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Development of A Robot for Labor Work

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ABSTRACT Design & Construction of multipurpose Robot is discussed in this work. The proposed robot can be mainly used in civil field. The design & placement of various sensors, wheel system as well as wireless controlling mechanism are discussed In detail:-

The co-ordination of its various part to perform different job is also discussed. The movement of the robot can be controlled wirelessly from mobile for civil use, it can be used in labour work by line follower feature, coolie work by human follower feature. It can also perform military surveillance like spying enemy base , exploring unknown territory. The structure and design of robot is adaptive and can be modified to enhance its capability to further level.

The robot uses arrays of optical sensors to identify the line, thus assisting the robot to stay on the track. The array of two sensor makes its movement precise and flexible. The robot is driven by DC gear motors to control the movement of the wheels. The dc gear motor is driven by the motor driven circuit. This project aims to implement the algorithm and control the movement of the robot by proper tuning of the control parameters and thus achieve better performance.. It can be used industrial automated equipment carriers, small household applications, tour guides in museums and other similar applications, etc. The proposed developed model can perform multiple operations such as human following, obstacle detection, line-following, and voice controlled. All these operations are operated or managed through the smartphone.

Keywords:- Robot, Sensors, Robotics, Wirelessly, Adaptive, Arrays, DC Motor, Algorithm, Automated

INTRODUCTION:-

In the past, generally, robotics mainly used for an automated production process in the factory. Presently, robotics finds its application in many fields such as medical science, mining, surveillance, autopilots, etc. Initially, robotics was understood to be a job eater and was seen as a destructive replacement technology. With time, robotics has emerged as a safe and viable technology in complex and unstructured conditions such as automating the number of human activities, automated driving, caring for a sick person, military sector and in the car industry, etc. In robotics design, there is mainly two points in which the designers are focusing the first one is to build a model that can act autonomously in complex and unstructured environmental conditions. Second, the developed model has the capability of making moral decisions.

[1]. At present, robotics has emerged as a potential technology that can ease human life and enable mankind to tackle several social and ethical issues. Learning, Ambiguous understanding about the problems, Creativity for solving the problems, Reasoning and Deduction, Classification, Ability to build analogies and many more are the common features of intelligent system.

[2]. In fact, multipurpose systems are the need of the hour and are well accepted in tech-savvy populations.

OBJECTIVE:-

This Robot named “MULTI-PURPOSE ROBOT” is a robot which is used as a :-

- Line Follower Robot
- Human Follower Robot
- Controlled by Bluetooth Module
- Decide own path by detecting Obstacle using sensors.

The line follower developed is also **sensing any type of obstacle in its way and can also control speed with the help of speed regulator**.

The main objective of this dissertation is to make a robot that can help humans with various tasks. In this paper, we present a prototype of a human following robot that uses Arduino Uno and different sensors for detection and following an object.

The Robot must follow the following objectives:

(1)The robot must be capable of accurately follow a person.

(2)It should be capable of taking various degrees of turns.

(3)The robot must be insensitive to environmental factors such as noise.

(4)The robot must be capable to avoid collision.

LITERATURE SURVEY:-

As the modern world is moving towards automation. Automation in the field of transport is an emerging field of research. As in the field of transportation when the auto mated vehicle is designed the security of human beings is top in priority. For bringing the car body panel into the accurate position an algorithm is proposed by Markus Herrmann et al., this proposed algorithm was able to detect the critical deviation in the panel as the panel is being grabbed. An autonomous car robot structure is proposed by Denis Varabin et al., the proposed robotic car is capable of moving independently or with the remote control. The reactive replanning problem for autonomous vehicles is addressed by Enrico Bertolazzi et al., . The reactive replanning problem occurs when the unforeseen obstacle is encountered. The solution provided by the author(s) is efficient and can be implemented with the hardware and very helpful for a robotic racing car. For automated racing car the optimal motion planning problem is addressed by Tizar Rizano et al. For controlling the mecanum wheel robotic car wirelessly by using computer vision approach is proposed by Min Yan Naing et al., . In this proposed method for mecanum wheel robotic car, the location of the robotic car is detected continuously and based on that detected location the robotic car approach towards the target pattern. In automation fault tolerance is important, a mobile robotic car which uses Astrocyte Neuron networks with the self-repairing feature is proposed by Junxiu Liu et al., . A method for simulating the robotic car by time-delay neural network is proposed by Alberto F. De Souza et al..The car velocity and direction of moving is simulated by these networks.

