Internet Of Things Project Report
on

SMART HUMAN FOLLOWING ROBOT USING ARDUINO UNO

Submitted to

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, ANANTHAPURAMU

In partial fulfillment of requirement for the award of the degree of

Bachelor of Technology

In

Computer Science and Engineering

By

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

NARAYANA ENGINEERING COLLEGE :: GUDUR

(AUTONOMOUS)

(An ISO 9001:2008 Certified Institution, Approved by AICTE New Delhi &Permanently Affiliated to JNTUA, Ananthapuramu) Accredited with "A" Grade by NAAC

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BONAFIED CERTIFICATE

This is to certify the Socially Relevant project entitled **SMART FOLLOWING ROBOT USING ARDUINO UNO** that is being submitted by **SD.ELIYAZ, Y.SIVA SATHVIK , SK.NAVEED, R.NIKHIL SAI, Y.MALLIKARJUN** in partial fulfuillment of the requirements for the award of degree of **Bachelor of Technology** in **COMPUTER SCIENCE AND ENGINEERING** to JNTUA Ananthapuramu is recorded to be bonafied work carried out by him/her under guidance and supervision.

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DECLARATION

We hereby declare that the Socially Relevant project entitled **FOLLOWING ROBOT USING ARDUINO UNO** been done by us under the guidance of **P. K. Venkateshwar Lal ASSOICATE PROFESSOR** Department of Computer Science & Engineering.This project work has been submitted to **NARAYANA ENGINEERING COLLEGE, GUDUR** as a part of partial fulfillment of the requirements for the award of degree of **Bachelor of Technology**.

We also declare that this project report has not been submitted at any time to another institute or University for the award of any degree.

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ABSTRACT

For a 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 thatare 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 pursuing 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. In order to make things simpler, a unique handmade tag was placed on the person that the robot needs to follow. The main hindrance in this kind of work is that the detection of the target is a sensitive thing to carry out. The object has to be unique for the robot to recognize it and carry out the objective. The simple tag removes this problem of uniqueness and makes the task fairly easy. Protecting the robot from collision with the object is another problem that needs to be tackled so in order to do this, a sensor is used. All the processing is carried out by the microprocessor while the control of the motors is carried out by the controller.

1. INTRODUCTION

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 “A Smart Human Following Robot” that can interact and co- exist with them. To perform this task accurately, robot needs a mechanism that enables it to visualize the person and act accordingly. The robot must be intelligent enough to follow a person in the crowded areas, vivid environment and in indoors and outdoors places

The image processing carried out to get the information about the surroundings visually is a very important thing. The following points should be carefully noted while doing the processing.

- The luminosity conditions should be very stable and should not fluctuate.
- The ranges should be set properly for the desired environment on which to perform the tracking.
- The target should not be very far from the visual sensor as the distance matters a lot.
- We should avoid the use of such colours around the robot that matches with that of the target. Otherwise the robot would get confused.

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. The capability of a robot to track and follow a moving object can be used for several purposeslike ,To help humans, To create ease for people, Can be used for defence purpose.

In this, we presented a method of a human following robot based on tag identification and detection by using a camera. Intelligent tracking of specified target is carried out by the use of different sensors and modulesi.e. ultrasonic sensor, magnetometer, infrared sensors. An intelligent decision is being made by the robot control unit based on the information obtained from the above sensors and modules, hence finding and tracking the particular object by avoiding the obstacles and without collision with the target.

2. IMPORTANCE,RESEARCH AND IDEA

The purpose of research is to provide simpler robotic hardware architecture but with powerful computational platforms so that robot's designer can focus on their research and tests. This simple architecture is also useful for educational robotics, because students can build their own robots with low cost and use them as platform for experiments in several courses. The main purpose of this project is to develop a physical user interface to control a robot via a wireless technology. There is a need to communicate with the robot physically in order to control the robot movements and pass critical data both ways. The current IR controls are not good enough because the robot does not have an IR transmitter but only a receiver, meaning that the communication is one way. The IR communication works only in line of direct sight and any objects in the way will obstruct the communication. Sensor communication will enable us to control the robot up to 5 meters without the need for direct sight which means that the robot could be located behind a wall or some other object and the communication would not be lost. This research can further be implemented in commercial cars in order to reduce the pollution level as it is an electronic car which comes with rechargeable battery. As this robot is semi-automatic and works on physical commands its some of the features can be added to wheel chairs for physically handicapped and old people in order to help them in movement on their own.

