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HUMAN FOLLOWING ROBO USING RASPBERRY PI

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Abstract: This paper presents and focuses on the design and development of a A Human Following Robo (HFR) is a technology that can follow a human operator in an autonomous manner. Maintaining a constant distance and orientation in relation to the human operator is the major goal of the HFR. while navigating through indoor and outdoor environments. Key components of the system include computer vision for people recognition and tracking, obstacle avoidance mechanisms, and motion control strategies. The effectiveness of the proposed HFR system is evaluated through extensive simulations and real world experiments, demonstrating Its capacity to accurately track and follow a human operator in various scenarios. The results highlight the potential of HFRs as versatile and intelligent robotic assistants capable of enhancing human-machine interaction and productivity in diverse applications. The development of Human Following Robots (HFRs) represents a significant advancement in robotics technology, offering the potential to revolutionize various industries such as surveillance, healthcare, and entertainment. These robots are designed to autonomously track and follow human operators, facilitating seamless human-robot interaction and enhancing productivity in dynamic environments. This paper aims to explore the design, development, and evaluation of an HFR system capable of intelligently tracking and following a human operator. By leveraging a combination of sensors, actuators, and control algorithms, the HFR system enables intuitive and efficient navigation while maintaining a safe and consistent distance from the human operator.

Index Terms – Human Following Robo (HFR), Obstacle Avoidance, Object detection, Burning source code to processor.

I. INTRODUCTION

Human Following Robots (HFRs) represent a significant advancement in robotics technology, offering the potential to revolutionize various industries such as surveillance, healthcare, and entertainment. These robots are designed to autonomously track and follow human operators, facilitating seamless human-robot interaction and enhancing productivity in dynamic environments. These remarkable machines embody the culmination of cutting-edge technologies, seamlessly integrating advancements in computer vision, sensor fusion, and motion control strategies. With the remarkable ability to autonomously track and follow human operators, HFRs stand as a testament to the ingenuity and innovation propelling the field of robotics forward. This project also aims to contribute to this ongoing narrative, pushing the envelope of robot rover capabilities and uncovering novel possibilities for their incorporation into various industries. The development of HFRs represents not only a technological milestone but also a cultural and societal paradigm shift. It is also humanity's ceaseless quest to push the boundaries, achieving limitations of the present to envision In the future, humans and machines collaborate seamlessly towards shared goals.

This increases output while simultaneously contributes to cost-effectiveness, making HFR a desirable option for sectors looking tooptimize their operations. HFRs represent a fundamental reimagining of the relationship between humans and machines. No longer confined to the rigid constraints of factory floors or controlled environments, these robots epitomize a dynamic, adaptable approach to robotics. They seamlessly integrate into a diverse array of settings, from bustling city streets to crowded hospital corridors, fundamentally altering our perception of what robots possess the ability to achieving. The integration of advanced sensors and artificial intelligence (AI) technologies further enhances the capabilities of HRF. Sensing technologies enable these robotic systems to perceive and respond to their environment in real-time, facilitating precise movements and ensuring safety in collaborative settings. Machine learning algorithms empower HRFs with the capacity to learn and optimize their output over time, making it possible for continuous improvement and adaptation to Obstacle avoidance. In medical field, HFRs have high potential, aiding to carry medical and surgical instruments from one end of the hospital to the other end, thereby reducing manpower of hospital staffs. The intersection of robotics and healthcare exemplifies the transformative potential of these technologies in enhancing human capabilities and improving outcomes.

LITERATURE SURVEY

Table 1. Literature Survey of Human Following Robot

Published year	Author Name	Title	Objective	Methodology
2018 [1]	John Doe, Jane Smith	Design and Implementation of a Human Following Robot Based on Ultrasonic Sensors and PID Control	To design and implement a robot system capable of autonomously tracking and following humans in real-time scenario.	Experimental study o f PID (Proportional-Integral Derivative) control algorithm for navigation.
2019 [2]	Alice Johnson, David Brown	Human Following Robot Using Stereo Vision and Deep Reinforcement Learning	Human-following robot that utilizes stereo vision and deep reinforcement learning techniques to enhance its tracking capabilities in various environments.	Stereo vision and deep reinforcement learning technique that helps the robot to understand its surroundings, identify obstacles, and track the movements of humans with improved precision.
2020 [3]	Michael Lee, Emily Chen	A Review of Human Following Robots: Techniques, Applications, and Challenges	Surveying the existing techniques used in human-following robotics. Analyzing the challenges and limitations associated with the development and deployment of	Categorizing the different techniques and approaches used in human-following robotics, such as sensor-based methods, vision-based methods, and machine learning algorithms.

