pandemic like COVID - 19, in which human-contactless environment is must, so therefore automation and robots are essential. Here our project is based on Arduino which is in physical computers, a microcomputer and also individual open source platform on which we will integrate our Robot which will be less with human- contact less features and multi-purpose functions .So that it will be applicable in covid-19 zone for serving and further applications.*

***KeyWords*: RFID, LFR, IR, Fabricating, Decentralized, MicroController, Callibration, Implication.**

1. INTRODUCTION

For robot that performs autonomously, the communication between the person and the robot is the most important factor. A significant awareness has been observed regarding the usage of such a technology. This research has a trivial involvement in the development of such robots. A robot that functions fully autonomously should not only complete the jobs that are desired of them but also somehow establish a connection between themselves and the person operating them. A lot of research has been done of these kinds of robot and a lot of work still needs to be done. In order for a robot to communicate and interact with the person, it should also be capable of following that particular person. Keeping this in mind, there should be a capacity in the robot to get information from the surroundings while persuing the required object. The primary goal of our work was to design and fabricate a robot that not only tracks the target but also moves towards it while doing the tracking. The objective of the project is to resolve the problem of human contact via giving multi- functioning to the robot in such kind of COVID-19 environment. & also exploring the Pros & Cons of the Robotics field & how the interfacing of the software and hardware occurs. It's objective function to produce a motion that best satisfies all the aspects of the task While doing this, it involves design,construction, operation and it's applications. Typically human following robots are equipped with several different diverse combination of sensors i.e. light detection and ranging sensor, radio frequency identification module (RFID), laser ranger finder (LFR), infrared (IR) sensing modules, thermal imaging sensors, camera, wireless transmitter/receiver etc. for recognition and locating the target. All the sensors and modules work in unison to detect and follow the target.

2. BACKGROUND MOTIVATION

Our background motivation scenario is way somewhere leaded to our daily life issues Hence we've gone through pandemic time period we've realized the need of Human-Contactless Environment & also we wanted to use the hardware criteria of a computer science engineer .Since in recent past years the software tech industry is gradually upgrading so the focal point of a cse engineer was software so we wanted to learn the hardware part also & implement it into some positive results which was through Robotics So we determined to build the model version of the c 19 arduino robot which can later give best when implemented on a industry scale .

3. SURVEY

We've done the survey process by reading some thesis of Human Detection & following Mobile Robot Using a Laser Range Sensor by Author Takafumi Matsumaru & Jianzhao Cai, Journal of Robotics & Mechatronics. Further the blog from Swimburne University of Technology named The Role of Robots in Covid 19 Era helped us to keep stick to this project .Some other research work was also onducted in this regard, Depth imaging was used by Calisi and the target was persued by designing a special algorithm. Ess and Leibe carried out the same work. They did a lot of ork on object tracking and detection. The biggest advantage of their method was that their algorithm worked in complex environments as well. Stereo vision was also carried out by Y. Salih in order to perform the detection. This method

enabled him to persue the required target with an effective manner. The combination of different sensors were used by R. Munoz to get the information about the target to be tracked. In addition to using different sensors, he also used stereo vision to get an accurate information. The data of the sensors combined with the information from the camera proved to be very helpful in carrying out the task. Different algorithms are being developed by the researchers for the detection purposes. Laser was used in one research to find the style of the moving legs and camera was used to detect a particular object or a person. Very simple technique was also used by a research. In this technique, the person used distance sensors on the robot and the person. These sensors emitted radio waves and were detected by the sensors on the person to be followed. This way the robot followed the required target.

4. SYSTEM COMPONENTS

Our system components includes 11 components of our Arduino Robot .Below these are named.

A. Arduino Uno

B. Motor Driver

C. Ultra-Sonic Sensor

D. Infrared Sensors

E. Gear Motor With Dual shaft Wheel

F. Jumper Wire

G. Ultrasonic Sensor Holder

H. Servo motor

I. Jumper Wire

J. Rockerz Switch

K. Li-Ion Battery

L. Bluetooth Module (Optional)

Software Components :

- ARDUINO IDE
- C/C++
- Libraries

5. METHODOLOGY

The Methodology adopted in developing the Arduino Robot is simple & easy to understand what given the functionality to the robot.

