A Report on

HUMAN FOLLOWING ROBOT

Submitted for partial fulfillment of award of

BACHELOR OF TECHNOLOGY
Degree
In
Electronics & Communication Engineering

By

1. Hemant Negi (1703031044)
2. Himanshi Kumari (1703031046)
3. Janhvi Thakur (1703031051)
4. Kartik Bansal(1703031055)

Under the Supervision of

Ms. Rashi Gupta

INDERPRASTHA ENGINEERING COLLEGE, GHAZIABAD,

Dr. A P J ABDUL KALAM TECHNICAL UNIVERSITY
LUCKNOW

JUNE 2021

Certificate

Certified that **Janhvi Thakur** has carried out the project work presented in this report entitled **"Human Following Robot"** for the award of **Bachelor of Technology** from Inderprastha Engineering College, Ghaziabad, under my supervision. The report embodies result of original work and studies carried out by Student himself/herself and the contents of the report do not form the basis for the award of any other degree to the candidate or to anybody else.

(Ms. Rashi Gupta)

Designation: Assistant Professor

Date:

Acknowledgement

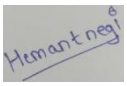
We take this opportunity to thank our teachers and friends who helped us throughout the project.

We would like to thank my guide for the project (**Ms. Rashi Gupta, Assistant Professor, Electronics & communication**) for her valuable advice and time during development of project.

We would also like to thank all faculty and staff members of Electronics & Communication Engineering for their constant support during the development of the project.

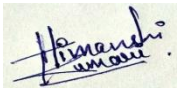
Hemant Negi

1703031044



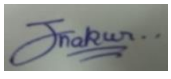
Himanshi Kumari

1703031046



Janhvi Thakur

1703031051



Kartik Bansal

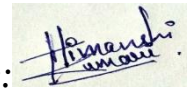
1703031055

Declaration

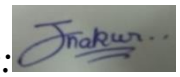
I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

Signature: 

Name: Hemant Negi

Signature: 

Name: Himanshi Kumari

Signature: 

Name: Janhvi Thakur

Signature: 

Name: Kartik Bansal

Abstract

Robotic industry has evolved so much and has been a revolutionary in helping human being to complete certain task. Without the help of industrial robotics to produce car, cell phone or a computer, productions will suffer as time is a very important factor for businesses. Researchers around the world understand this, and there is already an artificial intelligent robot being produced. Each year, there will be new findings to create a robot that may one day behave similarly like a human being. However, this paper will only discuss about person following robot, a robot that should help human in an environment such as hospitals, schools, or shopping malls.

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. Robots 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 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. A small camera records the video and the processor processes it to extract the desired information from it. 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.

TABLE OF CONTENTS:

List OF FIGURES

Chapter 1

INTRODUCTION

OVERVIEW

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 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 colors 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 purposes.

- To help humans.
- To create ease for people.
- Can be used for defence purpose.

In this paper, 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 modules i.e. ultrasonic sensor, magnetometer, infrared sensors and camera. 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

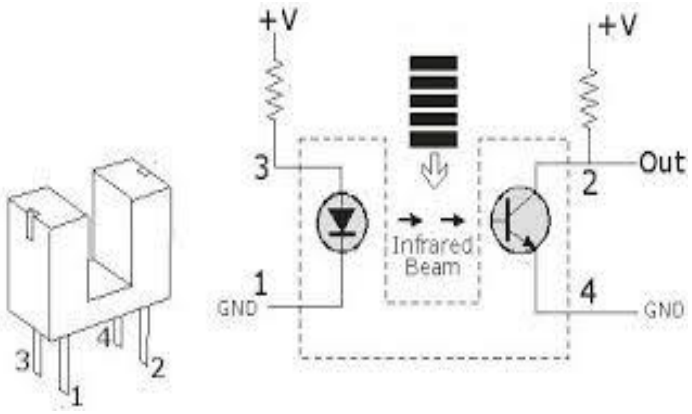


Figure 1.1: IR Slot Sensor

Block Diagram

The system design consists of separate processing and control unit. The processing unit only makes use of a camera and is linked with the control unit to serially transmit the visual information after bulk processing. The control unit is serially linked with the processor and it makes use of several sensors and modules i.e. ultrasonic sensor, magnetometer and infrared sensors Looking at the working of the above system, the first phase is the detection of a tag by means of a camera and carrying out the substantial processing in the processing unit.. After the detection of tag next phase is to establish a serial communication between the processor and control unit. We have used Arduino as a control unit. In this phase centre point coordinates of tag are serially transmitted to Arduino for further processing.

Next phase is to interface modules and necessary sensors with the control unit. For this purpose, we used ultrasonic sensor, magnetometer and IR sensors for the proper functioning of robot.