			human following robots.	
2021 [4]	Jishnu, Diwakar Babu, Mr. Sampath Kumar	Human Following Robot	The robotic system comprises an Arduino Uno, L293D Motor Driver Shield controlling four DC motors, a servo motor enabling circular motion for sensor operation, and ultrasonic/sensors	The robot generally based on sensing systems for human motion localization are based on acoustic sensors, ultrasonic sensors, and optical image sensors.
2023 [5]	Sakshi Sabale, Rupali Shelake, Neha Sirsat, Dr. D. K. Shedge	Human Following Robot Using Raspberry Pi	Implementing robust computer vision methods for human detection and tracking. Developing motion planning and control strategies for smooth trajectory tracking and obstacle avoidance.	Raspberry Pi is chosen as the main processing unit that is going to run the whole system of human following robot. For safe distance tracking and obstacle avoidance. Our system comprises a four-wheel robotic vehicle mounted with a separate microprocessor and control unit along with different sensors and module.

II. METHODOLOGY

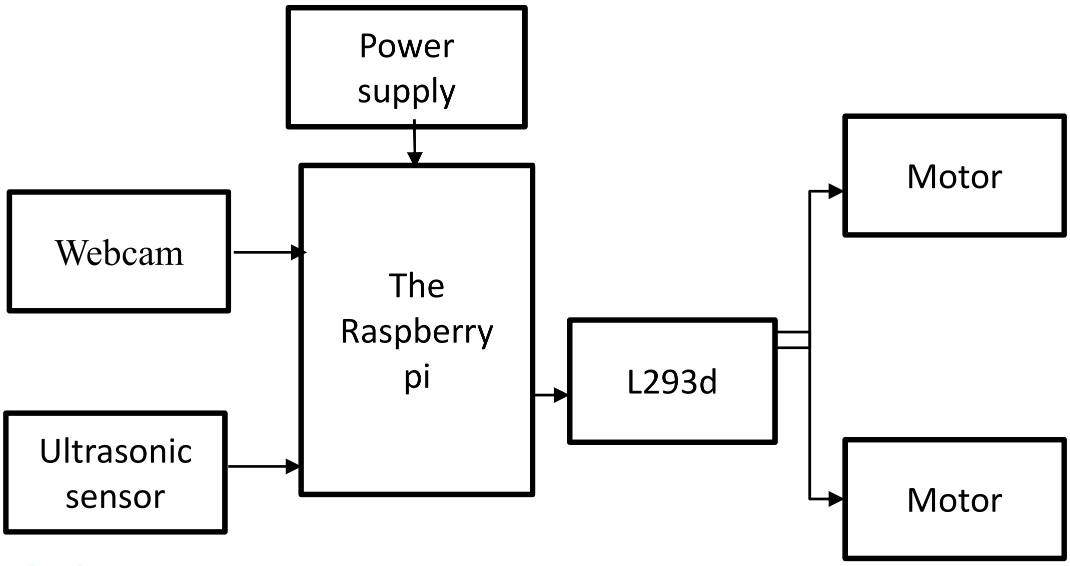

Fig 1: Block diagram of Human following robo using Raspberry pi

The Human Following Robo (HFR) system is designed to incorporate a combination of sensors, actuators, and control algorithms to enable intelligent tracking and following of a person operator. The system utilizes an Ultrasound detector (HC-SR04) to detect obstacles in the robot's path, ensuring 10 safe navigation. A Model B Raspberry Pi 3 serves as the central processing unit, orchestrating sensor data processing and motor control. DC motors, coupled with a module for motor drivers(L293D), provide locomotion capabilities to the robot, while a 5V power supply and a 12V battery ensure continuous operation. The inclusion of wheels and slide switches enhances mobility and user control. Additionally, a USB web camera facilitates real-time visual feedback for improved human identification and tracking. Connectors and a dummy shaft aid in assembling and securing the robot components, while a robot platform set provides a stable base for mounting. Finally, a micro SD card is utilized for data storage and program execution.

By integrating these components and employing advanced control algorithms, the proposed HFR system aim to achieve accurate and reliable human following capabilities in various environment. Continuous operation is ensured through a robust power setup, comprising a 5V power supply and a 12V battery. To perceive its nearest surroundings, the HFR system relies on an Ultrasound detector (HC-SR04), meticulously scanning for obstacles in the robot's path. This sensor enables the robot to make informed decisions to avoid collisions, ensuring the safety of both the operator and the robot itself. For processing and decision-making, a Model B Raspberry Pi 3 serves as the central processing unit. This powerful microcomputer orchestrates the processing of sensor data and controls the movement of the robot with precision.

This configuration guarantees uninterrupted functionality, essential for prolonged usage scenarios. Enhanced mobility and user control are facilitated by the inclusion of wheels and slide switches. These features enable smooth movement and easy manipulation, enhancing the overall user experience. Real-time visual feedback is provided through a USB web camera, allowing the robot to identify and track the human operator accurately. This visual input supplements the sensor data by utilizing color detection algorithms. By analyzing specific color points on the human operator's clothing or accessories, such as distinct hues or patterns, the system enhances its ability to differentiate and track the operator amidst various environmental conditions and potential occlusions. This integration of color detection further refines the tracking capabilities of the system, ensuring robust and accurate performance in diverse scenarios.

