

Human Following Robot Using Arduino Uno

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Abstract

A human-following robot is a mobile autonomous system designed to detect, track, and follow a specific individual in real-time while navigating through dynamic environments. This feature is essential for various applications, including delivery services, healthcare assistance, personal support, and collaborative industrial operations. It enhances efficiency, safety, and user experience by enabling intelligent and responsive interactions, making it an asset in both commercial and personal environments. The robot integrates cameras, LiDAR, ultrasonic sensors, and GPS with computer vision and machine learning algorithms to detect and follow its target accurately. These technologies work together to ensure smooth navigation and effective obstacle avoidance, enabling reliable performance in various environments and dynamic real-world conditions. This study details the development of a robust human-following robot capable of real-time target tracking, adaptive path planning, and safe autonomous navigation. The robot employs integrated sensor systems and intelligent algorithms to ensure accurate and consistent following behaviour. Emphasis is placed on maintaining stability and responsiveness, even in dynamic environments. Experimental validation was conducted in both indoor and outdoor settings, accounting for diverse lighting conditions and varying crowd densities. The results confirm the system's reliability and effectiveness, demonstrating strong potential for applications in personal assistance, security patrol, and service robotics in complex, real-world environments.

Keywords: Arduino UNO, IR sensor, ultrasonic sensor, lithium-ion battery, motor shield, servo motor, DC motor, battery holder, acrylic sheet, metal base

INTRODUCTION

Human-following robots have emerged as a significant area of research in mobile robotics, aiming to create intelligent systems that can autonomously follow and interact with humans in real-world environments. These robots are particularly useful in applications such as elder care, hospital assistance, baggage handling, and collaborative work in warehouses. The core challenge lies in enabling the robot

to accurately detect and track a specific person while navigating through dynamic spaces [1–5]. To achieve reliable human-following, the robot must integrate multiple technologies, including object detection, real-time tracking, motion prediction, and autonomous navigation. Sensors such as RGB cameras, depth sensors, LiDAR, and ultrasonic rangefinders provide environmental awareness, while software algorithms interpret human movements to determine the robot's path [6–9]. This project focuses on developing a robust human-following robot that operates in both indoor and outdoor settings. The system is designed to maintain a safe and consistent distance from the target, adapt to speed changes, and avoid obstacles in real time. Through this research, we aim to contribute to the

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field of socially assistive robotics.

LITERATURE SURVEY

A study proposed personal robotic assistants to facilitate natural human-machine interactions [7]. Researchers focus on advancements in automation that allow robots to interact seamlessly with humans for mobility support and household help. However, many systems lack physical functionality, such as dexterous manipulation in complex environments. This work serves as a foundation for enhancing hardware and software to make robotic systems more effective. Additionally, a model has been developed [10–14]. Another study introduced a novel vision-based system for human-following robots, crucial for service robotics. The proposed robot uses visual cues to track a human, demonstrating real-time responsiveness to environmental changes. This approach is based on computer vision algorithms that maintain accurate tracking, laying the groundwork for autonomous robots in elderly care and collaborative work environments.

SUGGESTED TECHNIQUE

Using a variety of sensors and control algorithms, a human-following robot tracks and follows a person autonomously. It typically employs cameras, LiDAR, infrared, or ultrasonic sensors to identify the target. Image processing or machine learning techniques assist in recognizing tracking movements [15–19]. The robot calculates the target's position and adjusts its path using control methods like PID or fuzzy logic. Obstacle detection and avoidance are integrated for safe navigation. This methodology enables applications in healthcare and logistics. Figure 1 showcases the block diagram of the proposed system.

The human-following robot works by detecting and tracking a person using sensors such as cameras or ultrasonic modules [20]. These sensors gather information about the target's location in real time. The robot's onboard processor interprets this data and sends commands to the motors to adjust speed and direction.