We used ultrasonic sensor for obstacle avoidance and to maintain a specific distance for the object. The ultrasonic sensor works accurately works accurately within a range the control unit determines that how much direction change is required to be back on track again by after avoiding the obstacle.

After interfacing of above sensors, the next most important part of this system design is to interface the encoders to wheel calculate the distance travelled by the robot to eliminate any further error in the robotic movement due to displacement. The slot sensor has IR transmitter and a photodiode mounted on it and facing each other. The light emitted by the IR LED is blocked because of alternating slots.

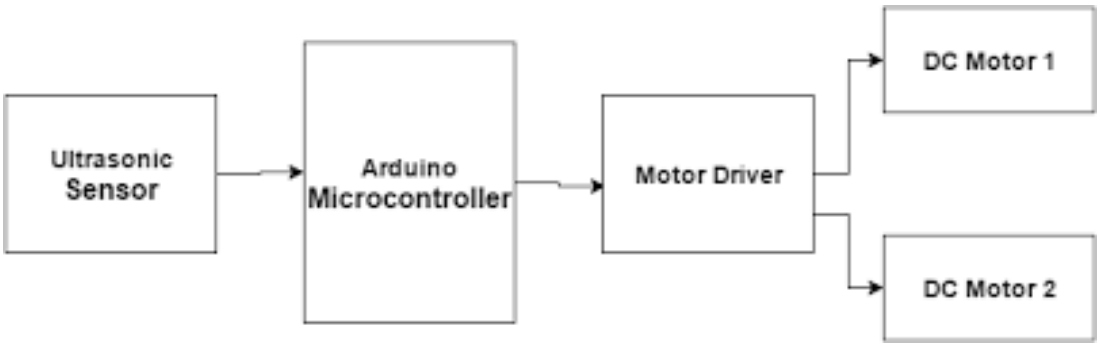


Figure 1.2: Block Diagram

A systematic research methodology is adopted keeping in mind the ultimate goal of a fully functional and autonomous human following 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. Link between microprocessor and controller are the main aspects of this project.

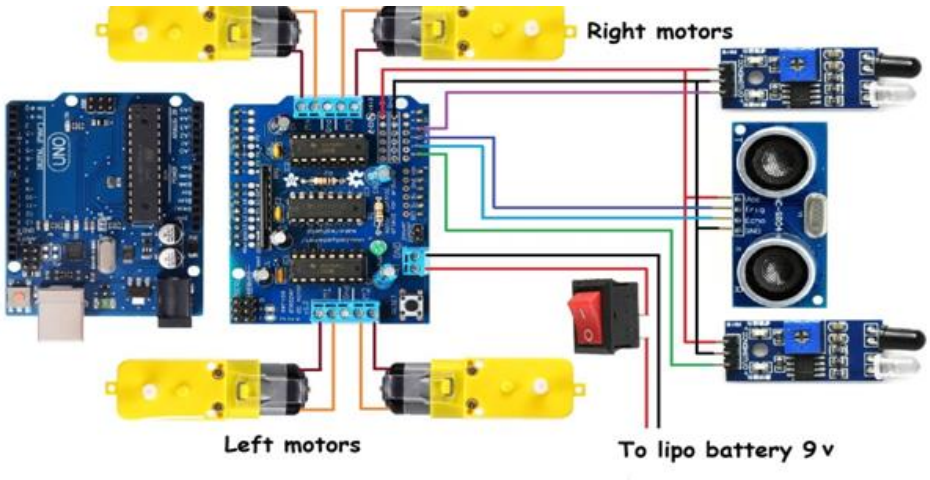


Figure 1.3: Human Following Robot

Circuit connection

Ultrasonic Sensor Connection:-

Trig pin is connected to arduino 2pin

Echo pin is connected to arduino 3pin

l293d motor driver connection:-

Motor driver l293d have 16pin...

1, 8, 9, 16pin of l293d is connected to +5v

4,5,10 and 11 pin of l293d is connected to Gnd

Connection between Arduino and l293d:-

2pin of l293d is connect to 4pin of arduino

7pin of arduino is connect to 5pin of arduino

9pin of arduino is connect to 6pin of arduino

15pin of arduino is connect to 7pin of arduino

Motor Connection:-

Motor1 is connected to 3 and 6pin of l293d, Motor2 is connected to 10 and 14 pin of l293d

