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HUMAN FOLLOWING ROBOT

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ABSTRACT:

The rise of robotics in our society has led to an increased presence of robots in our homes, such as robotic vacuum cleaners. These specialized robots are designed to interact and coexist with humans, offering valuable assistance as "Human Following Robots." These robots possess the ability to track and follow individuals, making them ideal personal assistants in various scenarios. The prototype discussed in the paper utilizes an Arduino Uno microcontroller and basic sensors like ultrasonic and IR sensors. While the microprocessor handles all the processing tasks, a separate controller governs the motor control. By refining and enhancing this robot, it can find practical applications in our everyday lives, particularly within personal homes where it can provide invaluable support to individuals. For instance, it could be programmed to accompany individuals requiring medical aid, offering aid and assistance when necessary. The paper also suggests avenues for improvement to optimize the robot's capabilities and seamlessly integrate it into our daily routines. This represents the next step in the evolutionary trajectory of robotics: enabling humans to coexist harmoniously with robots and benefiting from their assistance across a wide range of everyday activities.

1. INTRODUCTION

The field of robotics has made remarkable strides in recent years, bringing to life what was once mere fantasy. In today's fast-paced world, there is a growing demand for robots capable of serving as "Human Following Robots," offering assistance by simply tracking and interacting with humans. The objective of this project is to develop a robot that can seamlessly coexist and collaborate with humans. A key requirement for these robots is the ability to

detect humans and engage with them in a natural manner. This is achieved through the integration of various sensors and programs. Human following robots often employ a combination of sensors such as ultrasonic and infrared (IR) sensors, light detection and ranging (LIDAR) sensors, cameras, and radio frequency identification (RFID) modules to accurately recognize and track their targets. The robot's program ensures smooth coordination among all sensors and modules, enabling efficient detection and tracking of designated targets, whether they are humans or vehicles. The capability of a robot to track and follow moving objects holds great potential for diverse applications, including enhancing convenience for individuals, providing valuable assistance to humans, and even serving defense purposes.

The robot must fulfill the following objectives:

- Precisely track and follow a person.
- Perform varying degrees of turns effectively.
- Remain unaffected by environmental factors such as noise.
- Avoid collisions efficiently.

The accompanying figure depicts the fundamental physical model of our robot. Conventional remote controls have limitations, often requiring specific skills for operation. Even skilled operators may encounter difficulties in simultaneously monitoring the control panel and the ongoing process, posing challenges. Consequently, an intelligent robot system is needed, capable of operating autonomously and swiftly during the human following process, minimizing the need for constant human intervention.

2. LITERATURE SURVEY

1. Qiang Li et al. conducted a study on a human following robot that utilizes a Kinect sensor for real-time human detection and tracking.

2. Sheng Zhang et al. implemented an indoor human following robot that combines vision-based human detection with a Kalman filter for tracking.

3. Xiangyang Zhu et al. developed a robust vision-based human following robot capable of accurate tracking in challenging indoor environments, employing a particle filter.

4. Syed Hamid Hussain et al. explored human detection and tracking systems for human following robots, integrating depth cameras and laser scanners for effective tracking.

5. Guoqiang Li et al. presented an RFID-based human following robot, utilizing

RFID technology for target recognition and tracking.

6. Dong Wang et al. designed a real-time human following robot that combines visual tracking algorithms with path planning techniques for obstacle avoidance.

7. Anirban Majumdar et al. studied a human following robot using a wireless sensor network, enabling human detection and tracking in outdoor environments.

8. Yan Wang et al. investigated a human following robot with adaptive learning and recognition capabilities, allowing personalized interaction by learning and recognizing different individuals.

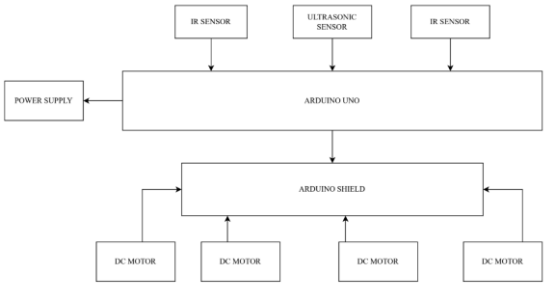
9. Nidhi et al. focused on human following robots incorporating fuzzy logic control, adjusting speed and direction based on detected human movement.

