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Human Following Robot Using Arduino

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ABSTRACT

This project focuses on the development of a human-following robot using an Arduino-based platform. The robot utilizes ultrasonic sensors, infrared sensors, and a servo motor to detect and follow a human within a defined range. The system operates through a combination of real-time sensor data processing and simple algorithms implemented on the Arduino microcontroller. The ultrasonic sensors measure the distance between the robot and the human, while infrared sensors help in detecting the movement and direction of the human. Based on the inputs received, the robot adjusts its movement to follow the person at an optimal distance, ensuring safe and efficient navigation in a variety of environments. The project demonstrates the potential of Arduino in creating autonomous robots for applications in personal assistance, elderly care, and automated service systems. This design emphasizes simplicity, cost-effectiveness, and reliability, showcasing the feasibility of building a functional human-following robot using readily available components. The most important factor for an autonomous robot is to have a continuous interaction between the person and the robot itself. The improvement of science and technology has led to many change in our lifestyles.Our project is about a robot that autonomously follows human assisting them providing the necessary help needed. Using the latest technology in most of the applications like robot, military, space research etc.

Keywords :
- **Motion tracking**
- **Robotics**
- **Wireless control**
- **Autonomous systems**
- **Personal assistant robot**
- **Mobile robotics**

INTRODUCTION

The development of autonomous robots has gained significant interest in recent years, with applications spanning from industrial automation to personal assistance. One such application is the human-following robot, which is designed to autonomously track and follow a person in real-time. This type of robot is particularly useful in various fields, including healthcare, service industries, and personal assistance for elderly or disabled individuals. By using sensors to detect the presence and movement of a human, the robot can adjust its motion to keep a safe and comfortable distance from the person.

In this project, we explore the creation of a human-following robot powered by an Arduino microcontroller**.** Arduino, known for its simplicity and accessibility, serves as the central controller for the robot's sensors and actuators, making it an ideal choice for building cost-effective, functional robots. The robot uses ultrasonic sensors to measure the distance between itself and the human target**,** infrared sensors for detecting motion, and movement accordingly.

The robot is programmed to continuously monitor the surroundings, using the sensor data to decide the robot's actions. When the human moves, the robot alters its path to stay within a predefined range, ensuring smooth and safe following behavior.

LITERATURE SURVEY

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 alog‟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. 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

METHODOLOGY

Creating a human-following robot using Arduino can be a fun and educational project! This kind of robot typically relies on sensors to detect and follow a human. The methodology involves combining several components, such as ultrasonic sensors, motors, and a microcontroller (Arduino). Here's a general guide on how to build it.

Materials Needed:

1. Arduino Uno (or any compatible Arduino board)
2. Ultrasonic Sensor (e.g., HC-SR04) for distance measuring
3. DC Motors with wheels (for movement)
4. Motor Driver (e.g., L298N) to control the DC motors
5. IR Sensors or Color Sensor for tracking the human (optional, depending on method)
6. Power Supply (e.g., battery pack)
7. Jumper Wires
8. Chassis (robot frame)
9. Breadboard (for easy connections)
10. Optional: Bluetooth module (for remote control functionality)

Step-by-Step Methodology:

1. Setting up the motors

The robot will move using two DC motors. Connect these motors to a motor driver (like the L298N), which will allow the Arduino to control their direction and speed.

Connect two DC motors to the output pins of the L298N motor driver.Connect the motor driver input pins to Arduino pins (for controlling motor direction and speed).

2. Setting up the ultrasonic sensor for human detection

The ultrasonic sensor (HC-SR04) will be used to detect the distance between the robot and the human. When the distance is within a certain threshold, the robot will follow.

3. Writing the Arduino Code

The basic logic for the robot to follow a human involves:

- Reading the distance from the ultrasonic sensor.
- Moving the motors based on the distance (if the robot is too far, move forward; if too close, move backward).
- Stopping or turning based on the sensor readings.

4. Testing and Calibration

- Power on your robot and upload the code to the Arduino.
- Test the robot by moving an object (like a person) in front of the ultrasonic sensor and check if it follows the object based on distance.
- Adjust the thresholds in the code for how close or far the robot needs to be to take action (move forward, backward, or stop).

5. Optional Enhancements

- Use IR Sensors or a Color Sensor to improve the robot's tracking. This could help the robot follow a person based on infrared or color signals.
- Bluetooth Control: Add a Bluetooth module (e.g., HC-05) for remote control, so you can manually override the robot's movements.
- More advanced sensors: You can also integrate cameras or depth sensors (e.g., an OpenCV system) for more precise following in more complex environments.