Chapter 2

LITERATURE REVIEW

In the field of unmanned vehicle (UV) systems, researchers have been striving to inverse the human-robot ratio such that one operator can control multiple robots. This goal has not yet been accomplished for military applications, despite ongoing research. Research suggests that the human-robot interaction (HRI) that takes place while an operator is in control of one or more UVs needs to be improved before the ratio can be inversed. This literature review included 53 references to provide an overview of current HRI research dealing with the operation of UVs and to identify the key human factors (HF) issues when conducting research within this area. The literature identified three key factors in HRI research related to operating UVs for military applications: operator capacity (that is, the number and type of UVs that a human operator controls or supervises), automation, and interface design. Within the literature HRI is most often measured through the three common metrics of situation awareness (SA), workload, and task performance. In general, research shows that increasing operator capacity increases workload and decreases SA, while the corresponding impact on performance has been shown to be inconsistent. Automation and multimodal interfaces have been shown to alleviate some of the increased workload and decreased SA as operator capacity is increased, however, there is a complex interaction between the three variables. The literature suggests that adaptive automation and adaptive interfaces are promising solutions to accommodate for this complex interaction, but further research and empirical studies are necessary before they can be implemented into military operations. Three additional characteristics of military applications also need to be investigated further: one operator in control of mixed UV platforms (i.e. UAVs and UGVs), operators controlling UVs in a mobile environment, and team coordination between multiple operators each in control of multiple UVs. To help further research in this area, the new Human-Robot Interaction laboratory being built at DRDC—Toronto should consider investigating HF issues in the design of a multimodal adaptive interface for mixed UV military operations. In particular, due to gaps in the literature and the need for more detailed research in certain areas, studies should look at the interactions between operator capacity, adaptive automation, automation reliability, adaptive interfaces, mobile environments, and team coordination.

Chapter 3

COMPONENTS USED

(Software and Hardware)

Hardware Components Used:

- Arduino Uno with USB cable.
- l293d motor driver
- Ultrasonic sensor hc-04
- Two dc gear motor
- Power Supply

1. Arduino Uno:

Figure 3.1: Arduino uno

Features:

- ATmega328P microcontroller

- Input voltage - 7-12V
- 14 Digital I/O Pins (6 PWM outputs)
- 6 Analog Inputs
- 32k Flash Memory
- 16Mhz Clock Speed

ATmega328P:

- 8-bit microcontroller
- 8KB ROM
- 256 bytes RAM
- 3 timers
- 32 I/O pins
- 1 serial port
- 8 interrupt sources

Arduino is an open-source electronics platform based on easy-to-**use** hardware and software. **Arduino** boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.

2. Servo Motor:

Figure 3.2: Servo Motor

This type of motor is basically a brushed DC motor with some form of positional feedback control connected to the rotor shaft. They are connected to and controlled by a PWM type controller and are mainly used in positional control systems and radio-controlled models.

Following are the steps to connect a servo motor to the Arduino:

1. The servo motor has a female connector with three pins.
2. Connect the power cable that in all standards should be red to 5V on the Arduino.
3. Connect the remaining line on the servo connector to a digital pin on the Arduino.
4.

3. Ultrasonic Sensor:

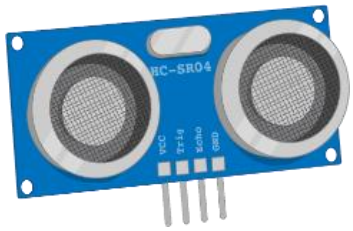


Figure 3.3: Ultrasonic Sensor HCSR04

An **ultrasonic sensor** is an electronic device that measures the distance of a target object by emitting **ultrasonic** sound waves, and converts the reflected sound into an electrical signal.

- 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

4. Power Supply:

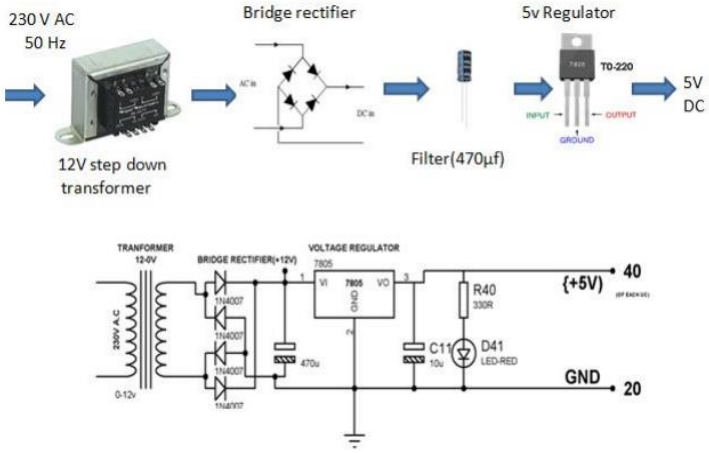


Figure 3.4: Power Supply

5. Motor Driver IC:

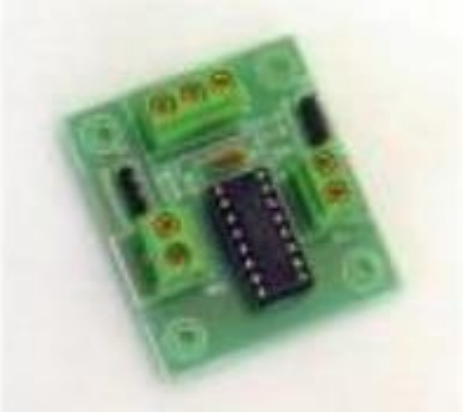


Figure 3.5: Motor Driver IC

This Motor Driver Board is designed to Work with L293D IC. This can control 2 DC Motors, their direction using control lines and their speed using PWM.

