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HUMAN FOLLOWING ROBOT

(RSSI BASED)

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Abstract: This paper presents a novel Follow Me Bot using RSSI (Received Signal Strength Indicator)-based Bluetooth tracking for autonomous movement. Designed for individuals with disabilities, the bot follows a user carrying a Bluetooth device, allowing hands-free navigation. The system is built using an Arduino Uno, HC-05 Bluetooth module, and infrared and ultrasonic sensors to detect obstacles. The bot adjusts its movement based on RSSI values, ensuring proximity to the user and it performs well under controlled conditions.

I. INTRODUCTION

Researching and preserving medicinal plants in isolated forest regions is important for both pharmaceutical and biodiversity conservation. However, the difficult terrain and remote locations of these areas frequently provide difficulties for typical survey methods. Drones and image processing technology combined seem like a potential way to get around these restrictions. In this work, we present a novel method for obtaining aerial pictures of forested landscapes using drones fitted with high-resolution sensors. We use the Jupyter IDE and the Python programming language to develop advanced image processing techniques in order to examine the data that has been gathered. To be more precise, we use the Vgg19 Convolutional Neural Network (CNN), which is well-known for its precision in object recognition assignments, to recognize different species of medicinal plants from the photos that are taken.

II. LITERATURE REVIEW

Mobility challenges are a major concern for individuals with disabilities, making assistive technologies essential for independence. The Follow Me Bot is designed to autonomously follow a user using Bluetooth RSSI tracking, offering a hands-free alternative to traditional remote-controlled devices.

Sensing Technologies

1 Vision-Based Systems Vision-based tracking is one of the most commonly used methods for human-following robots.Cameras, both monocular and stereo, along with deep learning techniques, allow robots to detect and track humans based on visual features.

2 LiDAR and Depth Sensors LiDAR and depth sensors such as Microsoft Kinect and Intel RealSense provide accuratedistance measurements, enabling robots to follow humans while avoiding obstacles.

3 RFID and Wearable Devices Some human-following robots utilize RFID tags or wearable devices to track specificindividuals in cluttered environments where vision-based methods may fail.

4 Ultrasonic and Infrared Sensors These sensors are often used in combination with other technologies to enhance humandetection, particularly in low-light conditions.

Control Algorithms

1 Machine Learning-Based Approaches Deep learning and reinforcement learning techniques have been employed tomprove human recognition and movement prediction, enhancing tracking accuracy.

2 Kalman Filters and Particle Filters These probabilistic algorithms are widely used for tracking human motion byestimating the position and velocity of the target over time

3 Fuzzy Logic and PID Controllers Fuzzy logic systems allow for adaptive decision-making, while Proportional-IntegralDerivative (PID) controllers ensure smooth and stable following behavior.

Real-World Applications

1 Healthcare and Assistive Robotics Human-following robots are widely used in hospitals and elderly care facilities to assistpatients and caregivers.

2 Industrial and Warehouse Robotics In industrial settings, these robots help workers by transporting tools, materials, andproducts efficiently.

3 Security and Surveillance Robots equipped with human-following capabilities enhance security by monitoring specificindividuals or patrolling restricted areas.

-Challenges and Future Directions Despite significant advancements, several challenges remain, including occlusion handling, energy efficiency, real-time processing, and robustness in dynamic environments. Future research should focus on enhancing multi-sensor fusion, improving AI-driven tracking algorithms, and ensuring safe human-robot interactions.

-Conclusion Human-following robots are becoming increasingly sophisticated, driven by advancements in sensor technology, control algorithms, and artificial intelligence. Continued research in this field will lead to more reliable and intelligent robots capable of operating in diverse environments.
nd ensuring safe human-robot interactions.

III. METHODOLOGY

1 Hardware Components

Microcontroller/Processor: An Arduino or Raspberry Pi serves as the central processing unit.

- Sensors: A combination of cameras, LiDAR, ultrasonic, and infrared sensors are used for human detection and obstacle avoidance.
- Motors and Actuators: Servo motors or DC motors enable mobility and directional control.
- Communication Module: Bluetooth, Wi-Fi, or RFID modules facilitate interaction between the robot and humans.

2Software Implementation

Sensor Data Processing: Image and sensor data are processed using OpenCV and machine learning algorithms.