A decentralized top down approach is used for this project. The project is divided in to five modules. Each module is independent from one another. Different phases were carried out step by step, starting from basic sensor testing and proceeding towards obstacle avoidance, object detection, object tracking and data transmission. Due to the decentralized approach, all modules and sensors act independently. Data obtained by different sensors and modules is collectively analyzed and an intelligent decision on the basis of information obtained is made that instruct the robot to follow a particular direction. Two separate units are used i.e. microprocessor and a controller. The processing is carried out by microprocessor and the information obtained by the sensors is controlled by a controller i.e. Arduino board. A serial communication between microprocessor and controller is established to exchange the visual sensing information.

This approach was most suitable because if there is a fault in any one of the modules then it would not affect the entire system. Hence this provides the best possible results by maintaining accuracy. Human tracking, obstacle avoidance, maintaining a specific distance from the object and establishing a communication.

6. PRINCIPAL OF OPERATION

The Arduino Robot is the first official Arduino on wheels. The robot has two processors, one on each of its two boards. The *Motor Board* controls the motors, and the *Control Board* reads sensors and decides how to operate. Each of the boards is a full Arduino board programmable using the Arduino IDE.

Both Motor and Control boards are microcontroller boards based on the ATmega32u4(datasheet). The Robot has many of its pins mapped to on-board sensors and actuators. Programming the robot is similar to the process with the Arduino Leonardo. Both processors have built-in USB communication, eliminating the need for a secondary processor. This allows the Robot to appear to a connected computer as a virtual (CDC) serial / COM port. As always with Arduino, every element of the platform – hardware, software and documentation – is freely available and open-source. This means you can learn exactly how it's made and use its design as the starting point for your robots.

7. IMPLEMENTATION

The implementation of human interactive robot seems to be an easy task but there are some problems . So we have designed a novel algorithm to overcome this problem.

The implementation of C19 Human Following Robot is as follows.

➢ **Sound Detection Algorithm –**

We Used an HC-SR04 ultrasonic sensor to give your robot the perception of distance. This popular ultrasonic distance sensor provides stable and accurate distance measurements from 2cm to 450cm. It has a focus of less than 15 degrees and an accuracy of about 2mm.This sensor uses ultrasonic sound to measure distance just like bats and dolphins do. Ultrasonic An infrared sensor (IR sensor) is a radiation-sensitive optoelectronic component with a spectral sensitivity in the infrared wavelength range 780 nm … 50 µm sound has such a high pitch that humans cannot hear it. This particular sensor sends out an ultrasonic sound that has a frequency of about 40 kHz. The sensor has two main parts: a transducer that creates an ultrasonic sound and another that listens for its echo. To use this sensor to measure distance, the robot's brain must measure the amount of time it takes for the ultrasonic sound to travel. If we name distance into d, time to t & speed of sound into v then distance will be calculated as:

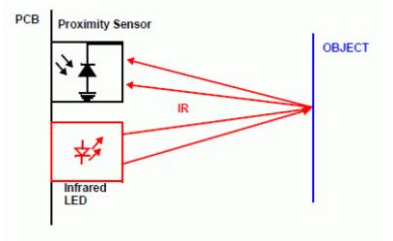
$$d = t * v$$

V in microsecond (µ)

For example, if it takes 100µs (microseconds) for the ultrasonic sound to bounce back, then the distance is ((100 / 2) / 29) centimeters or about 1.7 centimeters.

➢ **Object Detection Algorithm by Infrared Sensor -**

Infrared sensors work on the principle of reflected light waves. Infrared light reflected from objects or sent from an infrared remote or beacon. Infrared sensors are also used to measure distance or proximity. The reflected light is detected and then an estimate of distance is calculated between sensor and object.