6. Gear Motor:

Figure 3.6: Gear Motor

A gearmotor is an all-in-one combination of an electric motor and a gearbox. This makes it a simple, cost-effective solution for high-torque, low-speed applications because it combines a motor witha gear reducesystem.

Software Components Used:

- Tool Arduino IDE
- Programming languages used Embedded C/C++

Arduino Ide:

Figure 3.7: Screenshot 1

- An official software introduced by Arduino.cc, that is mainly used for writing, compiling and uploading the code in the Arduino Device. Almost all Arduino modules are compatible with this software that is an open source and is readily available to install and start compiling the code on the go.
- Making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process.
- The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board.
- The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.
- This environment supports both C and C++ languages.

Chapter:4

ADVANTAGES & APPLICATIONS

Advantages

It can **follow** a **human** whenever the person moves in that direction. The **robot** should also be able to exhibit an effective obstacle avoidance with target **following** and exploration behaviours. The **human follower robot** can help us in domestic environment as well as in an industrial area.

- These types of robot movement are usually automatic.
- The system in the robot is like once install and forget.
- It s relatively cheap.
- This type of robot is simple to build.
- They can also be used for long distance.

Disadvantage

Onto the **downsides of robots**. Here are the **robotics disadvantages** that aren't quite as enjoyable.

- They lead humans to lose their jobs.
- They need constant power.
- They are restricted to their constant programming.
- They perform relatively few tasks.

Applications

Some applications of this robot are

- Can assist in carrying loads for people working in hospitals, libraries, airport..
- Can service people at shopping centers or public areas.
- Can assist elderly people, special children and babies.
- Can follow a particular Vehicle
- In hotels they are being used for the transfer of things from one place to another following a straight path.

