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Human Following Robot

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ABSTRACT
Human-following robots have been actively researched and developed due to their diverse applications. These robots require techniques such as human target detection, robot control algorithms, and obstacle avoidance. Various approaches have been proposed, including ultrasonic sensors, voice recognition, laser range sensors, and CCD cameras. A robot that can assist in carrying items with greater accuracy and efficiency would be invaluable. For example, in hospitals, such a robot could bring medical items during emergencies, potentially saving lives. This robot could mimic human movements, making it intuitive to interact with. In this project, infrared sensors move the robot in both directions, and an ultrasonic sensor enables forward and reverse movement. The Arduino Uno microcontroller controls the robot's motors. The goal is to improve lives by introducing robots that autonomously sense and follow humans while avoiding obstacles. This technology has the potential to revolutionize industries and become a significant trend.
Keywords: Ultrasonic sensors, CCD cameras, Arduino Uno microcontroller

I. INTRODUCTION
In our technology-driven world, robots known as "Human Following Robots" are designed to detect and track humans within a specific range. These robots are revolutionizing daily life, offering convenience and efficiency in various settings. For example, they excel in shopping scenarios by autonomously carrying items and following humans without the need for manual control. In healthcare, they play a crucial role in swiftly and accurately delivering medicines. Human-following robots are versatile, serving as trolleys, stretchers, or even small baskets attached to cars. As society increasingly integrates robots into daily life for added luxury, these robots are becoming more prominent. They utilize IR sensors to efficiently track and follow humans, enhancing productivity and reducing task completion times. These robots also hold potential in defence applications, where they can be utilized to carry weapons for soldiers. With their ability to automatically sense obstacles andhumans, they could be integrated into vehicles in the future. By adding components such as cameras and tracking devices, these robots can be enhanced both aesthetically and functionally, making them a significant trend in future robotic technology.

II. SYSTEM CIRCUIT DIAGRAM AND COMPONENTS

2.1 Circuit Diagram

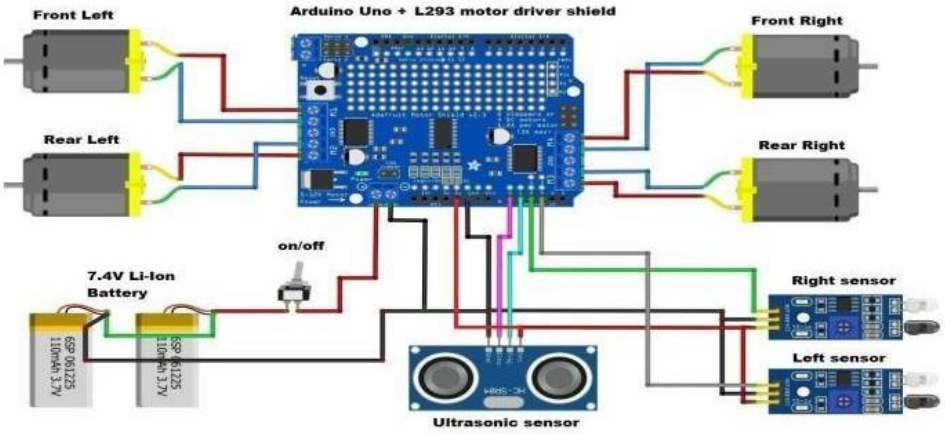

Figure 1: Human Following Robot Circuit

2.2 SYSTEM COMPONENTS

2.2.1 Arduino Uno:

The Arduino Uno is a microcontroller board based on the ATmega328P chip. It features 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, and a reset button. The board can be powered via the USB connection or with an external power supply. One of the key features of the Arduino Uno is its ease of use and versatility, making it suitable for a wide range of projects, from simple blinking LED experiments to more complex robotics and automation projects. It can be programmed using the Arduino IDE (Integrated Development Environment).

2.2.2 L298N Motor Driver:

The L298N is a dual H-bridge motor driver integrated circuit (IC) that is commonly used to control DC motors and stepper motors. It can drive motors with voltages ranging from 5 to 35 volts and currents up to 2 amperes per channel. The L298N is easy to use and can be controlled with a wide range of microcontrollers, making it ideal for robotics and motor control projects.

2.2.3 IR Sensors:

The IR sensor is an electronic device that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensor can detect these radiations. The emitter is simply an IR

2.2.4 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 40 kHz which travels through the air and if there is an obstacle or object, it will bounce back to the sensor. By calculating the travel time and the speed of sound, the distance can be calculated.

2.2.5 DC Motor:

A DC motor is a type of electric motor that runs on direct current (DC) electricity. It consists of a stator (stationary part) and a rotor (rotating part) connected to an output shaft. When electric current is passed through the motor, it generates a magnetic field that interacts with the magnetic field of the stator.

III. APPLICATIONS

Human-following robots have several potential applications across various industries and settings. Some notable applications include:

- Retail and Shopping Malls: Robots that can follow customers can assist them in finding products, provide information about discounts or promotions, and even carry their shopping bags.
- Hospitality: In hotels and resorts, human-following robots can serve as guides, providing information about facilities, guiding guests to their rooms, or delivering items such as towels or room service orders.
- Healthcare: In hospitals or care facilities, these robots can assist medical staff by carrying supplies or equipment, or guiding patients and visitors to their destinations.
- Events and Conferences: Human-following robots can be used to guide attendees to different sessions, provide event information, or even act as interactive displays.

