Title: Human Following Robot Using Arduino

Author Name:

1.Ashik ED
2.Irashad Khazi
2. Dr. Puja Shashi

Designation:

1) **Student, MCA III sem, The Oxford College of Engineering, Bommanahalli, Bengaluru**
2) **Student, MCA III sem, The Oxford College of Engineering, Bommanahalli, Bengaluru**
3) **Associate Professor, MCA Department, The Oxford College of Engineering, Bommanahalli, Bengaluru**

Email ID:

1) **ashikedmca2023@gmail.com**
2) **irashadkhazimca2023@gmail.com**
3) **drpujashashi@gmail.com**

Abstract: *Humanoid robotics is an emerging research field that has received significant attention during the past years and will continue to play an important role in robotics research and there is a need of robot such a "A Human Following Robot" that can interact and co-exist with them. Because of its human following capability, these robots can work as assistants for humans in various situations. In this paper we present we spent a prototype that uses Arduino Uno along with basic sensors such as ultrasonic and IR sensor. All the processing is carried out by the microprocessor while the control of the motors is carried out by the controller. This robot can further be modified by using many technologies such as Bluetooth, Pixy Camera etc.*

Keywords: Artificial Intelligence, Human following, Human tracking, Ultrasonic sensor, IR Sensor, Arduino Micro Controller.

I. INTRODUCTION

Robotics 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 significantly due to industrial, medical and military applications. In various fields with harsh environment such as underground mining, war-zones, medical, construction, space exploration etc. The work done by one is extremely dangerous. Life of individuals assisting are also put at risks. Tasks performed by humans have its own limitations in many ways. In order to perceive beyond the human limitation in vision, speed, consistency, flexibility, quality etc. We should make use of robots. A key requirement for these robots is the ability to detect humans and to interact with the min non-technical way. 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:

- The robot must be capable of accurately follow a person.
- It should be capable of taking various degree of turns
- The robot must be insensitive to environment factors such as noise.
- The robot must be capable to avoid collision.

II. LITERATURE SURVEY

"Design and Implementation of Human Following Robot Using Arduino and Ultrasonic Sensors" by K. Manikandan and S. Bharathidasan (2016): This paper discusses the design and implementation of a human-following robot using Arduino and ultrasonic sensors. The robot uses two ultrasonic sensors to detect the distance between itself and the person and to avoid obstacles. The results showed that the robot was able to follow the person successfully.

"Development of a Human Following Robot using Arduino" by M. Aslam and A. Baig (2019): This paper presents the development of a human-following robot using Arduino and a distance sensor. The robot is designed to follow a person in front of it and maintain a safe distance from the person. The study showed that the robot was able to follow the person successfully.

"Human Following Robot with Arduino and Infrared Sensor" by A. Ataei and M. Khayati (2018): This paper presents the design and implementation of a human-following robot using Arduino and an infrared sensor. The robot is designed to detect the position of a person using the infrared sensor and follow the person. The results showed that the robot was able to follow the person successfully.

"Design and Implementation of a Human Following Robot Using Arduino and LDR Sensor" by S. Sahoo and S. S. Das (2017): This paper discusses the design and implementation of a human-following robot using Arduino and an LDR (Light Dependent Resistor) sensor. The robot is designed to follow the person based on the change in light intensity caused by the person's movement. The study showed that the robot was able to follow the person successfully.

Conclusion: The literature survey shows that there is a considerable amount of research on Human Following Robot using Arduino. Different types of sensors such as ultrasonic sensors, infrared sensors, LDR sensors, and distance sensors have been used to detect the person's position and movement. The studies showed that the robots were able to follow the person successfully, and some of them also incorporated obstacle avoidance. These studies can be useful for further development of Human Following Robots using Arduino for various applications.

III. PROBLEM STATEMENT

3.1 Existing System

In the existing system, Human Following Robots are developed using various sensors and algorithms. These robots use different types of sensors such as ultrasonic sensors, infrared sensors, LDR sensors, and distance sensors to detect the person's position and movement. The robot's movement can be controlled using servo motors and wheels, and the Arduino microcontroller can be used to control the robot's behavior and process sensor data. The existing systems have been successful in demonstrating the concept of Human Following Robots using Arduino, but there are some limitations to the current systems. Some of the limitations include:

Limited range: Most of the existing systems have a limited range of operation, and the robot can only follow the person within a specific distance.

Limited accuracy: The accuracy of the sensors used in the existing systems is limited, and the robot may have difficulty detecting the person's movement in some situations.

Limited obstacle avoidance: Some of the existing systems have limited obstacle avoidance capabilities, and the robot may have difficulty avoiding obstacles on its path.