3. SYSTEM COMPONENTS

Our system consists of a four wheel robotic vehicle mounted with a separate microcontroller and control unit along with different sensors and modules i.e. ultrasonic sensor, infrared sensors. The ultrasonic sensor height is vertically self-adjusting and is initially mounted on robot at a height of half feet, from ground to enhance the visual capability and effectiveness. This robotic vehicle is controlled by the user by means of an object or a human hand gesture.

Consisting components are described below:

1. Arduino Uno R3
2. Motor Driver Sheild
3. Ultrasonic Sensor
4. TT Gear Motors
5. Servo Motor
6. Wheels
7. Infrared Sensor
8. Lithium Ion Batteries
9. Battery holder
10. Battery Charger
11. Switch
12. Male and Female Jumper wires
13. Form board
14. Glue Gun
15. Arduino Uno cable

Arduino UNO Board:

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), 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 a AC-to-DC adapter or battery to get started..You can tinker with your Uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

Fig 3.1 Arduino Uno

L293D Motor Driver Shield :

The L293D is a dual-channel H-Bridge motor driver that can control two DC motors or a single stepper motor. Because the shield includes two such motor drivers, it can control upto four DC motors or two stepper motors. The 74HC595 shift register, on the other hand, extends the Arduino's four digital pins to eight direction control pins of two L293D chips.

Fig 3.2 Motor Driver Sheild

Ultrasonic Sensor:

As the name indicates, ultrasonic / level sensors measure distance by using ultrasonic waves. Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. The transducer of the sensor acts as a microphone to receive and send the ultrasonic sound. Our ultrasonic sensors, like many others, use a single transducer to send a pulse and to receive the echo. The sensor determines the distance to atarget by measuring time lapses between the sending and receiving of the ultrasonic pulse.

The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. ultrasonic / level sensors measure the distance to the target by measuring the time between the emission and reception.

Fig 3.3 Ultrasonic Sensor

Gear Motor:

A gear motor(or geared motor)is a small electric motor(AC induction, permanent magnet DC, or brushless DC) designed with an integral (non-separable) gear reducer (gear head) attached. The end shield on the drive end of the motor is designed to provide a dual function. These inexpensive and reliable TT Gear Motors are an easy, low-cost way to getyour projects moving. These gear motors require a voltage of 3-6VDC with a no load current of less than 150mA at 3V and possess a stall torque of 0.8kg.cm at 6V, a gearbox ratio of 48:1, and it comes with 2 x 200mm wires with breadboard-friendly 0.1" male connectors. Perfect for plugging into a breadboard or terminal blocks.

Fig 3.4 TT Gear Motor

Servo Motor:

A servo motor is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision. If you want to rotate an object at some specific angles or distance, then you use a servomotor. If any changes happen in servo motor rotation we can easily calibrate the spinning of a motorby using the program of servo. To work this we use servo.h library.

Fig 3.5 Servo Motor

Robot Wheels :

Wheeled robots are robots that navigate around the ground using motorized wheels to propel themselves. This design is simpler than using treads or leg sand by using wheels they are easier to design, build, and program for movement in flat, not-so-rugged terrain. They are also more well controlled than other types of robots.

Fig 3.6 Robot Wheels

Infrared Sensors :

An infrared (IR) sensor is an electronic device that measures and detects infrared radiation in its surrounding environment. Infrared radiation was accidentally discovered by an astronomer named William Herchel in 1800. While measuring the temperature of each color of light (separated by a prism), he noticed that the temperature just beyond the red light was highest. IR is invisible to the human eye, as its wavelength is longer than that of visible light (though it is still on the same electromagnetic spectrum). Anything that emits heat (everything that has a temperature above around five degrees Kelvin) gives off infrared radiation.