BLOCK DIAGRAM OF SYSTEM

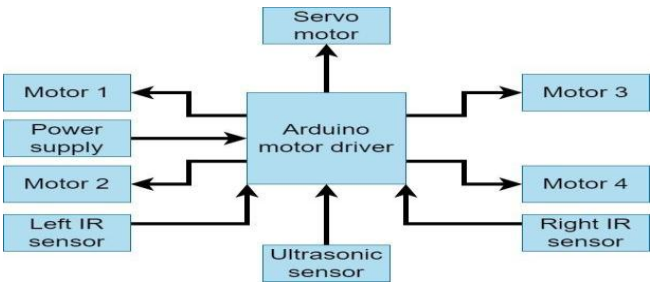

Figure 1: Block Daigram Of Project

A human-following robot using Arduino typically involves using sensors to detect the human's position and actuating the motors to follow them. The basic system can be divided into several key modules, such as sensors, actuators, microcontroll

1. Microcontroller (Arduino):

Purpose: The Arduino is the brain of the robot. It processes input from the sensors and controls the motors based on that input. Common Arduino models like Arduino Uno or Arduino Nano are used in such projects.

Role: The microcontroller reads sensor data and processes the information to control the motors, allowing the robot to follow the human.

2. Sensors:

Ultrasonic Sensors: These sensors (such as HC-SR04) measure the distance between the robot and the human. Typically, two ultrasonic sensors are placed at the front of the robot to detect obstacles and the person.

Left and Right Ultrasonic Sensors: To measure the distance to the left and right of the robot. If one sensor detects a closer object (i.e., the person), the robot can adjust its direction to follow.

IR Sensors (optional): Infrared sensors can also be used to detect obstacles and provide additional data for the robot's movement.

Camera (optional): In some advanced designs, a camera (like a Pi Camera with a Raspberry Pi) can track the human's position using computer vision algorithms. However, for simpler robots, ultrasonic or infrared sensors are sufficient.

3. Motor Driver and Motors:

Motor Driver (L298N): A motor driver (e.g., L298N) is used to control the direction and speed of the DC motors based on the signals from the Arduino. The Arduino sends PWM (pulse-width modulation) signals to the motor driver.

DC Motors: These motors are used to move the robot. The Arduino controls the direction and speed of the motors to make the robot move towards or away from the detected human.

4. Power Supply:

Battery Pack: The robot needs a power source, which is typically a battery pack (e.g., 12V Li-ion or 18650 cells). The Arduino and motors are powered from this battery pack.

Voltage Regulators: Ensure that each component gets the appropriate voltage (e.g., 5V for Arduino, and 12V or more for motors.

CONCLUSION

A human-following robot using Arduino is a fascinating project with applications in personal assistance, industry, healthcare, and logistics. It demonstrates the potential of embedded systems, sensors, and automation in real-world scenarios.

While the project is cost-effective and customizable, it has some limitations, such as sensor accuracy, limited tracking range, and battery constraints. However, these challenges can be addressed using advanced tracking techniques like AI-based vision, LiDAR, or machine learning.

Overall, this robot serves as an excellent learning platform for students and researchers while also having practical applications in smart mobility, warehouse automation, and assistive robotics. With further enhancements, it can be a more intelligent and reliable system for real-world tasks.

REFERENCE

1. Beginner-Friendly Books on Arduino & Robotics

📖 "Arduino for Beginners: Essential Skills Every Maker Needs" – John Baichtal

- Covers basic Arduino programming, sensors, and motor control.

📖 "Arduino Robotics" – John-David Warren, Josh Adams, Harald Molle

- Focuses on building different types of robots using Arduino.

📖 "Make: Getting Started with Arduino" – Massimo Banzi, Michael Shiloh

- Written by the co-founder of Arduino, this book is great for beginners.

2. Books on Sensor-Based Robotics

📖 "Learning Robotics Using Python" – Lentin Joseph

- Covers sensor integration, AI, and tracking with OpenCV (good for advanced tracking).

📖 "ROS Robotics Projects" – Lentin Joseph

- If you want to integrate AI and LiDAR, this book helps with ROS (Robot Operating System).

📖 "Practical Arduino Engineering" – Harold Timmis

- A good book for interfacing sensors, motors, and automation.

3. AI & Computer Vision for Advanced Tracking

📖 "Arduino + OpenCV for Computer Vision Applications" – Examples from OpenCV documentation

- Learn how to track humans using cameras instead of just ultrasonic sensors.

📖 "Programming Computer Vision with Python" – Jan Erik Solem

- Helps in adding AI-based object/human tracking to your project.

4. Online Resources & Tutorials

If books are not enough, check out:
🔗 Arduino Official Website – https://www.arduino.cc/
🔗 Adafruit & SparkFun Tutorials – Great for sensor integration.
🔗 MIT OpenCourseWare (OCW) on Robotics