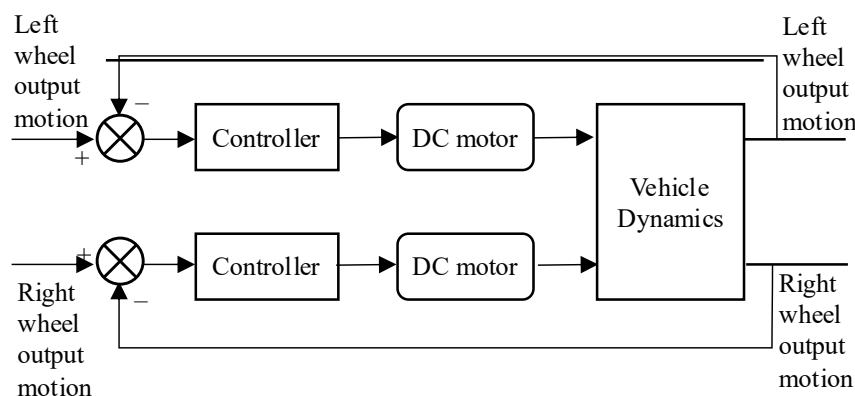


Figure 1. Block diagram of the proposed system.

- *Working: Ultrasonic Sensor:* An ultrasonic sensor is a proximity sensor that uses high-frequency sound waves to measure distance for obstacle identification and collision avoidance [21–24].
- *Infrared (IR) Sensor:* An IR sensor is a low-cost device used to detect objects by emitting infrared radiation. In this robot, IR sensors are used for proximity sensing.
- *Arduino Uno:* The ATmega328P microprocessor serves as the foundation for the Arduino Uno microcontroller board, a popular platform for creating interactive electronic projects.

Hardware Description

- *ARDUINO UNO:* For our robot, the Arduino Uno (Figure 2) is used for programming. It possesses a microcontroller device configured for specific tasks [25]. The motor shield controls DC and stepper motors, which is useful for power management.



Figure 2. Arduino uno.

- *IR Sensor:* An IR sensor (Figure 3) uses an infrared LED and a photodiode to detect reflected light. The detector modifies its output signal in response to objects in front of the sensor. These sensors are widely used for obstacle detection.



Figure 3. IR sensor.

The Ultrasonic Sensor

Ultrasonic sensors (Figure 4) use waves to calculate distance. A wave is emitted by the sensor head and reflected back by the target. The sensor calculates distance by measuring the time between signal release and acceptance [26–29]. This project uses it to maintain safe distance.



Figure 4. Ultrasonic sensor.

Servo Motor

- A servo motor: A servo motor (Figure 5) provides precise control of angular position, speed, and torque. Unlike DC motors, servo motors rotate to a specific position with high accuracy [30].
- *DC Motor:* The principle behind a DC motor (Figure 6) is electromagnetic induction. A magnetic field is created surrounding a conductor when an electric current passes through it, causing the rotor to move.
- *Power Supply (Lithium-ion Battery):* The flow of lithium ions (Figure 7) via an electrolyte powers the battery. During discharge, ions transfer from the anode to the cathode, releasing electrical energy.



Figure 5. Servo motor.



Figure 6. DC motor.



Figure 7. Lithium-ion battery.

Motor Shield

A motor shield (Figure 8) allows for the control of motors using a microcontroller. It provides the necessary drivers to power the motors with correct voltage levels.



Figure 8. Motor shield.

RESULTS

The Arduino Uno-powered human-following robot was tested for movement detection. Whenever the user places a hand in front, the robot recognizes the movement and follows. It is also suitable as a

shopping cart or personal assistant for transporting items between locations. Figures 9 and 10 show the final model and output.

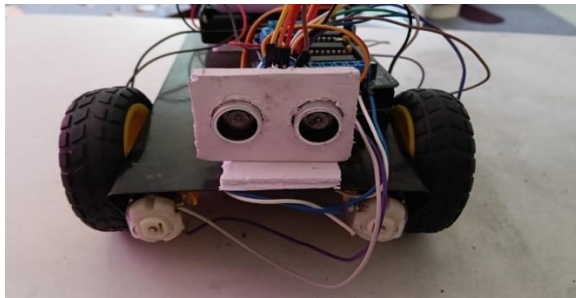


Figure 9. Results.



Figure 10. Output of human following robot.

CONCLUSIONS

The ability of the robot to track and follow a human target successfully illustrates the integration of sensor technologies and control systems. Utilizing ultrasonic sensors, microcontrollers, and motor drivers, the robot maintains a safe distance while navigating. Continued advancements can improve accuracy and obstacle avoidance in real-world scenarios.