Fig 3.7 Infrared Sensors

Lithium Ion Batteries and holder :

A lithium-ion (Li-ion) battery is an advanced battery technology that uses lithium ions as a key component of its electrochemistry. During a discharge cycle, lithium atoms in the anode are ionized and separated from their electrons. The lithium ions move from the anode and pass through the electrolyte until they reach the cathode, where they recombine with their electrons and electrically neutralize. conveying power from the batteries to the device in question. External connections on batteryholders are most often made by contacts either withpins, surface mount feet, soldered lugs orvia a set of wire leads. Battery holders are often designed to be incorporated within the body of an electrical item, but they're also frequently sold as external compartments or attachments.

Fig 3.8 Li-on Batteries with holder

Lithium Ion Battery Charger :

The Li ion charger is a voltage-limiting device that has similarities to the lead acid system. The differences with Li-ion lie in a higher voltage per cell, tighter voltage tolerances and the absence of trickle or float charge at full charge. While lead acid offers some flexibility in terms of voltage cut off, manufacturers of Li-ion cells are very strict on the correct setting because Li-ion cannot accept overcharge. The so-called miracle charger that promises to prolong battery life and gain extra capacity with pulses and other gimmicks does not exist.

Fig 3.9 Li-on charger

Switch :

The function of a switch in electrical circuit is to make and break the connection which is connected to the power. In this mechanism it will connect the circuit and disconnect the circuit by using on and off button.There are many different types of switches. Based on their size, robustness, environmental resistance and other characteristics, they are divided into switches for industrial equipment and switches for consumer and commercial devices.

Fig 4.0 Switch

Jumper wires:

Although jumper wires come in a variety of colours, they do not actually mean anything. The wire colour is just an aid to help you keep track of what is connected to which.

It will not affect the operation of the circuit. This means that a red jumper wire is technically the same as the black one.

Even so, the colours can be used to your advantage to differentiate the types of connections. For instance, red as ground and black as power. Literally, what works for you!

Fig 4.1 Jumper wires

Foam Board:

Foam board is a strong and light weight material that can be cut easily with a sharp craft knife or a mat cutter for placing the Arduino Uno and Motor Driver Shield and other components. We can easily cut and can driven holes easily with the help of heat materials.

Fig 4.2 Foam Board

Glue Gun:

Hot glue guns are portable devices that utilize and dispense hot melt adhesives. First produced in the 1940s, hot melts—thermoplastics in the shape of tubular sticks—were created as an improvement to water-based adhesives that weaken when exposed to humidity. Industrial users today use both sticks and bulk supplies, depending on their particular applications, while most hobbyists stick to sticks for their greater simplicity. When glue guns were initially introduced, they were used to bond shoe soles. They have since become ubiquitous in many industries.