Chapter:5

FLOW DIAGRAM

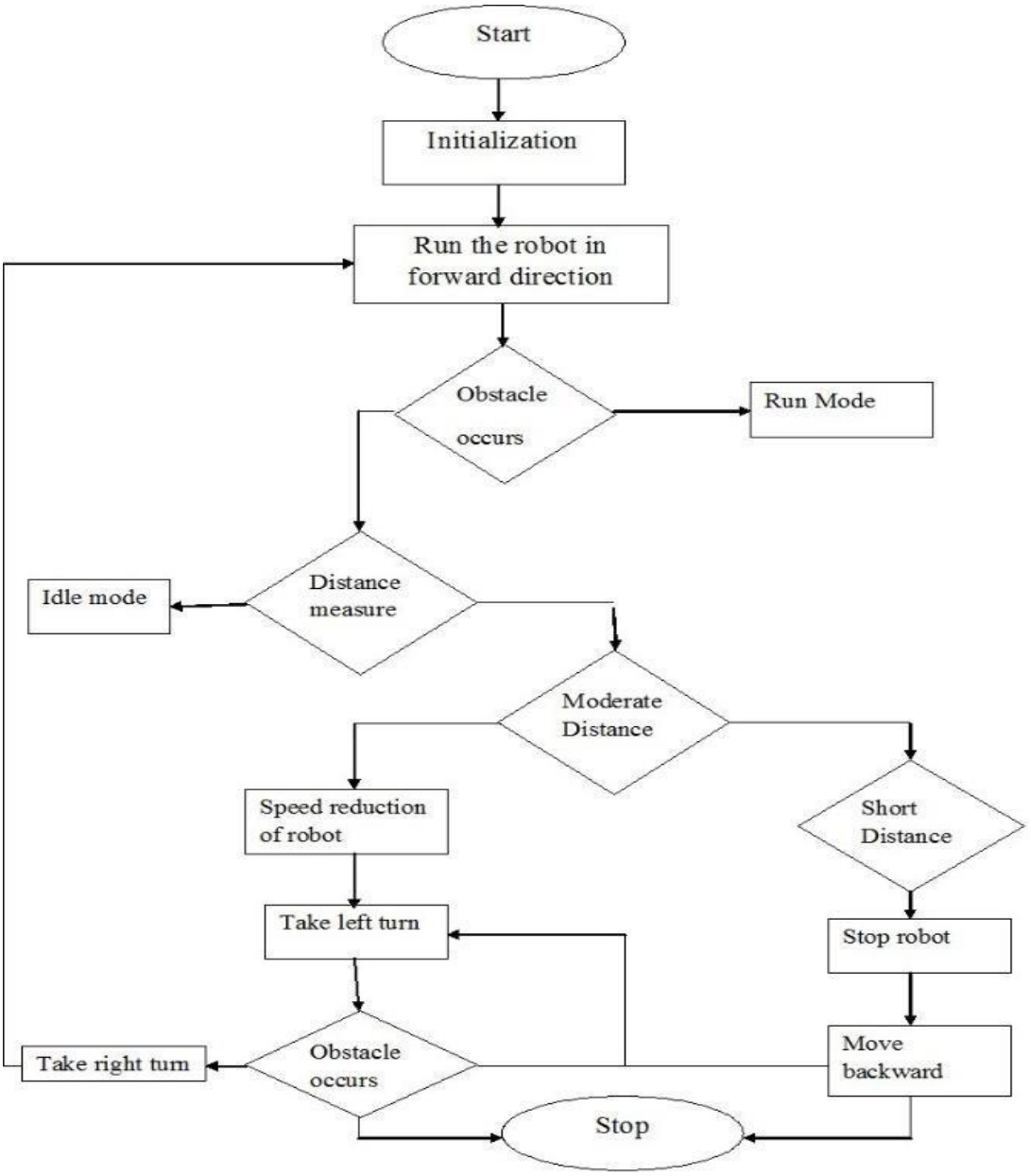


Figure 5.1:Human Following Robort(Flow Chart)

- Designed human follower robot using Arduino microcontroller.
- It can follow a human whenever he moves in a straight line.

Chapter:6

ScreenShorts

Figure 6.1: Screenshot 2

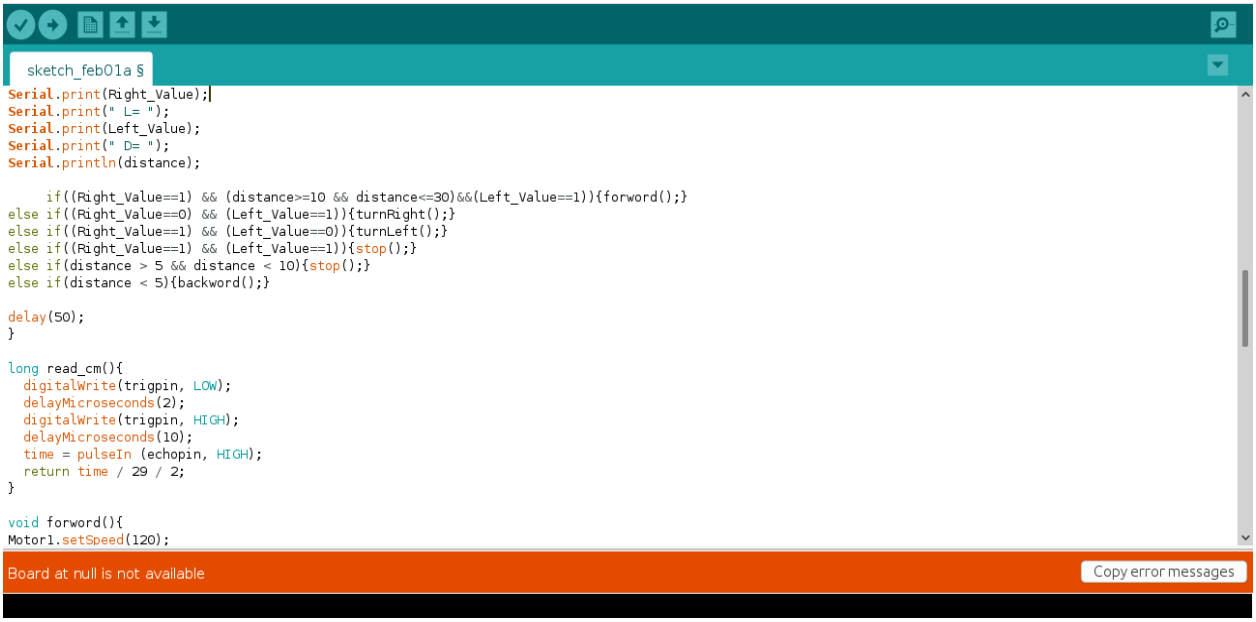


Figure 6.2: Screenshot 3

Figure 6.3: Screenshot 4

Figure 6.3: Screenshot 5

Figure 6.5: Screenshot 6

CONCLUSION

A successful implementation of a person follower robot is illustrated in this research. This robot does not only have the detection capability but also the tracking and following ability as well. The tracking is basically performed on the tag and the human is followed on the basis of that detection. It was also kept in mind that the „following" 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.

FUTURE SCOPE

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. E-g a vehicle follower. Similarly it can assist the public in shopping malls. So there it can act as a luggage carrier, hence no need to carry up the weights or to pull that. Using this algorithm the robot will automatically follow that person.

