SYNOPSIS

G H RAISONI COLLEGE OF ENGINEERING AND MANAGEMENT

(An Empowered Autonomous Institute under UGC Act 1956 & affiliated to Savitribai Phule Pune University)

Department of Computer Science & Engineering (Data Science)

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PROJECT TITLE:

"Arduino Based Human Following Robot"

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PROJECT AREA	PROJECT PLATFORM
Internet Of Things.	***Technology:*** ARDUINO IDE

Under the Guidance of Prof. Nilamadhab Mishra

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ABSTRACT

A robot that can assist us in many different ways, such as transporting objects and completing tasks faster and more accurately than previously. A doctor will find it more useful in an emergency if there is a robot that can assist us at the hospital or carry medical supplies. This kind of robot is very advantageous and will be used in the future. It is very likely that a robot of this kind may live close to humans. This helpful endeavor aims to pursue the appropriate person or challenge. This robot moves in both directions using infrared sensors, and it moves in both directions using ultrasonic sensors. The Arduino Uno microcontroller served as the project's central nervous system. This robot has four Dc motors driving it, and an ATmega L293d motor driver shield controls it. The primary goal in creating this practical project is to improve and elevate our quality of life. In this project, a robotic automobile uses an infrared sensor to automatically detect human presence and follows the person or barrier. Future trends will favor this kind of robot as it is more practical.

Keywords: Arduino, DC gear motor, microcontroller, ultrasonic sensor, infrared sensor, and robot.

INTRODUCTION

The rise of automation and robotics has transformed many facets of contemporary life and provided creative answers to challenging issues in a wide range of industries. Human-following robots are one of the many uses for robotics that have attracted a lot of interest because to its potential in the security, help, and entertainment sectors. These robots, whose functions range from personal help to security surveillance, are made to autonomously monitor and follow a human target.

In this sense, research and invention into the creation of a human-following robot powered by Arduino appear to be quite promising. An accessible and flexible platform for robotic system development and prototyping is offered by Arduino, an open-source electronics platform built on user-friendly hardware and software. Researchers and enthusiasts can create and deploy affordable human-following robots with different levels of capability and complexity by utilizing Arduino's capabilities.

This study's main goal is to design, build, and assess an Arduino-based person-following robot that can locate and follow a human target on its own in natural settings. The robot uses a variety of sensors, including as infrared and ultrasonic ones, to determine whether the target is there and moving. The robot's control system uses the vital data from these sensors to dynamically modify its speed and direction in order to keep a consistent distance from the target.

Three main parts make up the robot: a power supply for electrical operation, an Arduino microcontroller for processing sensor data and directing motor motions, and motors for locomotion. A proportional-integral-derivative (PID) algorithm is also incorporated into the robot's control system to enhance tracking performance and guarantee accurate and seamless movement in response to changes in the target's position.

The robot also has obstacle avoidance capabilities that allow it to avoid obstacles while tracking, which improves its capacity to work independently in dynamic surroundings. This capability is essential for guaranteeing the robot's operation's safety and effectiveness, especially in congested or messy areas.

Moreover, the information gained from this study may serve as a roadmap for future advancements in human-following robot technology.

LITERATURE SURVEY

Sr no	Published Year [References]	Research Paper Name	Description
1.	(2004) [1]	Human-Following Mobile Robot in a Distributed Intelligent Sensor Network	In this work, we suggest that the robots of the near future will be human-friendly machines that can successfully assist and coexist with people. Humans and robots must be as close to one another as feasible in order for this to be realized. Furthermore, it is essential that their exchanges take place organically. Being able to follow a human is a desirable human-affinitive movement for a robot.
2	(2021) [2]	Human Following Robot Using Arduino	A rapidly developing subject of study, humanoid robots has drawn a lot of interest recently and will be crucial to robotics research and many applications in the twenty-first century and beyond. Robots that can communicate and coexist with humans, like "A Human Following Robots," are necessary in this fast-paced society. due to its capacity for human followability.