IR LED Transmitter

IR LED emits light, in the range of Infrared frequency. IR light is invisible to us as its wavelength (700nm – 1mm) is much higher than the visible light range. IR LEDs have light emitting angle of approx. 20-60 degree and range of approx. few centimeters to several feets, it depends upon the type of IR transmitter.

The Design of our robot is compact not so vast hence it is a model version of a fully developed robot. Below are the circuit diagram, design of our project.

1. Circuit Diagram

2.3D Design

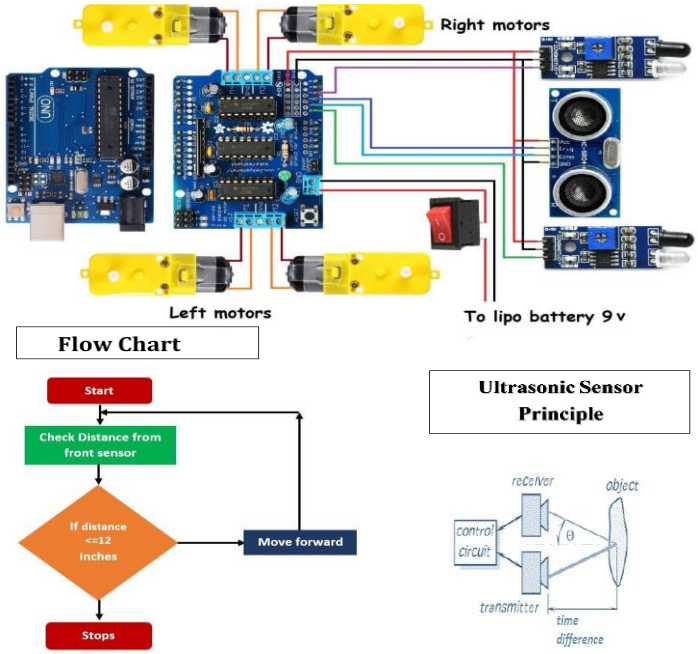
✓ Circuit Diagram –

The circuital diagram represents 4 gear motor with dual shaft, connected to the motor driver, ultrasonic sensors pins connected to the motor driver board, IR sensors three pins also mounted on motor driver .This motor driver will be fixed on arduino uno which will process through all the circuit while power supply is on.

✓ 3D Design –

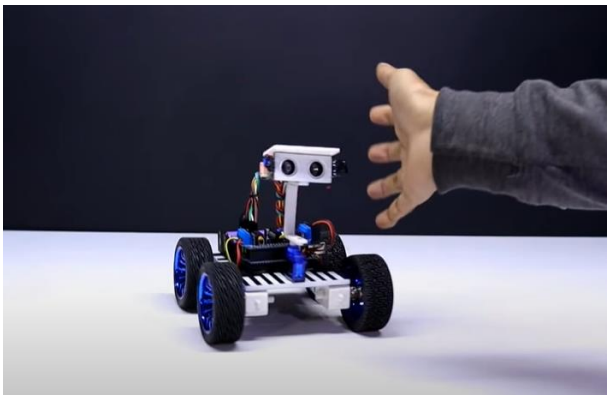
It shows the physical design & hardware component of the Robot which is compact and callibartion friendly.

