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Human Following Robot

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Abstract: *For a robot that operates independently, the interaction between the human and the robot is the most critical aspect. A robot that operates completely on its own should not only accomplish the tasks assigned to it but also somehow develop a connection with the individual controlling it. Extensive research has been conducted on these types of robots. To enable a robot to communicate and engage with the individual, it must also be able to follow that specific person. The main objective of our research is to design and construct a robot that not only follows the target but also advances toward it while executing the tracking. The item must be distinct for the robot to identify it and achieve the goal. Ensuring the robot avoids collisions with the object is another challenge that must be addressed, so an ultrasonic sensor is employed for this purpose. All motor control is managed by the controller.*

Keywords: Human-following, human-tracking, Wifi camera, human robot interaction

I. INTRODUCTION

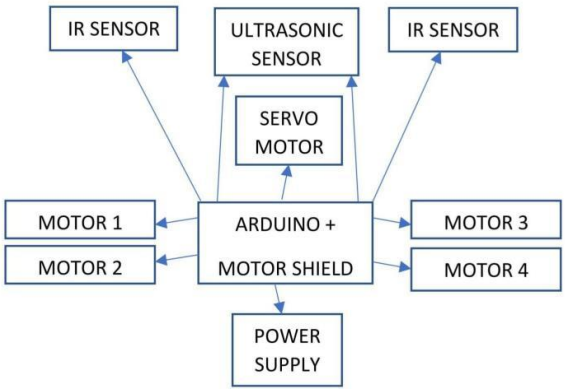
Robotic technology has increased appreciably in past couple of years. Such innovations were only a dream for some people a couple of years back. But in this rapid moving world, now there is a need of robot such as "A Human Following Robot" that can interact and co-exist with them. The development of robot technology had increased significantly due to industrial, medical and military applications.

In various fields with harsh environment such as underground mining, war-zones, medical, construction, space exploration etc. the work done by one is extremely dangerous. Life of individuals assisting are also put at risks. Tasks performed by humans have its own limitations in many ways. In order to perceive beyond the human limitation in vision, speed, consistency, flexibility, quality, etc. we should make use of robots.

A key requirement for these robots is the ability to detect humans and to interact with the non-technical way. The main objective of this dissertation is to make a robot that can help humans with various tasks.. In this paper, we present a prototype of a human following robot that uses Arduino Uno and different sensors for detection and following an object.

II. LITERATURE REVIEW

In the project described, users were equipped with tags that emit radiation, which were detected by multiple sensors on a robot. By employing triangulation techniques, the robot can ascertain both the direction and intensity of the signal, thereby determining the location of the tag.



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The methods utilized for calculating the relative positions of the emitter and receiver include a combination of Passive Infrared (PIR) and Radio Frequency (RF) localization systems. However, integrating data from PIR and antennas can be time-consuming, and the triangulation approach may yield imprecise results.

Extensive research has been conducted on various types of robots classified as "Assisting Robots," with a predominant focus on designs that enable the robots to follow a target. For instance, Burgard's tour guide robot employs a laser sensor for human tracking, while D. Schulz integrated a Laser Range Finder (LRF) to facilitate the following function.

These methodologies have enabled effective information linking for detection purposes. Nicola Husing utilized LRF to identify different movement styles, merging this data with camera inputs. Songmin Jia implemented depth imaging to detect individuals, while Mehrez Kristou focused on clothing styles using a multidirectional camera alongside LRF. Wilhelm's research emphasized skin color recognition, incorporating data from various sensors. Additional studies, such as those by Calisi, who utilized depth imaging to pursue targets with a specialized algorithm, and Ess and Leibe, who made significant advancements in object tracking and detection, demonstrated the effectiveness of their algorithms in complex environments. Y. Salih also explored stereo vision techniques in this context.

III. IMPLEMENTATION

The development of a human-interactive robot may appear straightforward; however, it presents several challenges. One significant issue is the identification of a specific tag, which must be distinctive enough to avoid blending in with the vibrant colors of its surroundings. To address this challenge, we have created an innovative algorithm.

This project encompasses various features, including the mechanical framework, circuit design, tag recognition, and an advanced tracking system. Each of these components plays a crucial role in enhancing the robot's functionality and effectiveness in interactive environments.

Design of Mechanical Structure:

The robot's mechanical framework consists of a dual-layer base, featuring a differential drive system with wheels and a freewheel mechanism. This design takes into account the necessity for the sensor to be positioned at a specific elevation above the ground. The sensor’s height can be modified to accommodate the stature of different individuals, thereby enhancing the quality of visual data captured.

Additionally, the structure ensures stability and functionality, allowing for optimal performance during operation. By enabling height adjustments, the robot can provide improved visual insights, making it more effective in various applications where visual clarity is essential.