REFERENCES

- J. Sales, R. Marín, E. Cervera, S. Rodríguez, and Javier Pérez, "Multi-sensor person following in low-visibility scenarios," Sensors 2010, 10, 10953-10966, 2010.
- T. Yoshimi, M. Nishiyama, T. Sonoura, H. Nakamoto, S. Tokura, H. Sato, F. Ozaki, N. Matsuhira, and H. Mizoguchi, "Development of a Person Following Robot with Vision Based Target Detection," in 2006 IEEE/RSJ International Conference on Intelligent Robots and Systems, 2006, pp. 5286–5291.
- C. Schlegel, J. Illmann, H. Jaberg, M. Schuster, and R. Wörz, "Vision Based Person Tracking with a Mobile Robot.," in BMVC, 1998, pp. 1–10.
- N.-Y. Ko, D.-J. Seo, and Y.-S. Moon, "A Method for Real Time Target Following of a Mobile Robot Using Heading and Distance Information," J. Korean Inst. Intell. Syst., vol. 18, no. 5, pp. 624–631, Oct. 2008.
- K. S. Nair, A. B. Joseph, and J. I. Kuruvilla, "Design of a low cost human following porter robot at airports."
- V. Y. Skvortzov, H.-K. Lee, S. Bang, and Y. Lee, "Application of Electronic Compass for Mobile Robot in an Indoor Environment," in 2007 IEEE International Conference on Robotics and Automation, 2007, pp. 2963– 2970.
- "http://www.nskelectronics.com/slot_sensor.html," Slot Sensor.

HUMAN FOLLOWING ROBOT

Kartik Bansal
Dept. of Electronics and Communication Engineering
Inderprastha Engineering College
Ghaziabad, Uttar Pradesh
katikbansal67@gmail.com

Janvi Thakur
Dept. of Electronics and Communication Engineering
Inderprastha Engineering College
Ghaziabad, Uttar Pradesh
janhwisingh99@gmail.com

Hemant Negi
Dept. of Electronics and Communication Engineering
Inderprastha Engineering College
Ghaziabad, Uttar Pradesh
hemantsnegi82@gmail.com

Himanshi Kumari
Dept. of Electronics and Communication Engineering
Inderprastha Engineering College
Ghaziabad, Uttar Pradesh
manshik0912@gmail.com

Abstract - *The Robotic industry has evolved so much and has been a revolutionary in helping human beings to complete certain tasks . Without the help of industrial robotics to produce cars , cellphone or a computer , production will suffer as time is a very important factor for businesses. Each year, there will be new findings to create a robot that may one day behave similarly like a human being. However, this paper will only discuss the robot following the person, a robot that should help humans in an environment such as hospitals, schools, or shopping malls.*

Robots that function 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. 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.

Keywords- *robot , person , ultrasonic sensor.*

1. INTRODUCTION

Robotic technology has increased appreciably in the 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 for robots such as "A Human Following Robot" that can interact and co-exist with them. To perform this task accurately, a 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 colors 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 range 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 purposes.

- *To help humans.*
- *To create ease for people.*
- *Can be used for defence purposes.*

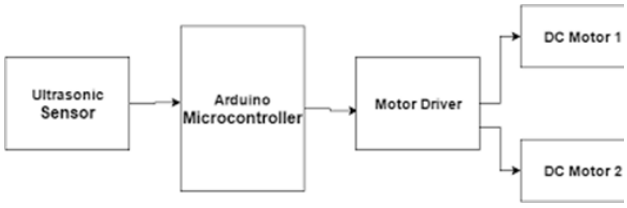
In this paper, we presented a method of a human following robot based on tag identification and detection by using a camera. Intelligent tracking of specified targets is carried out by the use of different sensors and modules i.e. ultrasonic sensor, magnetometer, infrared sensors and camera. An intelligent 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.

A decentralized top down approach is used for this project. The project is divided into 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 links between microprocessor and controller are the main aspects of this project.



Block Diagram

2. LITERATURE REVIEW

In the field of unmanned vehicle (UV) systems, researchers have been striving to inverse the human-robot ratio such that one operator can control multiple robots. This goal has not yet been accomplished for military applications, despite ongoing research. Research suggests that the human-robot interaction (HRI) that takes place while an operator is in control of one or more UVs needs to be improved before the ratio can be inverted. This literature review included 53 references to provide an overview of current HRI research dealing with the operation of UVs and to identify the key human factors (HF) issues when conducting research within this area. The literature identified three key factors in HRI research related to operating UVs for military applications: operator capacity (that is, the number and type of UVs that a human operator controls or supervises), automation, and interface design. Within the literature HRI is most often measured through the three common metrics of situation awareness (SA), workload, and task performance. In general, research shows that increasing operator capacity increases workload and decreases SA, while the corresponding impact on performance has been shown to be inconsistent. Automation and multimodal interfaces have been shown to alleviate some of the increased workload and decreased SA as operator capacity is increased, however, there is a complex interaction between the three variables. The literature suggests that adaptive automation and adaptive interfaces are promising solutions to accommodate for this complex interaction, but further research and empirical studies are necessary before they can be implemented into military operations. Three additional characteristics of military applications also need to be investigated further: one operator in control of mixed UV platforms (i.e. UAVs and UGVs), operators controlling UVs in a mobile environment, and team coordination between multiple operators each in control of multiple UVs. To help