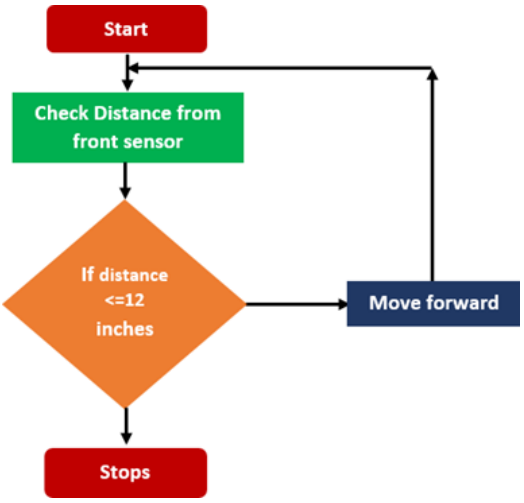
✓ Callibration & Implication

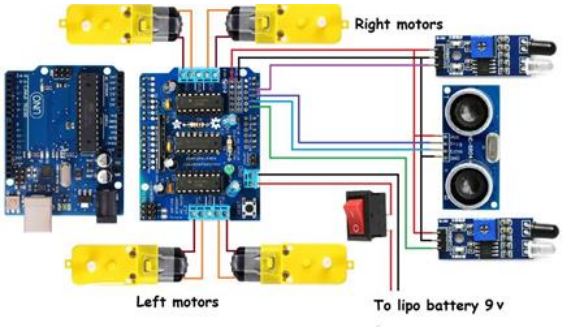


Circuit Diagram, Flow Chart & Ultrasonic Sensor Principle

3D Design

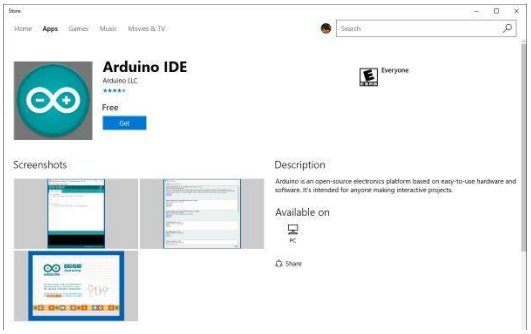






8. CALLIBRATION & IMPLICATION

- Each of the boards is a full Arduino board programmable using the Arduino IDE.
- To give functionality to the robot, the Arduino uno needs to be connect .
- This allows the Robot to appear to a Connected computer as a virtual (CDC)serial/ COM Port.
- To upload the code to the Arduino board, you have to put the cable to Arduino & upload the code after compiling, to arduino uno.
- Need to check the wiring connection.
- A Good Power Backup is must.
- Arduino Code is to be written in C/C++.



9. FEATURES & APPLICATION

- Features –
  - Human-Following
  - Webcam enabled
  - Portable
  - Obstacle-avoidance
  - Callibration enabled
  - Bluetooth enabled
  - Real-Time Scanning
  - Light sensor
  - Ranging Sensor
  - Infrared sensing modules
  - Wireless transmitter/receiver
  - Android controlled system
- Application –
  - For serving & scanning of Covid patients in covid centre
  - To help humans.
  - To create ease for people
  - Can assist in carrying loads for people working in hospitals, libraries, airports, etc.
  - Can service people at shopping centers or public areas.
  - Can assist elderly people, special children and babies.
  - Can follow a particular Vehicle.

10. FUTURE SCOPE

When this model version of Human – following Robot will be uploaded to Large industry scale It can give best results that are as follows.

- By developing it to industry scale we can make its physical appearance to metallic, rigid & Thermal Resistive.
- In Future we can Use Artificial Intelligence & Machine Learning, we can make it a Humanoid Robot.
- By making web cam enabled, we can operate it remotely.
- By Android app we can connect it and admin it by smartphone.
- By using Bluetooth Module we can connect it to internet & wifi & can turn it into voice enabled Robot assistant .

- Can use it into House alert system.

A wireless communication functionality can be added in the robot to make it more versatile and control it from a large distance. By mounting a real time video recorder on top of the camera, we can monitor the surroundings by just sitting in our rooms. We can also add some modifications in the algorithm and the structure as well to fit it for any other purpose. Further using AI & ML We can turn it into Humanoid Robot also.

11. CONCLUSION

A successful implementation of a Covid 19 robot is illustrated in this project. This robot does not only have the detection capability but also the tracking and following ability as well.It as also kept in mind that the functionality & capability of the robot should be as efficient as possible. The tests were performed on the different conditions to pin point the mistakes in the algorithm and correct them. The different sensors that were integrated with the robot added an additional advantage.

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BIOGRAPHIES

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