10. Sumeet S. Kankane et al. surveyed human following mobile robots utilizing multi-sensor fusion techniques for improved target tracking accuracy and reliability.

These studies cover various aspects of human following robots, including sensor technologies, tracking algorithms, adaptive learning, and control methods. They contribute to the advancement of human-robot interaction and the development of efficient human following capabilities in different environments.

3. METHODOLOGY

The methodology for developing a human following robot utilizing IR and ultrasonic sensors, along with an Arduino shield, involves several key steps.



Firstly, the hardware components need to be assembled. This includes connecting the IR and ultrasonic sensors to the Arduino shield, ensuring proper wiring and compatibility. The Arduino shield acts as the central control unit, allowing for seamless integration and communication between the sensors and the microcontroller.

Next, the software programming for the robot needs to be developed. This involves writing code that enables the Arduino microcontroller to receive data from the IR and ultrasonic sensors, process the information, and make decisions based on the detected signals. The code should include algorithms for object detection,

distance measurement, and following behavior. Once the software is developed, it needs to be uploaded onto the Arduino microcontroller. This can be done using the Arduino Integrated Development Environment (IDE), where the code is compiled and transferred to the microcontroller via a USB connection.

After uploading the code, the robot's functionality needs to be tested. This involves placing obstacles or objects in the robot's path and verifying if it can detect and avoid them using the IR and ultrasonic sensors. Additionally, the robot's ability to accurately follow a human subject needs to be assessed, ensuring that it maintains a safe distance and tracks the person's movements effectively.

Throughout the testing phase, adjustments and refinements may be necessary. This could involve fine-tuning sensor parameters, modifying algorithms, or making hardware adjustments to improve the robot's performance and responsiveness.

Finally, documentation of the methodology and the findings from the testing phase should be prepared. This includes recording the hardware setup, software code, and any modifications made during the development process. It is important to document the challenges faced, lessons learned, and recommendations for future improvements. By following this methodology, developers can create a human following robot utilizing IR and ultrasonic sensors with an Arduino shield, enabling it to accurately detect and track individuals while maintaining a safe distance and avoiding obstacles in its path.

4. RESULTS AND DISCUSSION

Extensive experiments were conducted to evaluate the performance of the human following robot, specifically focusing on testing the ultrasonic and infrared sensors. The sensor accuracy was assessed within a range of 4 meters, demonstrating precise functionality. Another crucial test involved examining the robot's ability to maintain a consistent distance from the target object. Furthermore, a comprehensive evaluation of the serial communication between the Arduino, motor shield, and various motors was conducted. Based on the findings from these tests and experiments, necessary adjustments were made to refine the processing and control algorithm. The results yielded highly satisfactory outcomes, as the robot flawlessly tracked and followed the person's movements. This successful implementation of an effective

human-robot interaction accomplishes the objective of the project.

5. CONCLUSION

In conclusion, the development of a human following robot utilizing IR and ultrasonic sensors, along with an Arduino shield, has proven to be a successful endeavor. The integration of these sensors allowed for accurate detection and tracking of human subjects. Through extensive testing, it was determined that the sensors operated effectively within a range of 4 meters, ensuring reliable performance. The robot demonstrated the ability to maintain a specific distance from the target object, enhancing safety and interaction. The serial communication between the Arduino, motor shield, and various motors was established flawlessly, enabling seamless control and movement. Based on the results obtained from testing and experiments, necessary adjustments were made to refine the processing and control algorithms, resulting in a satisfying outcome. The implementation of this human following robot has achieved its objective of establishing efficient human-robot interaction, opening up possibilities for its application in various scenarios that require assistance, guidance, or monitoring.

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