IV.WORKING AND DESIGN

Our system comprises a four-wheel robotic vehicle equipped with a separate microprocessor, control unit, and various sensors and modules, including ultrasonic and infrared sensors. First, construct the frame or chassis as required, then arrange the components according to the circuit diagram. Connect the ultrasonic sensor's trigger pin to Arduino pin A2 and the Echo pin to pin A1. The left IR sensor should be connected to pin A3. The servo motor connects to pin 10 of the Arduino.For the motor driver (L293D), connect pins 1, 8, 9, and 16 to the +5V pin, and pins 4, 5, 10, and 11 to the ground pin. Connect pin 2 of the motor driver to pin 4 of the Arduino, and pin 7 of the Arduino to pin 10 of the motor driver.

Finally, connect pin 8 of the Arduino to pin 15 of the motor driver.Connect the motors as follows: motor 1 to pins 1 and 2, motor 2 to pins 3 and 4, motor 3 to pins 5 and 6, and motor 4 topins 7 and 8 of the motor driver shield.

4.1 Ultrasonic and IR Sensor Principle

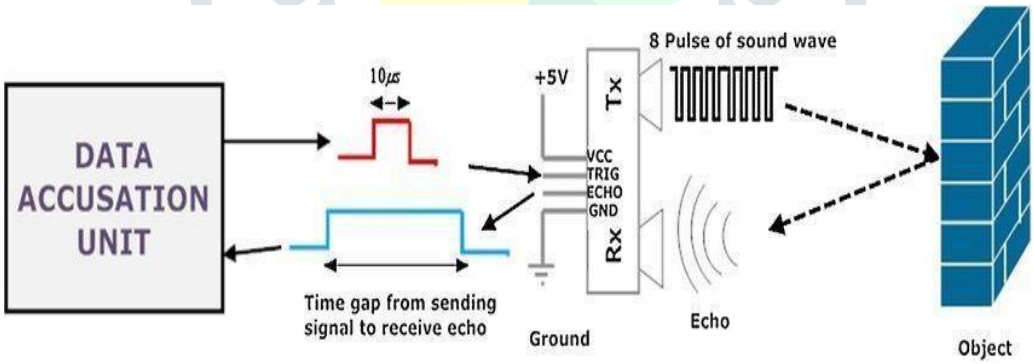

Figure 2: Ultrasonic Sensor Principle

The ultrasonic sensor is utilized for obstacle avoidance and maintaining a specific distance from objects, operating accurately within a 4-meter range. Ultrasonic sensors function by calculating time differences. This helps calculate the distance traveled by the robot and corrects any errors in robotic movement caused by displacement. The IR sensor controls the motor movement, while the ultrasonic sensor detects obstacles and halts the motors.

V. RESULTS

After successfully completing the human following robot, which can track objects and humans, we conducted tests on the ultrasonic and infrared sensors. The sensors were found to work accurately within a range of 10 cm. The ultrasonic sensor controls the robot's forward and backward movements, while the infrared sensors control its left and right movements. We also tested the serial communication between the Arduino, motor shield, and various motors. During the project, we faced numerous challenges, particularly with the program code, which contained a large number of errors that needed rectification. Additionally, there were issues with the motor drivers' connections being interchanged, but these were

resolved, and the robot functioned correctly. After much effort and time, we achieved our objective of implementing effective human-robot interaction.

Through various experiments, we tested the performance of the human following robot. The sensors were tested for their accuracy within a 4-meter range, and the robot's ability to maintain a specific distance from the target object was assessed. Based on the test results, we made necessary adjustments to the processing and control algorithm. The final result was highly satisfying, as the robot effectively followed a person wherever they went, achieving our goal of successful human-robot interaction.

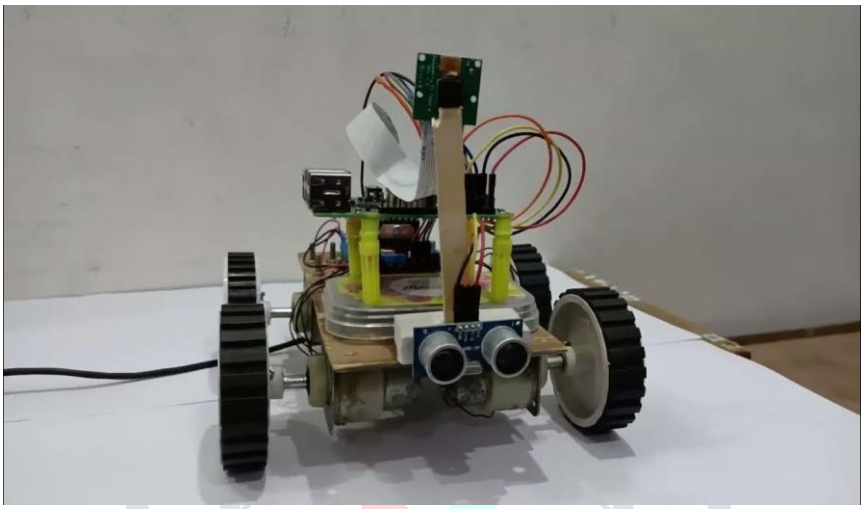

Figure 3: Human Following Robot

VI. 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. Eg 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.

VII. CONCLUSION

The research on this robot has various intriguing applications across different fields, including military and medical sectors. Adding wireless communication capabilities would enhance its versatility, allowing remote control from a considerable distance. This feature could be particularly valuable for military applications. By equipping the robot with a real-time video recorder, we can monitor surroundings remotely. Modifications in the algorithm and structure could tailor the robot for other purposes, such as a vehicle follower or a luggage carrier in shopping malls. The robot would autonomously follow a designated person, eliminating the need for manual labor.

The robotics field is evolving rapidly, and this Object Following Robot could be enhanced with a GSM module to provide its location or configured with wireless remote controls for manual or automatic object following.

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