further research in this area, the new Human-Robot Interaction laboratory being built at DRDC—Toronto should consider investigating HF issues in the design of a multimodal adaptive interface for mixed UV military operations. In particular, due to gaps in the literature and the need for more detailed research in certain areas, studies should look at the interactions between operator capacity, adaptive automation, automation reliability, adaptive interfaces, mobile environments, and team coordination.

3. COMPONENTS USED

Hardware Components Used:

1. Arduino Uno:

Figure 3.1: Arduino uno

Features:

- *ATmega328P microcontroller*
- *Input voltage - 7-12V*
- *14 Digital I/O Pins (6 PWM outputs)*
- *6 Analog Inputs*
- *32k Flash Memory*
- *16Mhz Clock Speed*

ATmega328P:

- *8-bit microcontroller*
- *8KB ROM*
- *256 bytes RAM*
- *3 timers*
- *32 I/O pins*
- *1 serial port*
- *8 interrupt sources*

Arduino *is an open-source electronics platform based on easy-to-**use** hardware and software. **Arduino** boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and*

turn it into an output activating a motor, turning on an LED, publishing something online.

2. Servo Motor:

Figure 3.2: Servo Motor

This type of motor is basically a brushed DC motor with some form of positional feedback control connected to the rotor shaft. They are connected to and controlled by a PWM type controller and are mainly used in positional control systems and radio-controlled models.

3. Ultrasonic Sensor:

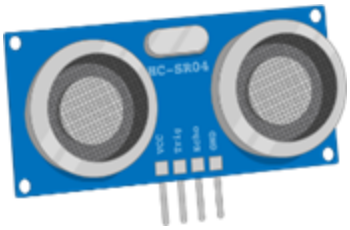


Figure 3.3: Ultrasonic Sensor HCSR04

*An **ultrasonic sensor** is an electronic device that measures the distance of a target object by emitting **ultrasonic** sound waves, and converts the reflected sound into an electrical signal.*

- *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*

4. Power Supply:

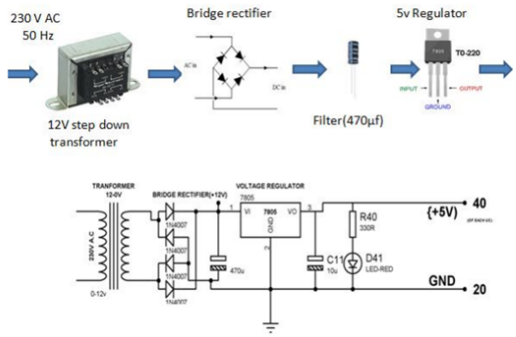


Figure 3.4: Power Supply

5. Motor Driver IC:

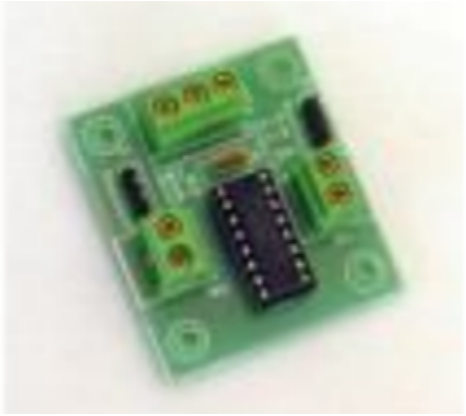


Figure 3.5: Motor Driver IC

This Motor Driver Board is designed to Work with L293D IC. This can control 2 DC Motors, their direction using control lines and their speed using PWM.

6. Gear Motor:

Figure 3.6: Gear Motor

A gearmotor is an all-in-one combination of an electric motor and a gearbox. This makes it a simple, cost-effective solution for high-torque, low-speed applications because it combines a motor with a gear reducer system.

Software Components Used:

- *Tool Arduino IDE*
- *Programming languages used Embedded C/C++*

4. WORKING

The system design consists of a separate processing and control unit. The processing unit only makes use of a camera and is linked with the control unit to serially transmit the visual information after bulk processing. The control unit is serially linked with the processor and it makes use of several sensors and modules i.e. ultrasonic sensor, magnetometer and infrared sensors Looking at the working of the above system, the first phase is the detection of a tag by means of a camera and carrying out the substantial processing in the processing unit.. After the detection of tag, the next phase is to establish a serial communication between the processor and control unit. We have used Arduino as a control unit. In this phase centre point coordinates of tag are serially transmitted to Arduino for further processing.