3	(2015) [3]	Design and development of human following robot	This paper describes a prototype that combines an Arduino Uno with common sensors like an infrared and ultrasonic sensor. The controller is responsible for controlling the motors, while the microprocessor handles all processing. Numerous technologies, including Bluetooth and Pixy Camera, can be used to further customize this robot.
4	(2023) [4]	Autonomous Human Following Robot Based on Follow the Gap Method	The importance of human-robot interaction has grown for a variety of applications with the latest developments in robotics and artificial intelligence. It is necessary for autonomous robots to recognize people, keep them safe, and in some situations, follow them. Numerous methods for identifying and following people have been developed. Our proposal in this study is to combine two distinct algorithms for tracking and detecting humans—the Joint Leg Tracker and the RWTH Upper Body Detector—in order to provide a more reliable method for tracking humans.
5	(2022) [5]	Human Following Robot using Kinect in Embedded Platform	The current research describes an embedded robotic system that tracks a target's movement in its environment and detects individual targets using Kinect sensor technology. The system that has been built simultaneously incorporates embedded robotics and computer vision characteristics. Since tracking is crucial to localization and mapping, a skeleton-based tracking method is used in this work. Rather than using a conventional touch-based control system that can be used as a stand-alone system or subsystem to incorporate into a larger system.

MOTIVATION

There are a variety of reasons why someone would want to build an Arduino-based human-following robot, including social, practical, technological, educational, and entrepreneurial ones. It is the result of a convergence of goals and interests in order to use technology to solve issues, spur creativity, and enhance human experience.

PROBLEM STATEMENT

The aim of this project is to create and integrate an Arduino-powered robot that can independently track a human target. The robot needs to have the following features: -

- Human Detection: The robot needs sensors that can identify whether or not a human target is in its field of vision.
- Tracking: After identifying a human target, the robot must keep a steady distance from the target while tracking its movements in real time.
- Obstacle Avoidance: The robot has to be able to follow the human target while securely navigating through its surroundings and avoiding obstacles.
- Autonomous Operation: The robot should be able to make decisions on its own, without constant human interaction, using sensor data and preprogrammed algorithms.
- Communication: The robot should be able to engage with the user, share its status, and give instructions or feedback as required.
- Cost-effectiveness: To guarantee cost and accessibility, the solution should be constructed utilizing commonly available components and Arduino microcontrollers.

Phases of hardware design, sensor integration, programming, and testing will all be involved in this project. The final objective is to build an Arduino-Based Human Following Robot prototype that can navigate autonomously and effectively while following humans and avoiding obstacles.

GOALS & OBJECTIVES

- Create an accessible and affordable Arduino-based person-following robot that can track and follow a human target on its own.
- Combine many sensors, such as infrared and ultrasonic ones, to precisely identify the target's existence and movement.
- Develop a strong control system that processes sensor data and steers the robot's motors for accurate movement using an Arduino microcontroller.
- To maximize the robot's tracking performance and ensure precise and seamless movement in response to changes in the target's position, apply the proportional-integral-derivative (PID) algorithm.

PROPOSED SYSTEM

1) First, we'll collect hardware components like Arduino microcontroller, sensors, motors, power supply (batteries).
2) Then we'll implement the software that means sensor data processing, control system, train the system.
3) Then when we Assemble the hardware components and connect them to the Arduino board according to the system design. Upload the software code to the Arduino board and test the functionality of individual components, such as sensors, motors, and control algorithms. Conduct comprehensive testing of the integrated system to evaluate its performance in tracking and following a human target in various environments and scenarios.
4) Then we'll address any identified issues or limitations through iterative testing, debugging, and refinement of the system components and software code. Consider additional features or enhancements, such as user interface improvements, power management optimizations, or integration of additional sensors, based on project requirements and feedback from testing.
5) Then we'll make document the design, construction, and implementation details of the Arduino-based human-following robot, including hardware specifications, software architecture, and testing results. Prepare user manuals, tutorials, or instructional materials to facilitate the replication and dissemination of the project for educational or DIY purposes.
6) Then we'll deploy the robot in relevant applications or environments, such as educational settings, research laboratories, or real-world scenarios, to demonstrate its capabilities and potential impact.
7) Our model will learn the parameters and will be ready to take good quality performance, or to ensure the successful realization of the project objectives.