The history of infrared sensors contains examples of real breakthroughs, particularly true in the case of focal plane arrays that first appeared in the late 1970s, when the superiority of bi-dimensional arrays for most applications pushed the development of technologies providing the highest number of pixels. An impressive impulse was given to the development of FPA arrays by integration with charge coupled devices (CCD), with strong competition from different technologies (high-efficiency photon sensors, Schottky diodes, multi-quantum wells and, later on, room temperature microbolometers/cantilevers). This breakthrough allowed the development of high performances choksystems of small size, light weight and low cost – and therefore suitable for civil applications – thanks to the elimination of the mechanical scanning system and the progressive reduction of cooling requirements (up to the advent of microbolometers, capable of working at room temperature). In particular, the elimination of cryogenic cooling allowed the development and commercialization ofschokSmart Sensors; strategic components for important areas like transport, environment, territory control and security.

Infrared history is showing oscillations and variations in raw materials, technology processes and in device design and characteristics. Various technologies oscillating between the two main detection techniques (photon and bolometer effects) have been developed and evaluated as the best ones, depending on the system use as well as expectable performances. Analysis of the „waving change" in the history ofschoksensor technologies is given with the fundamental theory of the various approaches.

Highlights of the main historical chok developments and their impact and use in civil and military applications is shown and correlated with the leading technology of silicon microelectronics: scientific and economic comparisons are given and emerging technologies and forecasting of future developments are outlined

Infrared detectors are in general used to detect, image, and measure patterns of the thermal heat radiation which all objects emit. Early devices consisted of single detector elements that relied on a change in the temperature of the detector. Early thermal detectors were thermocouples and bolometers which are still used today. Thermal detectors are generally sensitive to all infrared wavelengths and operate at room temperature. Under these conditions, they have relatively low sensitivity and slow response.

As photolithography became available in the early 1960's it was applied to makeschoksensor arrays. Linear array technology was first demonstrated in PbS, PbSe, and InSb detectors. Photovoltaic (PV) detector development began with the availability of single crystal InSb material.

In the late 1960's and early 1970's, "first generation" linear arrays of intrinsic MCT photoconductive detectors were developed. These allowed LWIR forward looking imaging radiometer (FLIR) systems to operate at 80K with a single stage cryoengine, making them much more compact, lighter, and significantly lower in power consumption.

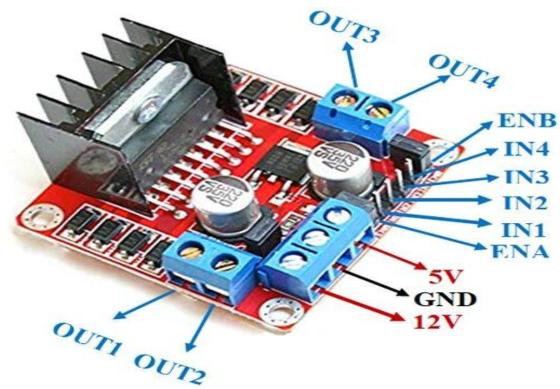
The 1970's witnessed a mushrooming ofschokapplications combined with the start of high volume production of first generation sensor systems using linear arrays. At the same time, other significant detector technology developments were taking place. Silicon technology spawned novel platinum silicide (PtSi) detector devices which have become standard commercial products for a variety of MWIR high resolution application.