3.2 Proposed System

The proposed system aims to address the limitations of the existing system by using advanced sensors and algorithms. The proposed system will use a combination of sensors such as ultrasonic sensors, infrared sensors, and LIDAR sensors to detect the person's position and movement with high accuracy. The robot will also be equipped with advanced obstacle avoidance capabilities using LIDAR sensors and machine learning algorithms.

In addition, the proposed system will use advanced machine learning algorithms to improve the robot's movement and behavior. The robot will learn from the person's movement patterns and adjust its speed and direction accordingly. The proposed system will also have a longer range of operation, enabling the robot to follow the person over a more extended distance.

Overall, the proposed system will be more advanced and sophisticated than the existing system, with better accuracy, longer range, and advanced obstacle avoidance capabilities. The proposed system will be more efficient, reliable, and effective in following and assisting people in various applications.

IV. SYSTEM CIRCUIT DIAGRAM AND COMPONENTS

4.1 Circuit Diagram

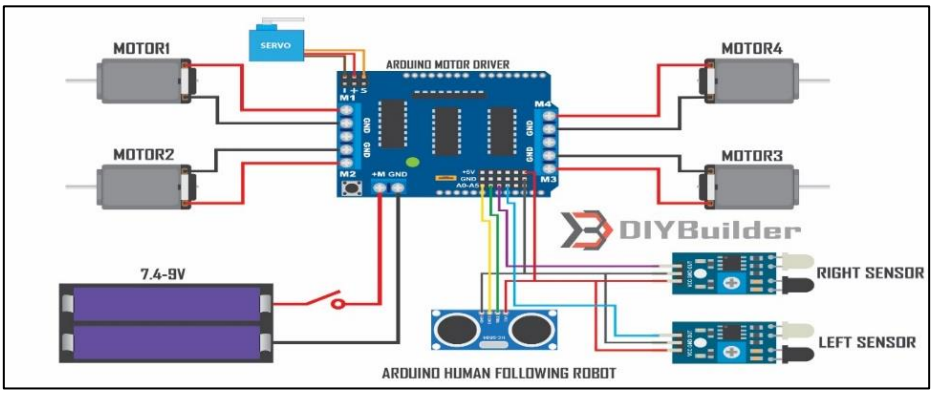

Figure 1: Human Following Robot Circuit

4.2 System Components

4.2.1 Arduino Uno

It is the brain of our project. It can give all the command to their subordinate components which should be operated by the human behavior. And it also gives feedback to the other components and human. So that it can be used as a medium of communication between human and robots and vice versa. It has specification of 8-bit CPU, 16 MHZ clock speed, 2KB SRAM 32KB flash memory, 1KB EEPROM.

4.2.2 DC Motors

DC motor is a device that converts any form of energy into mechanical energy or impacts motion. In constructing a robot, motor usually plays an important role by giving movement to the robot. Here 4 DC motors are used to drive the robot.

4.2.3 Motor Shield

The Motor Shield is a driver module for motors that allows you to use Arduino to control the working speed and direction of the motor. The Motor Shield can either be powered by Arduino directly or by an external 6V~15V power supply via the terminal input. Here Motor Driver Board is designed to work with L293D IC.

4.2.4 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 object 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.

4.2.5 IR 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 forms of thermal radiations are invisible to your 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.

V. WORKING AND DESIGN

Our system consists of a four-wheel robotic vehicle mounted with a separate microprocess and control unit along with different sensors and modules i.e., Ultrasonic sensor, Infrared sensors which helps them to move with respect to people and objects in their surroundings. The above sensors work in unison with each other and helps the robot in its operation and to navigate its path. We used ultrasonic sensor for sensing an object and to follow them to its particular path and maintain a specific objective. The ultrasonic sensor works accurately within a range of 4 meters.