SYSTEM ARCHITECTURE

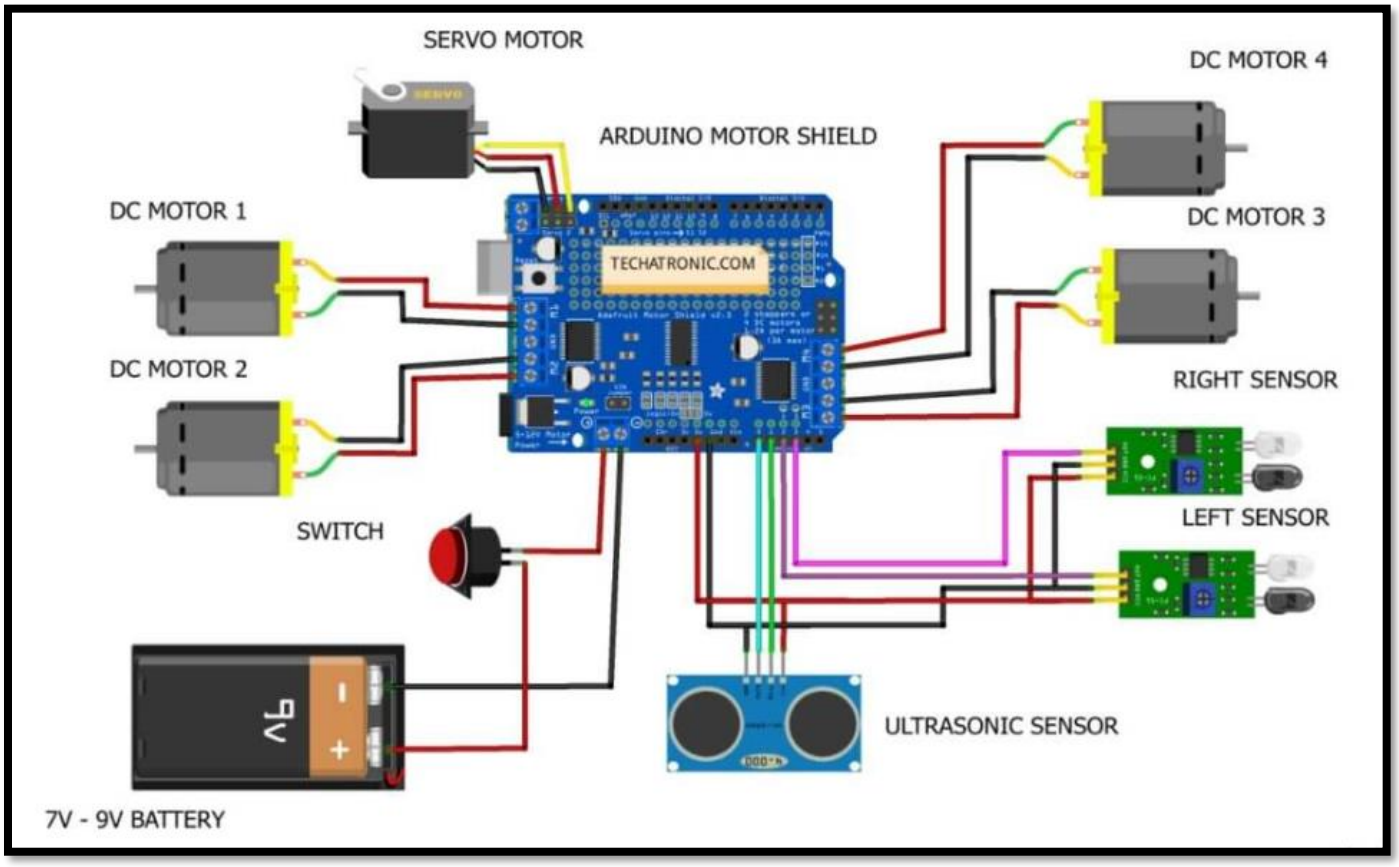

Fig Name: - CIRCUIT DIGRAM

SCOPE

- **Security and Surveillance:**
  The robot can be used in surveillance applications to automatically patrol assigned regions and pursue persons who appear suspicious, sending security staff notifications and real-time video feeds.
- **Assistive robotics:**
  A robot that follows and supports people with mobility limitations as they move around their surroundings can be used in healthcare settings. It can also be used to transport goods or give things to people who are in need.
- **Retail and Hospitality:**
  By following and helping customers or visitors, offering product recommendations, or directing them to particular areas inside the premises, retail outlets and hospitality organizations can use the robot to improve customer service.
- **Education and entertainment:**
  By allowing students to learn about robotics, programming, and sensor technologies through practical experimentation, the robot can be used as an instructional tool in STEM (Science, technologies, Engineering, and Mathematics) programs. It can also engage in amusing conversations or interactive demos to delight audiences at exhibitions or events.
- **Industrial Automation:**
  By autonomously following predetermined routes or people within a facility, robots can be used in industrial settings for duties like inventory management, material handling, or quality inspection.

RELEVANT MATHEMATICS ASSOCIATED

Software used: Arduino IDE (Integrated Development Environment)

Technologies: Arduino microcontroller, sensors (such as ultrasonic and infrared sensors), motors, control algorithms (e.g., PID), possibly Bluetooth or Wi-Fi for communication.

Input: Data from various sensors, such as accelerometers or gyroscopes for motion tracking, as well as data from ultrasonic and infrared sensors identifying the presence and location of the human target.

Output: Based on the analyzed sensor data, control signals for movement (speed and direction) are sent to motors.

Mathematical Formulation: Geometry and Trigonometry, Kinematics, Control Theory, Signal Processing, Probability and Statistics, Optimization.

Possible Success Conditions: It accurately and fluidly moves in the direction of the human target, keeping a safe distance and dodging obstructions in its way.

Failure Conditions: Ineffectiveness in difficult settings, including dimly lit rooms or congested areas.

ADVANTAGES