So far a lot of research has been done on the kinds of robot that fall into the category of the "Assisting Robots". People have used different logics and a log "s to implement their design. All of their primary focus has entirely been on the design of robots that follows the target. Laser sensor is used by Burgard in his tour guide robot for human tracking . LRF was incorporated by D. Schulz to perform the following. Using the above mentioned process, they performed the information linking for the detection. Nicola, Husing used a technique for pointing out the different styles of movement by using LRF. This information was fused with the information obtained by the camera . Depth imaging was used by Songmin Jia to carry out the detection. The model of a person was determined using the depth imaging . The particular style of clothing was used by Mehrez Kristou. He used a multidirectional camera. LRF was also incorporated by him in the design . A research was conducted by Wilhelm with the focus on the color of the particular person's skin. Information from different sensors was also used by him in the research. Some other research work was also conducted 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 work 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. A 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.

COMPONENTS DISCRIPTION:-

Motor Driver :- Motor driver is a current enhancing device; it can also be act as Switching Device. Thus, after inserting motor driver among the motor and microcontroller. Motor driver taking the input signals from microcontroller and generate corresponding output for motor.

IC L293D -- This is a motor driver IC that can drive two motor simultaneously. Supply voltage (Vss) is the voltage at which motor drive. Generally, 6V for dc motor and 6 to 12V for gear motor are used, depending upon the rating of the motor. Logical Supply Voltage deciding what value of input voltage should be considered as high or low .So if the logical supply voltage equals to +5V, then -0.3V to 1.5V will be considered as Input low voltage and 2.3V to 5V is taken into consider as Input High Voltage. The Enable 1 and Enable 2 are the input pin for the PWM led speed control for the motor L293D has 2 Channels .One channel is used for one motor.



Arduino Microcontroller:-Arduino is a microcontroller that can be easily programmed, erased, and reprogrammed to control system. It is the brain of our project. It can give all the command to their sub ordinate components which should by operated by the human behavior . And it also give feedback to the other components and human. So that it can be the used as a medium of communication between human and robots & vice versa. It is mentioned that Arduino ATMEGA-328 (commonly known as Arduino Uno) has 14 digital input/output pins (6 of which can be used as PWM outputs), 6 analogue inputs, a 16MHz crystal oscillator, a USB connection, a power jack, and ICSP header, and a reset button. The software used to program the device is Arduino Software IDE, which runs on C++ language as its programming language.

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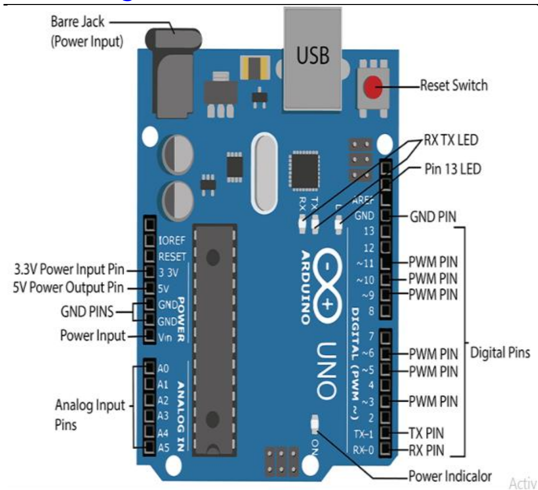
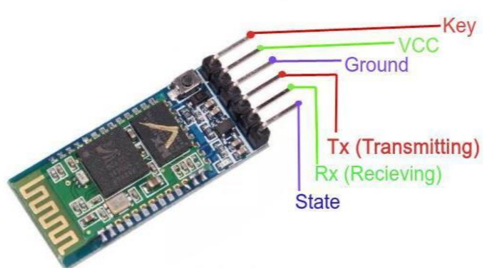