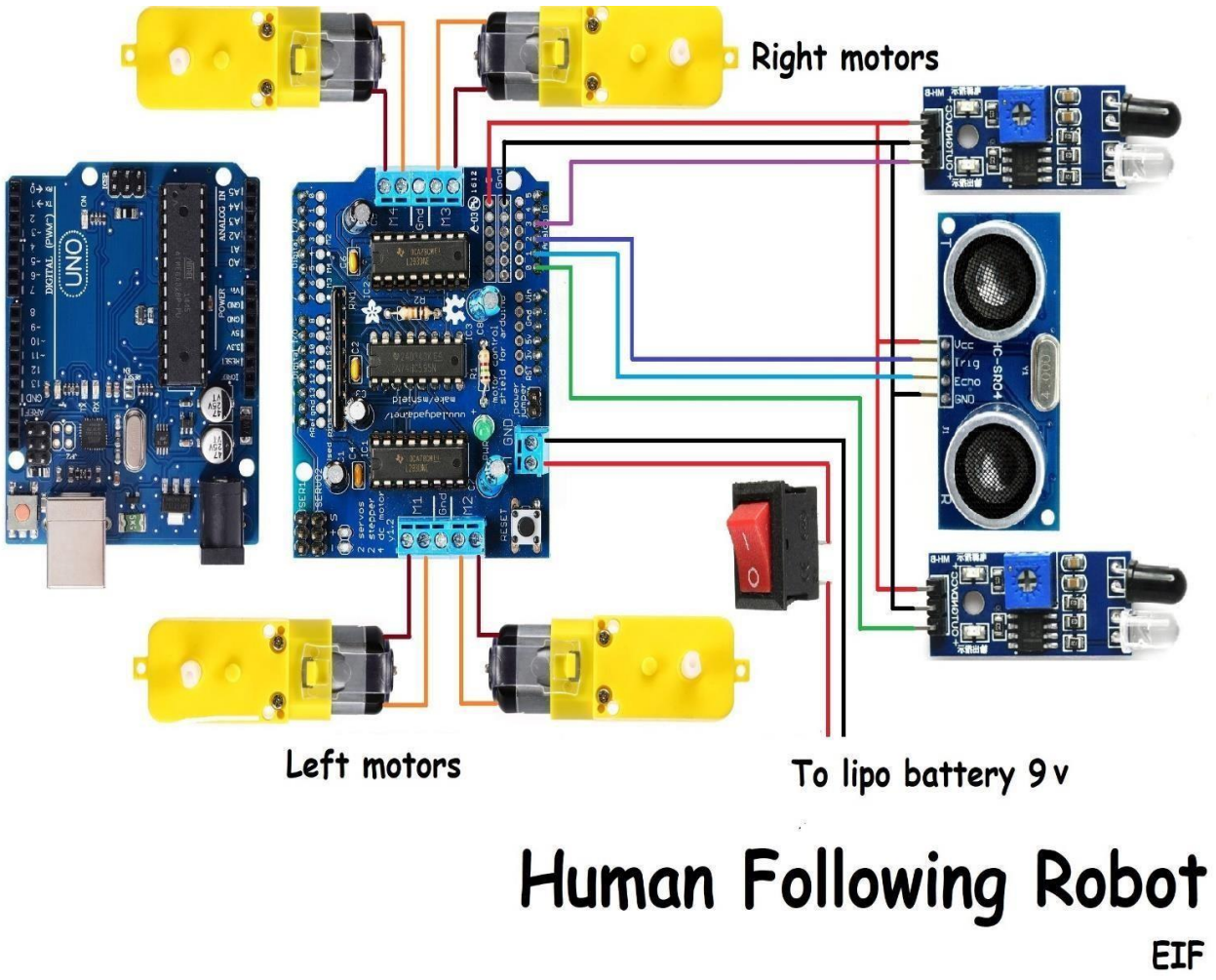
Fig 4.3 Glue gun

Arduino Uno cable:

Cable For Arduino UNO/MEGA is the most common A to B Male/Male type peripheral USB cable for Arduino. It is compatible with most Arduino boards such as Arduino Mega, Uno, Arduino Duemilanove. Often used for printers and other peripherals. While still a little bulky in shape for small embedded systems, this is a standard cable found everywhere. Use this cable with Arduino UNO and others, but not for Arduino Leonardo based boards.

Fig 4.4 Arduino uno cable

4. BLUEPRINT


Right motors
Left motors
To lipo battery 9 v
Human Following Robot
EIF

5. METHODOLOGY

First, we have to build a frame or chassis as per the requirement now arrange the component in chasis as per the circuit diagram. Now connect trigger pin to A2 number pin in Arduino, now connect Echo pin to A1 of the Arduino. Likewise left IR sensor is connected to the A3 pin of the arduino board, the servo motor is connected to PIN10 ofArduino. Likewise, the motor driver(L293D) has 16 pins, first, 1,8,9 and 16 pins of the motor driver are connected to +5 volt pin and 4,5,10 and 11 pins of the motor driver are connected to the ground pin. Similarly,PIN 2 of the motor driver is connected to the PIN 4 of Arduino, and PIN 7 of Arduino is connected to PIN 10 of the motor driver, and now PIN 8 of Arduino is connected to the PIN 15 of the motor driver pin . Likewise in motor, motor1 is connected to the 1 and 2 pins of the motor drive shield. And now, similarly motor2 is connected to 3 and 4 pins of the motor driver shield , and now motor3 connects to 5 and 6 pins of the motor driver. And last one motor4 connect to 7 and 8 of the motor driver pins.