- Affordability: -

  Due to its relative affordability as compared to proprietary robotics platforms, Arduino-based systems are available to researchers, students, and hobbyists on a tight budget.

- Versatility: -

  With the addition of extra sensors, actuators, and modules, Arduino boards can be readily expanded and customized to meet the demands of particular projects.

- Low Power Consumption: -

  Longer operation times and greater autonomy are made possible by this low power consumption, particularly in situations requiring constant tracking or observation.

- Educational Value: -

  With the help of Arduino-based robotics projects, students may gain practical, hands-on experience with electronics, programming, and robotics. Project-based learning fosters creativity, critical thinking, and problem-solving abilities in addition to giving students hands-on exposure with real-world technologies.

DISADVANTAGES

- Limited Processing Power: -

  Comparing Arduino microcontrollers to more sophisticated embedded systems or microprocessors, they usually have less memory and computing capability.

- Limited Connectivity Options: -

  The robot's capacity to communicate with other devices or networks may be restricted by the limited communication choices available on Arduino boards, such as USB, serial, or Bluetooth.

- Hardware Limitations: -

  Certain hardware features or interfaces, such high-resolution sensors, motor controllers, or communication protocols, may be absent from Arduino boards that are needed for particular robotics applications.

- Lack of Professional Support: -

  Compared to commercial robotics platforms, Arduino-based projects do not have the same professional support networks and documentation, which could be problematic for developers looking for help with hardware malfunctions, software faults, or technical problems.

CONCLUSION

The Arduino-based human-following robot project has been a compelling exploration into the realm of robotics and artificial intelligence. The primary objective of creating a robot capable of autonomously tracking and following a human subject has been successfully achieved through the integration of Arduino microcontrollers, sensors, and motor control systems.In this way, we completed this project by believe that our project will be helpful in future and it will help human to do any kind of works and hence my purpose will be successful.

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