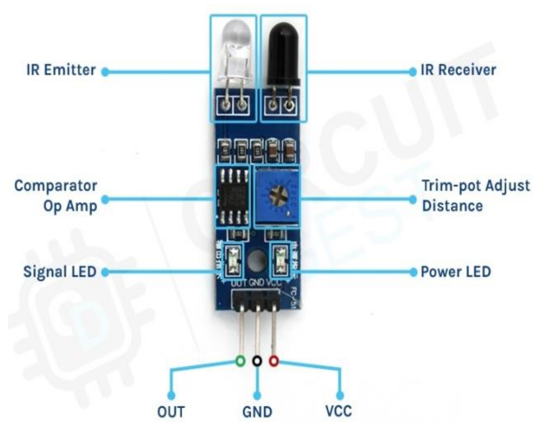
Bluetooth Module HC-05:- It is used for many applications like wireless headset, game controllers, wireless mouse, wireless keyboard, and many more consumer applications.It has range up to <100m which depends upon transmitter and receiver, atmosphere, geographic & urban conditions. It is IEEE 802.15.1 standardized protocol, through which one can build wireless Personal Area Network (PAN). It uses frequency-hopping spread spectrum radio technology to send data over air.It uses serial communication to communicate with devices. It communicates with microcontroller using serial port (USART).



Ultrasonic Sensor:- An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves.The working principle of this module is simple, it sends an ultrasonic pulse out at 40kHz which travels through the air and if there is an obstacle or object, it will bounce back to the sensor. By calculating the travel time and the speed of sound, the distance can be calculated.

- Ultrasonic sensor has a transmitter and receiver
- Frequency is 44KHz
- Speed of Sound waves is 340m/s
- Distance can be calculated as Speed x Time / 2

Infrared Sensor:- IR sensor is an electronic device, that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensor can detect these radiations. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode.



DC Motor:- DC Motor is a device that converts any form of energy into mechanical energy or imparts motion. In constructing a robot, motor usually plays an important role by giving movement to the robot. Here 4 DC motor are used to drive the robot. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. We have used two 60 rpm DC motors for forward and reverse direction according to microcontroller instruction. For the DC Motors we have used directly supply from charging and discharging lead acidic battery 12V , 1.3A/hrs.

Servo Motor:- A servo motor is an electrical device that can be used to push or rotate an object with great precision. If you want to rotate an object at some specific angle or distance, then servo motor can be used easily for that purpose. Servo motor can rotate ninety degrees in both directions. They can be used to move many equipment that require moving at any angle Servo mechanism.

Battery Supply:- Twelve-volt batteries are commonly used in RV, boat, and other automobile systems. From a technical perspective, a battery uses one or more cells to allow a chemical reaction creating the flow of electrons in a circuit. Batteries do not create energy or power on their own. The power you get from a battery is direct current (DC) power and is different than the alternating current (AC) power you get from the wall outlets in your home.

WORKING:-

Bluetooth Controlled Robot

Bluetooth controlled car is controlled by using Android mobile phone instead of any other method like buttons, gesture etc. Here only needs to touch button in android phone to control the car in forward, backward, left and right directions. So here android phone is used as transmitting device and Bluetooth module placed in car is used as receiver. Android phone will transmit command using its in-built Bluetooth to car so that it can move in the required direction like moving forward, reverse, turning left, turning right and stop.

Line Follower Robot

Line Follower Robot (**LFR**) is a simple autonomously guided robot that follows a line drawn on the ground to either detect a dark line on a white surface or a white line on a dark.

As stated earlier, line follower robot (LFR) follows a line, and in order to follow a line, robot must detect the line first. We all know that the reflection of light on the white surface is maximum and minimum on the black surface because the black surface absorbs maximum amount of light. So, we are going to use this property of light to detect the line. To detect light, either LDR (light-dependent resistor) or an IR sensor can be used. For this project, we are going with the IR sensor because of its higher accuracy.