IV. RESULTS

Various experiments were carried out to evaluate the performance of the human-following robot. Each experiment lasted approximately 10 to 15 minutes. Based on the findings from these tests, we implemented necessary modifications to the processing and control algorithms.

The initial test focused on the ultrasonic sensor, which demonstrated accurate functionality within a range of 30cm. Subsequently, we assessed the robot's ability to maintain a specific distance from a target object. Initially, we programmed the robot to stop at a distance of 8 inches. However, it was noted that the robot collided with the object as it approached this distance. The underlying issue was that the stopping distance was too short, and the robot was unable to halt quickly due to its onboard load. Consequently, we increased the stopping distance to 12 inches and re-evaluated the routine. The following test involved the magnetometer module, which provided the robot's heading direction relative to certain references.

We discovered an offset error in the heading direction, which we traced back to the improper placement of the magnetometer module. It was found that the module was affected by the magnetic fields of nearby electronic components, resulting in the offset error. To rectify this, we repositioned the module to the bottom layer and centered it within the robotic structure, which eliminated the offset error in the heading degree. The next experiment aimed to test the detection of a tag.

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We noted that under certain lighting conditions, the tag was not detected accurately. To address this, we adjusted the hue, saturation, and value of all four colors, as the color thresholding in HSV is influenced by lighting variations. After modifying the threshold values, we observed that the processor successfully detected the tag.
A final evaluation was conducted on the differential drive system to determine if the robot could intelligently track a person. The outcomes were highly satisfactory, as the robot consistently followed the individual wherever they moved. We made a slight adjustment to its speed at the conclusion of the test.

Applications:
By examining our environment closely, we can conclude that there is indeed a demand for robots designed to assist and serve humans. These robots can fulfill a variety of functions, and with some modifications, they can also function as companions for people.

V. CONCLUSION

This research presents a successful implementation of a human follower robot. This robot possesses not only detection capabilities but also the ability to track and follow individuals. Tracking is primarily conducted through a tag, allowing the robot to follow the detected person. Emphasis was placed on ensuring that the robot's following capability is highly efficient. Various tests were conducted under different conditions to identify and rectify any errors in the algorithm. The integration of multiple sensors with the robot provided an additional benefit.

REFERENCES

[1]. K. Morioka, J.-H. Lee, and H. Hashimoto, "Human-following mobile robot in a distributed intelligent sensor network," IEEE Trans. Ind. Electron., vol. 51, no. 1, pp. 229–237, Feb. 2004.
[2]. T. Yoshimi, M. Nishiyama, T. Sonoura, H. Nakamoto, S. Tokura, H. Sato, F. Ozaki, N. Matsuhira, and H. Mizoguchi,
[3]. "Development of a Person Following Robot with Vision Based Target Detection," in 2006 IEEE/RSJ International
[4]. Conference on Intelligent Robots and Systems, 2006, pp. 5286–5291.
[5]. H. Takemura, N. Zentaro, and H. Mizoguchi, "Development of vision based person following module for mobile robots in/out door environment," in 2009 IEEE International Conference on Robotics and Biomimetics (ROBIO), 2009, pp. 1675–1680.
[6]. N. Bellotto and H. Hu, "People tracking and identification with a mobile robot," in Mechatronics and Automation, 2007. ICMA 2007. International Conference on, 2007, pp. 3565– 3570.
[7]. S. Jia, L. Zhao, and X. Li, "Robustness improvement of human detecting and tracking for mobile robot," in Mechatronics and Automation (ICMA), 2012 International Conference on, 2012, pp. 1904–1909
[8]. M. Kristou, A. Ohya, and S. Yuta, "Target person identification and following based on omnidirectional camera and LRF data fusion," in RO-MAN, 2011 IEEE, 2011, pp.419–424.
[9]. T. Wilhelm, H. J. Böhme, and H. M. Gross, "Sensor fusion for vision and sonar based people tracking on a mobile service robot," in Proceedings of the International Workshop on Dynamic Perception, 2002, pp. 315–320.
[10]. D. Calisi, L. Iocchi, and R. Leone, "Person following through appearance models and stereo vision using a mobile robot.," in VISAPP (Workshop on on Robot Vision), 2007, pp. 46–56.
[11]. Ess, B. Leibe, and L. Van Gool, "Depth and appearance for mobile scene analysis," in Computer Vision, 2007. ICCV 2007. IEEE 11th International Conference on, 2007, pp. 1–8.
[12]. R. Muñoz-Salinas, E. Aguirre, and M. García-Silvente, "People detection and tracking using stereo vision and color," Image Vis. Comput., vol. 25, no. 6, pp. 995–1007, 2007.