6. WORKING OF THE PROJECT

This project mainly uses ultrasonic sensors and Infrared sensors for following the human. The Radio frequency identification technology is used for authentication purposes. So that the robot correctly follows the person owning it and not anyone else. Stage 1: The RFID tag works as a key to the robot. In technical terms, the unique identification number of the RFID tag is used as an allowing condition for the robot to follow the subject. The loops for and if are used to condition whether to access the code that prompts the robot to follow the human by accessing the ultrasonic sensor and infrared sensor. If the UID matches with the one that isfed in the program the servo motor rotates 90 degrees and back as an indication to the access. If the UID does not match with the one that is written in the code then the robot will stay idle meaning the access is denied. HumanFollowingRobot.ino International Journal of Advance Research, Ideas and Innovations in Technology Stage 2: After the correct UID (correct tag) has been identified, the code to follow the human starts executing. Firstly, the Ultra sonic sensor checks whether the subject to be followed is in the front. The two IR sensors check whether the subject is at either side of the robot to guide it towards that particular direction. During this process, both the IR sensors and the ultrasonic sensor work in coordination. They sense the human using ultrasonic technology and infrared technologies respectively and give the input to the Arduino. The Arduino acts a processor and gives the output to the motor driver. Now, the motor driver prompts in ways as follows: Outputs given to dc motors according to the input by:

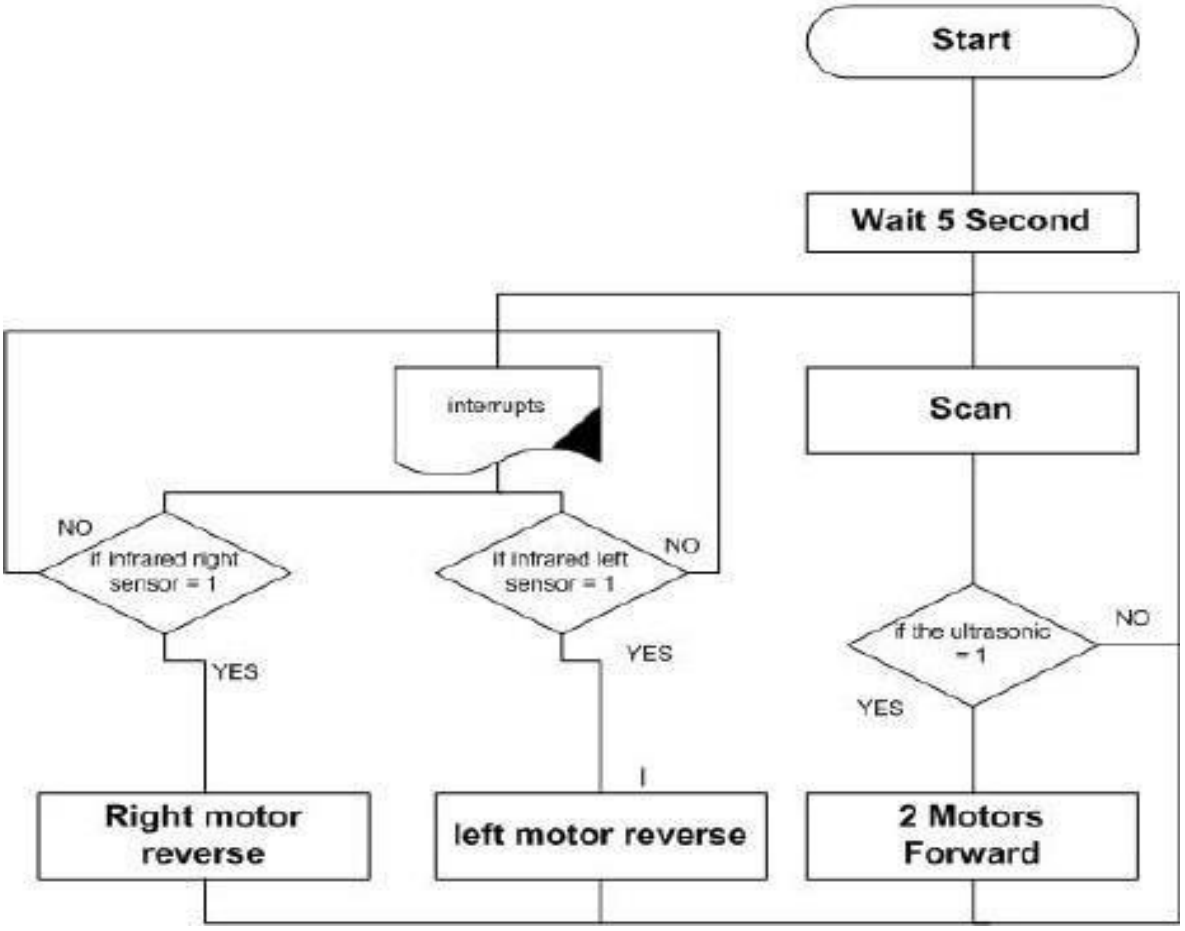
(a) ULTRASONIC SENSOR- all motors move forward, making the robot to move ahead.

