Arduino-Based Human Following RoBot

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CERTIFICATE OF APPROVAL

This is to certify that the project titled "**Arduino-Based Human Following RoBot**" carried out by

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for the partial fulfillment of the requirements for B.Tech degree in **Electronics and Communication Engineering** from **Maulana Abul Kalam Azad University of Technology, West Bengal** is absolutely based on his/her own work under the supervision of Mr. **Subhrajit Sinha Roy**. The contents of this report, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

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Table of contents

Introduction

In an era of advancing robotics and automation, the development of intelligent systems capable of interacting with humans in dynamic environments has become increasingly significant. One such example is the Arduino-based human-following bot, a project that combines hardware, software, and robotics principles to create a mobile robot capable of autonomously tracking and following a human target. This project harnesses the power of Arduino microcontrollers, sensors, and actuators to enable the bot to perceive its surroundings, detect human presence, and navigate towards the target while maintaining a safe distance.

This project revolves around the creation of a mobile robot equipped with sensors and actuators, empowered by an Arduino microcontroller. Its primary objective is to autonomously track and follow a human target, demonstrating the potential for practical applications in fields such as assistance robotics, surveillance, and interactive installations.

By integrating sensors for human detection, motor control mechanisms for mobility, and sophisticated algorithms for decision-making, the Arduino-based human-following bot exemplifies the convergence of embedded systems, robotics, and artificial intelligence. It represents a tangible embodiment of the pursuit to bridge the gap between humans and machines, showcasing the potential for harmonious coexistence in a technologically driven world.

By fostering a deeper understanding of human-robot interaction, the Arduino-based human-following bot stands as a testament to the transformative power of technology in shaping the future of human-machine collaboration.

Literature Review

J. H. Lee, T. Tsubouchi, K. Yamamoto, and S. Egawa,

Different algorithms are being developed by the researchers for the detection purposes. Laser was used in one research to find the style of the moving legs and a camera was used to detect a object or aperson. A very simple technique was also used by researchers. In this technique, the person used distance sensors on the robot and the person. These sensors emitted radio waves and were detected bythe sensors on the person to be followed. This way the robot followed the required target.

K. Morioka, J-H. Lee, and H. Hashimoto,

Depth imaging, utilized by Calisi, and their targeted pursuit through a specially designed algorithm showcase significant strides in object tracking and detection. Their approach stands out for its efficacy even in intricate environments. This innovation likely heralds advancements in fields like robotics, surveillance, and augmented reality, where robust detection and tracking capabilities are paramount.

K.B Kharka, T.R.W Bhutia, Lalita Chettri, Neetes Luitel, Roshan Subba, Eshant Giri, Samuel Lepcha from International Research Journal of Modernization in Engineering Technology and Science (IRJMETS). They had 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 they test theserial communication of Arduino, motor shield, and various motors . They 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 which was rectified and their robot works perfectly fine. Finally, after the lots of effort and time their objective was achieved which was to implement a good Human-Robot interaction.

N. Belloto, H.Hu,

The study concluded that multisensor integration is crucial for enhancing human-robot interaction. By combining data from different types of sensors, the robot can achieve more reliable and accurate human detection and tracking. This approach addresses several challenges associated with single-sensor systems, such as occlusion and environmental variability. The research showed that multisensor fusion is an effective strategy for developing autonomous robots capable of seamless interaction with humans in dynamic and unstructured environments.

D. Sati, S. Avkirar and R.Pandey,

The project highlights the importance of precise sensor placement and fine-tuning parameters like motor speed and distance thresholds to optimize performance. Overall, the research validates the feasibility of creating affordable and efficient human-following robots using readily available components and simple programming.

Method/Experiment

- The Requirements to create the project are Arduino, Motor Driver(L298n), 300rpm Johnson DC Motors, 2 IR Sensors, 1 Ultrasonic Sensor, Chasis and Wheels and Jumper Wires.

- The robot begins by initializing its motor and sensor pins for output and input, respectively. It sets the motor control pins to output to allow for controlling motor direction and speed and initializes the IR sensor pins to input to read the sensor values. The motors are initially stopped to ensure the robot does not move until intended.

- In the main loop, the robot continuously measures the distance to objects in front using an ultrasonic sensor. The ultrasonic sensor emits a sound wave and calculates the time it takes for the wave to bounce back, converting this time into a distance measurement. Simultaneously, the robot reads the states of two infrared sensors. These sensors detect nearby objects by returning a low signal when an object is present and a high signal when no object is detected.

- Based on the sensor readings, the robot decides its movement. If the right infrared sensor detects an object while the left one does not, the robot turns right. It achieves this by decreasing the speed of the right motor and increasing the speed of the left motor, making the robot pivot towards the right. Conversely, if the left infrared sensor detects an object while the right one does not, the robot turns left by increasing the speed of the right motor and decreasing the speed of the left motor, causing it to turn towards the left.