To detect the line, we place two IR sensors one on the left and other on the right side of the robot. We then place the robot on the line such that the line lies in the middle of both sensors. Infrared sensors consist of two elements, a transmitter and a receiver. The transmitter is basically an IR LED, which produces the signal and the IR receiver is a photodiode, which senses the signal produced by the transmitter.

The IR sensors emits the infrared light on an object, the light hitting the black part gets absorbed thus giving a low output but the light hitting the white part reflects back to the transmitter which is then detected by the infrared receiver, thereby giving an analog output. Using the stated principle, we control the movement of the robot by driving the wheels attached to the motors ,the motors are controlled by a microcontroller.

Human Follower Robot

Human Following robot ,a robot that follows the human-like puppy. This Arduino robot having a sensor that can detect any object near it and can follow this object. If you come in front of the robot it will start following you. This robot consists ultrasonic sensor and IR sensor which help to follow the object. This is similar to the obstacle avoiding robot only but opposite in the working.

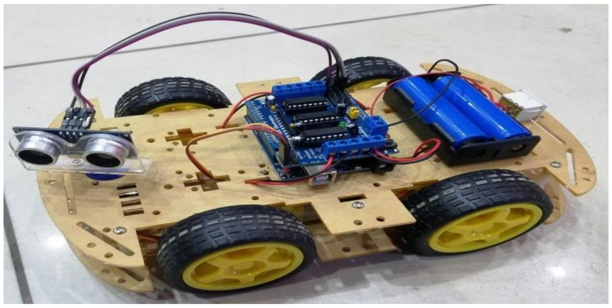
The human following robot can use in the defense sector also to carry weapons for the soldiers. This type of robot can sense obstacles and humans automatically and it can use in the future in our cars. A human following robot can be modified in the future with more developed components and can make it more advanced. This robot can be enhanced by structure by adding more components like camera ,tracking device and make it more beautiful and workable . This robot will be more trendy in our future.

Obstacle Avoiding Robot

Obstacle avoiding robot was designed, constructed and programmed which may be potentially used for educational and research purposes. The developed robot will move in a particular direction once the infrared (IR) and the PIR passive infrared (PIR) sensors sense a signal while avoiding the obstacles in its path. The robot can also perform desired tasks in unstructured environments without continuous human guidance. The hardware was integrated in one application board as embedded system design. The software was developed using C++ and compiled by Arduino IDE 1.6.5. The main objective of this project is to provide simple guidelines to the polytechnic students and beginners who are interested in this type of research. It is hoped that this robot could benefit students who wish to carry out research on IR and PIR sensors.

Design of Mechanical Structure

The mechanical structure of the robot is comprised of two layers base and it consist of four wheel differential drive system and a free wheel. It is designed keeping in view that the ultrasonic sensor on robot has to be mounted over a certain height from the ground. The height of ultrasonic sensor this is adjustable according to height of a person so that better visual information can be obtained. So initially the height of the camera is set up to 4 ft. The software design of the mechanical structure is shown below:



Coding Used inProject

```
#include <SoftwareSerial.h>
SoftwareSerial BT_Serial(2, 3); // RX, TX
#define enA 10//Enable1 L298 Pin enA
#define in1 9 //Motor1  L298 Pin in1
#define in2 8 //Motor1  L298 Pin in1
#define in3 7 //Motor2  L298 Pin in1
#define in4 6 //Motor2  L298 Pin in1
#define enB 5 //Enable2 L298 Pin enB
#define servo A4
#define R_S A0 //ir sensor Right
#define L_S A1 //ir sensor Left
#define echo A2    //Echo pin
#define trigger A3 //Trigger pin
int distance_L, distance_F = 30, distance_R;
long distance;
```

```
int set = 20;
int bt_ir_data; // variable to receive data from the serial port and IRremote
int Speed = 130;
int mode=0;
int IR_data;
void setup(){ // put your setup code here, to run once
pinMode(R_S, INPUT); // declare if sensor as input
pinMode(L_S, INPUT); // declare ir sensor as input
pinMode(echo, INPUT );// declare ultrasonic sensor Echo pin as input
pinMode(trigger, OUTPUT); // declare ultrasonic sensor Trigger pin as Output
pinMode(enA, OUTPUT); // declare as output for L298 Pin enA
pinMode(in1, OUTPUT); // declare as output for L298 Pin in1
pinMode(in2, OUTPUT); // declare as output for L298 Pin in2
pinMode(in3, OUTPUT); // declare as output for L298 Pin in3
pinMode(in4, OUTPUT); // declare as output for L298 Pin in4
pinMode(enB, OUTPUT); // declare as output for L298 Pin enB
Serial.begin(9600); // start serial communication at 9600bps
BT_Serial.begin(9600);
pinMode(servo, OUTPUT);
 for (int angle = 70; angle <= 140; angle += 5)  {
   servoPulse(servo, angle);  }
 for (int angle = 140; angle >= 0; angle -= 5)  {
   servoPulse(servo, angle);  }

 for (int angle = 0; angle <= 70; angle += 5)  {
   servoPulse(servo, angle);  }
delay(500);
}
void loop(){
if(BT_Serial.available() > 0){  //if some date is sent, reads it and saves in state
bt_ir_data = BT_Serial.read();
Serial.println(bt_ir_data);
if(bt_ir_data > 20){Speed = bt_ir_data;}
}
    if(bt_ir_data == 8){mode=0; Stop();}     //Manual Android Application and IR Remote Control Command
else if(bt_ir_data == 9){mode=1; Speed=130;} //Auto Line Follower Command
else if(bt_ir_data ==10){mode=2; Speed=255;} //Auto Obstacle Avoiding Command
analogWrite(enA, Speed); // Write The Duty Cycle 0 to 255 Enable Pin A for Motor1 Speed
analogWrite(enB, Speed); // Write The Duty Cycle 0 to 255 Enable Pin B for Motor2 Speed
if(mode==0){
//==============================================================================
//                    Key Control Command
//==============================================================================
    if(bt_ir_data == 1){forword(); }  // if the bt_data is '1' the DC motor will go forward
else if(bt_ir_data == 2){backword();}  // if the bt_data is '2' the motor will Reverse
else if(bt_ir_data == 3){turnLeft();}  // if the bt_data is '3' the motor will turn left
else if(bt_ir_data == 4){turnRight();} // if the bt_data is '4' the motor will turn right
else if(bt_ir_data == 5){Stop(); }     // if the bt_data '5' the motor will Stop
//==============================================================================
//                    Voice Control Command
```

```
//=========================================================================
====
else if(bt_ir_data == 6){turnLeft(); delay(400); bt_ir_data = 5;}
else if(bt_ir_data == 7){turnRight(); delay(400); bt_ir_data = 5;}
}
if(mode==1){
//=========================================================================
====
// Line Follower Control
//=========================================================================
====
if((digitalRead(R_S) == 0)&&(digitalRead(L_S) == 0)){forword();} //if Right Sensor and Left Sensor are at White color then it will call forword function
if((digitalRead(R_S) == 1)&&(digitalRead(L_S) == 0)){turnRight();}//if Right Sensor is Black and Left Sensor is White then it will call turn Right function