(b) Right IR SENSOR – The motors to the left side move forward, making the robot to travel in right direction.

(c) LEFT IR SENSOR- The motors to the right move forward, making the robot to travel in the left direction.

(d) If no object is sensed by either of the sensors then the robot will come to a stable condition.

7. WORK FLOW DIAGRAM



8. TECHNOLOGIES ADAPTED

ARDUINOIDESOFTWARE

TheArduinoIntegratedDevelopmentEnvironment-orArduinoSoftware(IDE)

- contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them. Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension(.ino).The editor has features for cutting/pasting andfor searching/replacing text. The message are a gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand cornerof the window displays the configured board and serial port. The toolbar buttons allow youto verify and upload programs, create, open, and save sketches, and open the serial monitor.

Installation

The steps to get started with Arduino UNO are listed below:

Install the drivers of the board. As soon we connect the board to the computer, Windows from XP to 10 will automatically install the board drivers. But, if you have expanded or downloaded the zip package, follow the below steps:

1. Click on Start ->Control Panel->System and Security.
2. Click on System -> Device Manager -> Ports (COM &LPT) -> Arduino UNO (COMxx). If the COM &LPT is absent, look Other Devices ->Unknown Device.
3. Right-click to Arduino UNO (COmxx) -> Update Driver Software ->Browse my computer for driver software.
4. Select the file "inf" to navigate else, select "ArduinoUNO.inf" Installation Finished.

9. PROTOTYPE

10. RESULT

We have successfully made the human following robot which is used to follow objects as well as humans. This robot uses ultrasonic range sensors and Infrared sensors. The test was performed on the both ultrasonic sensor and infrared sensor that the sensor was working accurately within the range of 10 cm. An ultrasonic sensor is used to move the robot forward and backward. Infrared sensors are used to move the robot in the left or right direction accordingly. Then we test the serial communication of Arduino, motor shield, and various motors . This robot took a lot of time to complete this project. We were faced lots of problems regarding the program code, as there was huge numbers of error in the code which was further rectified it and lastly it works. Motors drivers connections got interchanged whichwas rectified and our robot works perfectly fine. Finally, after the lots of effort and time our objective was achieved which was to implement a good Human-Robot interaction.

11. ADVANTAGES

- A human following robot requires several techniques such as humans target detection, robot control algorithm and obstacle avoidance.
- It can be used for home for floor cleaning
- In hotels they are being used for the transfer of things from one place to another following a straight path.
- Increase production
- More accurate than humans
- Time saving
- Can work 24/7

12. APPLICATIONS

Looking deeply into environment or our surroundings, we were be able interpret that 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 modifications, the robot can act as a human companion as well. The tasks these kind of robots can perform are limitless including assisting in carrying loads for people working in hospitals, libraries, airports etc.

13. FUTURE WORK

There are many interesting applications of this research in different fields whether military or medical. A wireless communication functionality can be added in the robot to make it more versatile and control it from a large distance. This capability of a robot could also be used for military purposes. 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. Similarly it can assist the public in shopping malls. So there it can act as a luggage carrier, hence no need to carryup the weights or to pull that. Similarly, ample amount of modifications could be done to this prototype for far and wide applications.

14. CONCLUSION

A successful implementation of a prototype of human following robot is illustrated in this paper. This robot does not only have the detection capability but also the following ability as well. While making this prototype it was also kept in mind that the functioning of the robot should be as efficient as possible. Tests were performed on the different conditions to pin point the mistakes in the algorithm and to correct them. The different sensors that were integrated with the robot provided an additional advantage. The human following robot is an automobile system that has ability to recognize obstacle, move and change the robot's position toward the subject in the best way to remain on its track. This project uses arduino, motors different types of sensors to achieve its goal. This project challenged the group to cooperate, communicate, and expand understanding of electronics, mechanical systems, and their integration with programming.

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