Next phase is to interface modules and necessary sensors with the control unit. For this purpose, we used ultrasonic sensors, magnetometer and IR sensors for the proper functioning of robots.

We used ultrasonic sensors for obstacle avoidance and to maintain a specific distance for the object. The ultrasonic sensor works accurately within a range the control unit determines how much direction change is required to be back on track again after avoiding the obstacle.

After interfacing of above sensors, the next most important part of this system design is to interface the encoders to wheel calculate the distance travelled by the robot to eliminate any further error in the robotic movement due to displacement. The slot sensor has an IR transmitter and a photodiode mounted on it and facing each other. The light emitted by the IR LED is blocked because of alternating slots.

5. ADVANTAGES & APPLICATIONS

Advantages:

*It can **follow** a **human** whenever the*

*person moves in that direction. The **robot** should also be able to exhibit an effective obstacle avoidance with target **following** and exploration behaviours. The **human follower robot** can help us in domestic environments as well as in an industrial area.*

- *These types of robot movement are usually automatic.*
- *The system in the robot is like once installed and forgotten.*
- *It's relatively cheap.*
- *This type of robot is simple to build.*
- *They can also be used for long distances.*

Disadvantages:

*Onto the **downsides of robots**. Here are the **robotics disadvantages** that aren't quite as enjoyable.*

- *They lead humans to lose their jobs.*
- *They need constant power.*
- *They are restricted to their constant programming.*
- *They perform relatively few tasks.*

Applications:

Some applications of this robot are-

- *Can assist in carrying loads for people working in hospitals, libraries, airports..*
- *Can service people at shopping centers or public areas.*
- *Can assist elderly people, special children and babies.*
- *Can follow a particular Vehicle*
- *In hotels they are being used for the transfer of things from one place to another following a straight path.*

6. FLOW DIAGRAM

- *Designed human follower robot using Arduino microcontroller.*
- *It can follow a human whenever he moves in a straight line.*

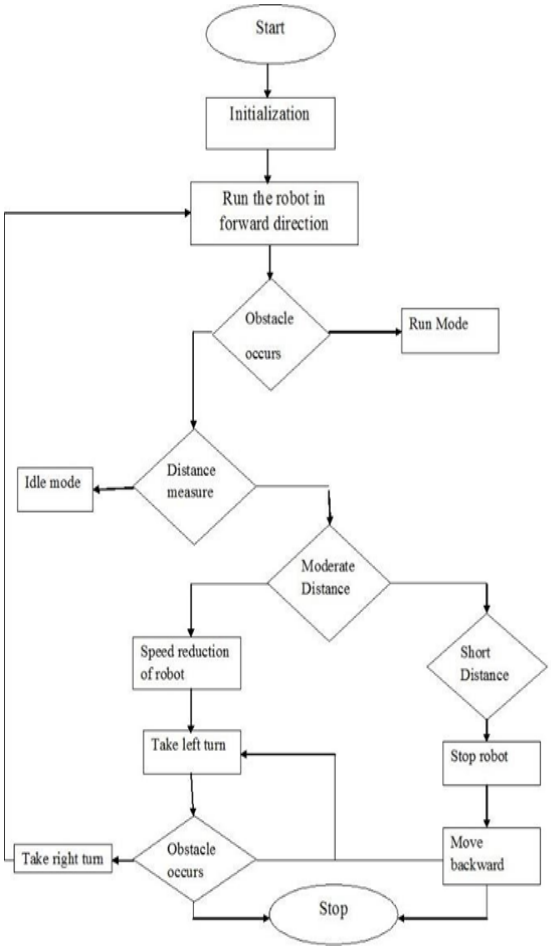


Figure 6.1:Human Following Robot(Flow Chart)

7. REFERENCES

Ø *J. Sales, R. Marín, E. Cervera, S. Rodríguez, and Javier Pérez, "Multi-sensor person following in low-visibility scenarios," Sensors 2010, 10, 10953-10966, 2010*

Ø *T. Yoshimi, M. Nishiyama, T. Sonoura, H. Nakamoto, S. Tokura, H. Sato, F. Ozaki, N. Matsuhira, and H. Mizoguchi, "Development of a person following robot with vision based target detection," International Conference on Intelligent Robots and System, pp. 5286-5291, 2006.*

Ø *"A Study on Techniques of Person Following Robot"-Author:Muhammad Najib Abu Bakar,Faculty of Computer Science and InformationTechnology, University Selangor, Malaysia,2015*