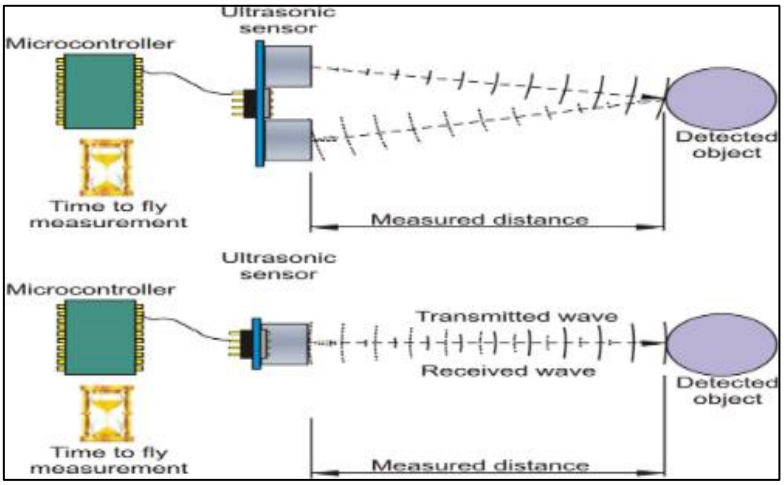

Figure 2: Ultrasonic Sensor Principle

5.1 Ultrasonic and IR Sensor Principle

This ultrasonic sensor is placed at the top of robot and pair of IR sensor are attached on either side of the ultrasonic sensor. We used ultrasonic for obstacle avoidance and to maintain a specific distance for the object. The ultrasonic sensor works accurately works accurately within a range of 4 meters. Ultrasonic sensor operates by calculating the times differences. Infrared sensors detect the object's distance wit infrared radiation when the beam from transmitter detects an object it returns to the receiver with an angle after reflection also known as method of triangulation this also helps in calculation of distance travelled by robot and eliminate any further error in the robotic movement due to displacement. IR sensor controls the movement of motors and ultrasonic sensor detects the obstacle and stops the motors.

VI. RESULTS

Different experiments were conducted and the performance and the performance of the human following robot was tested. Test was performed on the ultrasonic sensor. It was noted that the sensor was working accurately within a range of 4 meters. Then we performed the test to check whether the robot maintain a specific distance with the target object. Then we checked the serial communication between Arduino, motor shield and various motors. On the basis of results obtained from the tests and experiments, we observed that the results produced were very satisfying the robot was perfectly following the person where it goes. Hence the objective of implementing a good Human-Robot interaction was achieved.

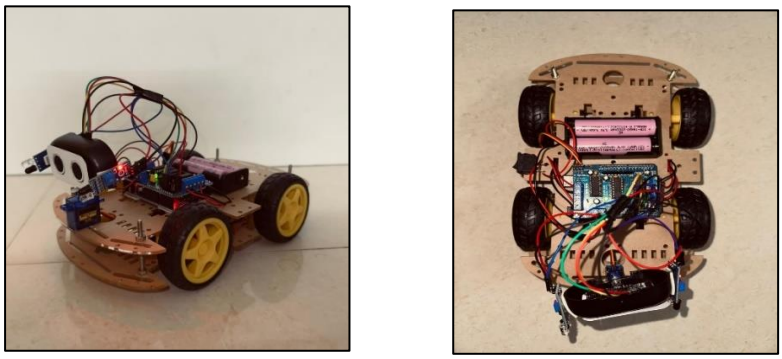

Figure 3,4: Human Following Robot

VII. APPLICATIONS

Looking deeply into environment or our surroundings, we were be able to interpret that there is a need of such robot that can assist humans and can serve them. Such a robot can be for many purposes. With a few modifications, the robot can act as a human companion as well. The tasks these kinds of robots can perform in carrying loads for people working in areas like,

Hospitals: In hospitals, the Human Following Robot can assist the medical staff by carrying equipment, supplies, and medications from one location to another. The robot can also follow patients and monitor their condition.

Shopping Malls: The Human Following Robot can assist shoppers by carrying their bags and guiding them to the stores they want to visit.

Airport Assistance: The Human Following Robot can assist passengers in airports by following them and carrying their luggage to their destination

VIII. FUTURE ENHANCEMENT

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 int 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 carry up the weights or to pull that. Similarly, some number of modifications could be done to this prototype for far and wide applications.

IX. 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 sensors that were integrated with the robot provided obstacle, move and change the robots position toward the subject in the best way to remain on its track. This project uses Arduino, motors different type of sensors to achieve its goal. This project challenged the group to co-operate, communicate, and expand understanding of electronics, mechanical system, and their integration with programming.

X. REFERENCE

1. K. Morioka, J-H. Lee, and H. Hashimoto, "Human-following mobile robot in a distributed intelligent sensor network", IEEE Trans. Ind. Electron., vol 51, no. 1, pp. 229-237, Feb. 2004.
2. Y. Matsumoto and A. Zelinsky, "Real-time face tracking system for human-robot interaction", in 1999 IEEE International conference on systems, Man, and Cybernetics, 1999. IEEE SMC '99 Conference Proceedings, 1999, col. 2, pp. 830-835 vol 2.
3. N. Bellotto and H. Hu, "Multisensory integration for human-robot interaction", IEEE J. Intel. Cybernetic. System., vol. 1, 2005.
4. Muhmmad Sarmad Hassan, MafazWali Khan, "Design and Development of Human Following Robot", 2015, Student Research Paper Conference, Vol-2, No-15.
5. H. Takemura, N. Zentaro, and H. Mizoguchi, "Development of vision-based person following module for mobile robots in/out door environment", in 2009 IEEE International Conference on Robotics and Biometrics (ROBIO), 2009, pp.