REFERENCES

1. Godase MV, Mulani A, Ghodak R, Birajadar G, Takale S, Kolte M. A MapReduce and Kalman filter based secure IIoT environment in Hadoop.
2. Gadade B, Mulani AO, Harale AD. IoT based smart school bus and student monitoring system. *Naturalista Campano*. 2024;28(1):730–7.
3. Dhanawade A, Mulani AO. IoT based Smart farming using Agri BOT.
4. Mulani A, Mane PB. DWT based robust invisible watermarking. Scholars' Press; 2016.
5. Nagtilak AG, Ulegaddi SN, Mane M, Mulani AO. Solar Powered Pesticide Sprayer. *Int J Microwave Eng Technol*. 2023;9(2):7–18.
6. Paneru B, Paneru B, Sapkota S. Elevating Inaugurations with Robotics: Design and Development of a Bluetooth Interface-Based Ribbon-Cutting and Monitoring Robot. SSRN 4907242. Volume 20, June 2024.
7. Swami SS, Mulani AO. An efficient FPGA implementation of discrete wavelet transform for image compression. In: ICECDS. IEEE; 2017. p. 3385–9.
8. Mane PB, Mulani AO. High speed area efficient FPGA implementation of AES algorithm. *Int J Reconfigurable Embedded Syst*. 2018;7(3):157–65.
9. Kashid MM, Karande KJ, Mulani AO. IoT-based environmental parameter monitoring using machine learning. In: ICCIC 2022;1:43–51.
10. Nagane UP, Mulani AO. Moving object detection and tracking using Matlab. *J Sci Technol*. 2021;6(1):2456-5660.
11. Kulkarni PR, Mulani AO, Mane PB. Robust invisible watermarking for image authentication. In: ICECIT 2015. Springer; 2016. p. 193–200.
12. Mandwale AJ, Mulani AO. Different Approaches For Implementation of Viterbi decoder on reconfigurable platform. In: ICPC 2015. IEEE.
13. Jadhav MM, Chavan GH, Mulani AO. Machine learning based autonomous fire combat turret. *Turk J Comput Math Educ*. 2021;12(2):2372–81.
14. Shinde G, Mulani A. A robust digital image watermarking using DWT-PCA. *Int J Innov Eng Res Technol*. 2019;6(4):1–7.
15. Mane DP, Mulani AO. High throughput and area efficient FPGA implementation of AES algorithm. *Int J Eng Adv Technol*. 2019;8(4).
16. Deshpande HS, Karande KJ, Mulani AO. Area optimized implementation of AES algorithm on FPGA. In: ICCSP. IEEE; 2015. p. 0010–0014.

17. Kulkarni P, Mulani AO. Robust invisible digital image watermarking using DWT. *Int J Eng Res Technol.* 2015;4(1):139–41.
18. Jadhav HM, Mulani A, Jadhav MM. Chatbot development based on reinforcement learning. In: *ML Algorithms for Signal & Image Processing.* 2022. p. 219–29.
19. Mulani AO, Mane P. Secure and area efficient implementation of digital image watermarking. *Int J Innov Technol Exploring Eng.* 2018;8(2):56–61.
20. Kalyankar PA, Mulani AO, et al. Scalable face image retrieval using AESC technique. *J Algebraic Stat.* 2022;13(3):173–6.
21. Takale S, Mulani A. DWT-PCA based video watermarking. *J Electron Comput Netw Appl Math.* 2022:2799–1156.
22. Kamble A, Mulani AO. Google assistant-based device control. *Int J Aquatic Sci.* 2022;13(1): 550–5.
23. Kondekar RP, Mulani AO. Raspberry Pi based voice operated robot. *Int J Recent Eng Res Dev.* 2017;2(12):69–76.
24. Ghodake RG, Mulani AO. Microcontroller based automatic drip irrigation. In: *Techno-societal.* Springer; 2016.
25. Mulani AO, Birajadar G, et al. Deep learning for dermatological disease detection. *Traitement du Signal.* 2023;40(6):2819.
26. Boxey A, Jadhav A, et al. Face recognition using Raspberry Pi. *J Image Process Intell Remote Sens.* 2022:2815-0953.
27. Patale JP, Jagadale AB, Mulani AO, Pise A. Estimation of electrical vehicle parameters. *J Electron Comput Netw Appl Math.* 2023.
28. Mandwale A, Mulani AO. Implementation of convolutional encoder & Viterbi decoder. In: *IEEE Conf Commun Signal Process.* 2014.
29. Maske Y, Jagadale AB, Mulani AO. BIOBOT system for COVID patients. *Eur J Mol Clin Med.* 2023;10(1):2023.
30. Utpat VB, Karande DK, Mulani DA. Grading of pomegranate using quality analysis. *IJRASET*;10.