if((digitalRead(R_S) == 0)&&(digitalRead(L_S) == 1)){turnLeft();} //if Right Sensor is White and Left Sensor is Black then it will call turn Left function
if((digitalRead(R_S) == 1)&&(digitalRead(L_S) == 1)){Stop();} //if Right Sensor and Left Sensor are at Black color then it will call Stop function
}
if(mode==2){
//=========================================================================
====
// Obstacle Avoiding Control
//=========================================================================
====
 distance_F = Ultrasonic_read();
 Serial.print("S=");Serial.println(distance_F);
  if (distance_F > set){forword();}
   else{Check_side();}
}
delay(10);
}
void servoPulse (int pin, int angle){
int pwm = (angle*11) + 500;      // Convert angle to microseconds
 digitalWrite(pin, HIGH);
 delayMicroseconds(pwm);
 digitalWrite(pin, LOW);
 delay(50);                   // Refresh cycle of servo
}
//*******Ultrasonic_read*********
long Ultrasonic_read(){
  digitalWrite(trigger, LOW);
  delayMicroseconds(2);
  digitalWrite(trigger, HIGH);
  delayMicroseconds(10);
  distance = pulseIn (echo, HIGH);
  return distance / 29 / 2;
}
void compareDistance(){
     if (distance_L > distance_R){
  turnLeft();
  delay(350);
  }
  else if (distance_R > distance_L){
  turnRight();
  delay(350);
  }
  else{
  backword();
  delay(300);
  turnRight();
  delay(600);
  }
}
void Check_side(){
```

```
   Stop();
   delay(100);
 for (int angle = 70; angle <= 140; angle += 5)  {
  servoPulse(servo, angle);  }
   delay(300);
   distance_L = Ultrasonic_read();
   delay(100);
  for (int angle = 140; angle >= 0; angle -= 5)  {
  servoPulse(servo, angle);  }
   delay(500);
   distance_R = Ultrasonic_read();
   delay(100);
 for (int angle = 0; angle <= 70; angle += 5)  {
  servoPulse(servo, angle);  }
   delay(300);
   compareDistance();
}
void forword(){  //forword
digitalWrite(in1, HIGH); //Right Motor forword Pin
digitalWrite(in2, LOW);  //Right Motor backword Pin
digitalWrite(in3, LOW);  //Left Motor backword Pin
digitalWrite(in4, HIGH); //Left Motor forword Pin
}
void backword(){ //backword
digitalWrite(in1, LOW);  //Right Motor forword Pin
digitalWrite(in2, HIGH); //Right Motor backword Pin
digitalWrite(in3, HIGH); //Left Motor backword Pin
digitalWrite(in4, LOW);  //Left Motor forword Pin
}
void turnRight(){ //turnRight
digitalWrite(in1, LOW);  //Right Motor forword Pin
digitalWrite(in2, HIGH); //Right Motor backword Pin
digitalWrite(in3, LOW);  //Left Motor backword Pin
digitalWrite(in4, HIGH); //Left Motor forword Pin
}
void turnLeft(){ //turnLeft
digitalWrite(in1, HIGH); //Right Motor forword Pin
digitalWrite(in2, LOW);  //Right Motor backword Pin
digitalWrite(in3, HIGH); //Left Motor backword Pin
digitalWrite(in4, LOW);  //Left Motor forword Pin
}
void Stop(){ //stop
digitalWrite(in1, LOW); //Right Motor forword Pin
digitalWrite(in2, LOW); //Right Motor backword Pin
digitalWrite(in3, LOW); //Left Motor backword Pin
digitalWrite(in4, LOW); //Left Motor forword Pin
}
```

Output

https://drive.google.com/file/d/123xrPkTFIHvrOmcHGyHl-uAaKW9AfR-Y/view?usp=drivesdk

APPLICATIONS:-

Looking deeply into environment or our surroundings, we will be able interpret that "YES" there is a need of such robot that can assist humans and can serve them. Such a robot can be used for many purposes. With a few changes, the robot can act as a human companion as well. Some other applications of this robot are:

- 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.
- Human secured by this technology.
- Saving time and man power.

The project gives profound knowledge into different advancements and devices for improvement of the venture.

It can move smoothly in rough terrain and can make its own route to the destination avoiding obstacles. The movement of the proposed robot can be controlled wirelessly from the Bluetooth communication.

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