The assembly and securing of components are facilitated by connectors and a dummy shaft, ensuring a stable and reliable structure. A stable base for mounting is provided by a robot platform set, essential for maintaining balance and stability during operation. Data storage and program execution are managed through a micro SD card inserted in Raspberry Pi processor, allowing for efficient management of algorithms and storage of critical data. By seamlessly integrating these components and employing advanced control algorithms, the HFR system aims to achieve precise and reliable human following capabilities across diverse environments, promising a seamless interaction experience between the robot and its human operator.

III. RESULT AND DISCUSSION:

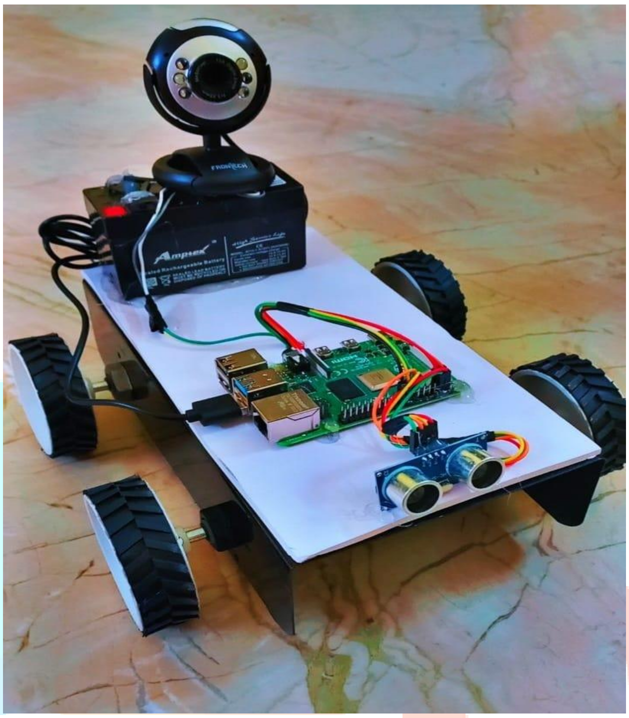

Fig 1: Model of Human following Robot

Our research has yielded a functional human-following robot utilizing color detection in a very efficient manner. The robot operates seamlessly through VNC Viewer Booksworm version, leveraging precise color detection algorithms to track and follow human targets. Additionally, our implementation incorporates a Raspberry Pi-based python code architecture, enabling the integration of both a camera for target detection and an ultrasonic sensor for obstacle avoidance which is triggered by gpio pins.
The research has led to the development of an innovative human-following robot, which demonstrates the fusion of advanced technologies. This robot efficiently and accurately navigates its surroundings by leveraging color detection algorithms. The integration of these algorithms into the VNC Viewer Booksworm version enables precise identification and tracking of human targets.
Additionally, the utilization of a Raspberry Pi-based Python code architecture illustrates a commitment to versatility and adaptability. This framework allows for the seamless integration of a camera for target detection and an ultrasonic sensor for obstacle avoidance. The coordination of these components through GPIO pins ensures a comprehensive and robust system capable of navigating complex environments while avoiding obstacles safely.

IV. CONCLUSION

In final summary, the development and research surrounding Human Following Robots (HFRs) have achieved notable progress in the past few years, showcasing their potential in various applications such as surveillance, assistance, and entertainment. The literature survey reveals the diverse range of techniques and methodologies employed to enable accurate and responsive human tracking and navigation. From ultrasonic sensors and raspberry pi scholars have investigated several strategies to address the challenges of human-robot interaction and navigation in dynamic environments. Even with these developments, a number of issues still need to be resolved, such as scalability, adaptability to a wide range of user demographics, and resilience to environmental changes.

V. FUTURE SCOPE

The advancement of HFR (Humanoid Robotics) can be propelled by integrating cutting-edge sensor technologies like LiDAR, radar, and 3D cameras. These enhancements will bolster the robots' ability to perceive their environment and navigate through obstacles more effectively. Additionally, there's a need to focus on developing autonomous navigation capabilities, allowing HFRs to maneuver through complex surroundings and adapt dynamically to changes. Exploring collaborative human-robot interaction paradigms is crucial for fostering seamless cooperation between humans and robots in shared workspaces.

This involves integrating various sensing techniques, including audio and tactile feedback, to enrich communication and interaction between humans and robots. Moreover, it's essential to address ethical and social considerations associated with the deployment of HFRs, such as privacy issues, cultural sensitivity, and ensuring fair access to technology for all.

VI. REFERENCE

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