- If the ultrasonic sensor detects that the distance to an obstacle is within a specific range, the robot moves straight ahead. It does this by setting both motors to move forward at a constant speed, ensuring the robot travels in a straight line. If the distance is outside this range or if no specific turning condition is met, the robot stops by setting both motor speeds to zero.

- The motor control function adjusts the direction and speed of the motors based on the input speeds. For the right motor, a negative speed sets the

motor to reverse, a positive speed sets it to move forward, and zero stops it. The left motor follows the same logic. This method ensures smooth operation, allowing the robot to respond appropriately to the sensor inputs and navigate its environment effectively.

- We have coupled the Motor Driver(L298n) with four 300rpm Johnson Motors with the required connections using jumper wires. This setup provides the necessary control and power distribution for the motors, allowing them to drive the robot's movement effectively.
- We have established the required connections with the IR sensors (to sense the heat that our body radiates) and Ultrasonic Sensors (to detect the obstacles).
- Now we upload the code in arduino according to our algorithm.

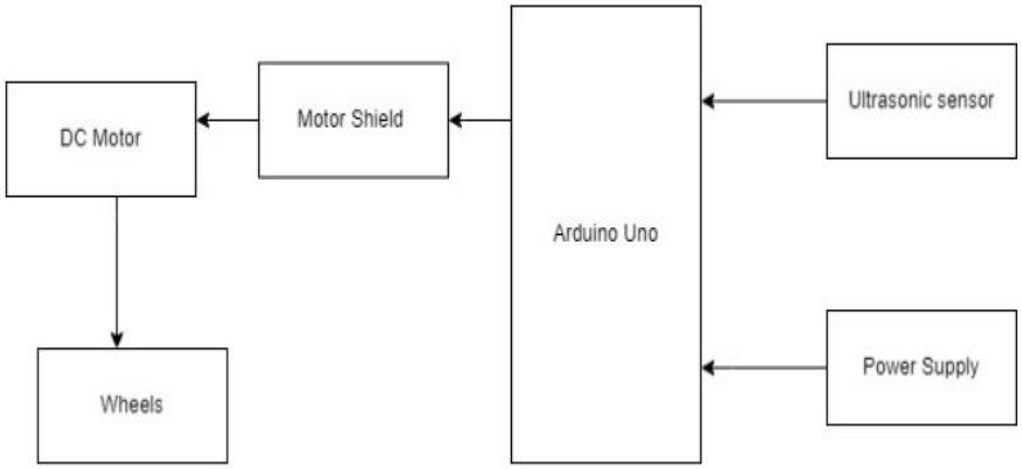

Fig. 1

Block Diagram of Proposed System

Result and Discussions

Test was performed on the ultrasonic and infrared sensor. Then we performed the test to check whether the robot maintains 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 these tests and experiments, we made the necessary changes in the processing and control algorithm. After the completion, we observed that the results produced were very satisfying the robot was perfectly following the person wherever it goes.

Conclusion

The Arduino-based Human Following Bot project demonstrates the practical application of robotics and sensor technology to create a responsive, autonomous system capable of tracking and following a human subject. By integrating ultrasonic sensors, motor drivers, and an Arduino microcontroller, the bot successfully detects and maintains a safe distance from the target, showcasing its potential for use in various assistive and personal robotic applications. The project highlights the effectiveness of combining basic electronic components with programming to achieve complex, real-world functionality, underscoring the versatility and accessibility of Arduino platforms for innovative DIY robotics projects.

Future scope

Arduino-based Human Following Bot is quite promising, with numerous avenues for enhancement and modification.

- **Wireless Communication**: Implement wireless communication capabilities (e.g., Bluetooth, Wi-Fi) to enable remote control or monitoring of the bot from a smartphone or computer. This would allow for greater flexibility in controlling the bot and accessing real-time data from its sensors. 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.

- **Autonomous Navigation**: Implement algorithms for autonomous navigation and mapping, allowing the bot to explore and navigate its environment without human intervention. This could involve techniques such as SLAM (Simultaneous Localization and Mapping) to build a map of the environment and localize the bot within it.

- **Multi-bot Coordination**: Explore the possibility of coordinating multiple Human Following Bots to work together collaboratively. This could involve communication between bots to avoid collisions, divide tasks, or cooperate on complex objectives.

- **Disaster Management :** To track trapped human inside a collapsed building or in a tunnel due to natural calamities instead of Sniffer Dogs.

- **Improved Tracking Algorithms**: Enhance the bot's tracking capabilities by incorporating advanced computer vision algorithms or machine learning techniques. This could enable the bot to track multiple targets simultaneously, recognize gestures or specific individuals, and navigate complex environments more efficiently.

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