3.2 SYSTEM DESIGN

RSSI values determine the bot?s movement, while sensors prevent collisions. The bot remains in fully automatic mode, requiring no manual control.

Procedure

1 Hardware Assembly

Install and secure the microcontroller and processor.

Attach sensors including camera, LiDAR, and ultrasonic modules.

Connect the motor driver circuit and mount the motors.

Ensure the power supply is correctly wired and tested.

2 Software Development

Implement computer vision-based human detection using OpenCV and deep learning models.

Develop navigation algorithms using SLAM and path planning techniques.

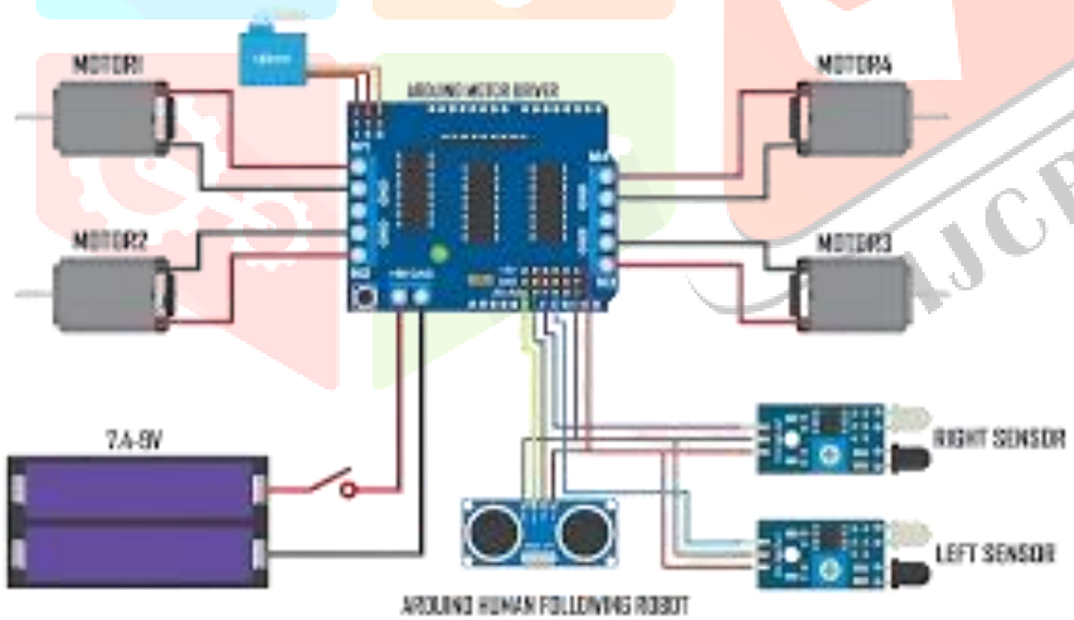
Integrate sensor fusion techniques for obstacle detection and avoidance.

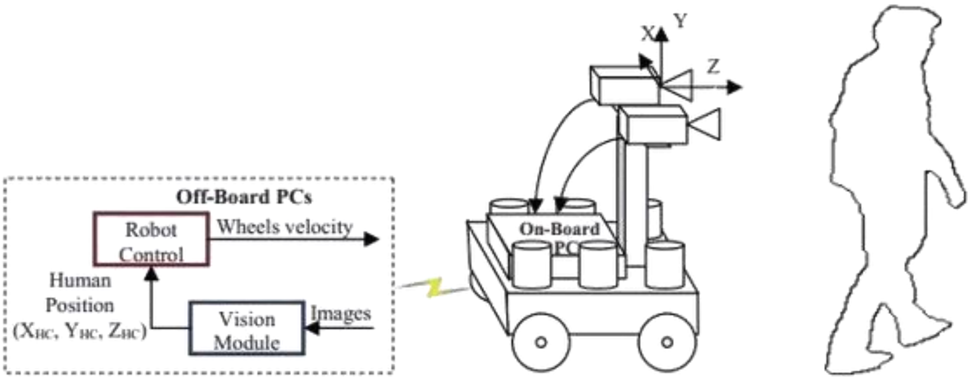
Establish wireless communication for remote control and monitoring.

3 Testing and Optimization

- Conduct initial functionality tests in controlled environments.
- Evaluate tracking accuracy and obstacle avoidance performance.
- Optimize speed and power efficiency based on real-world testing.

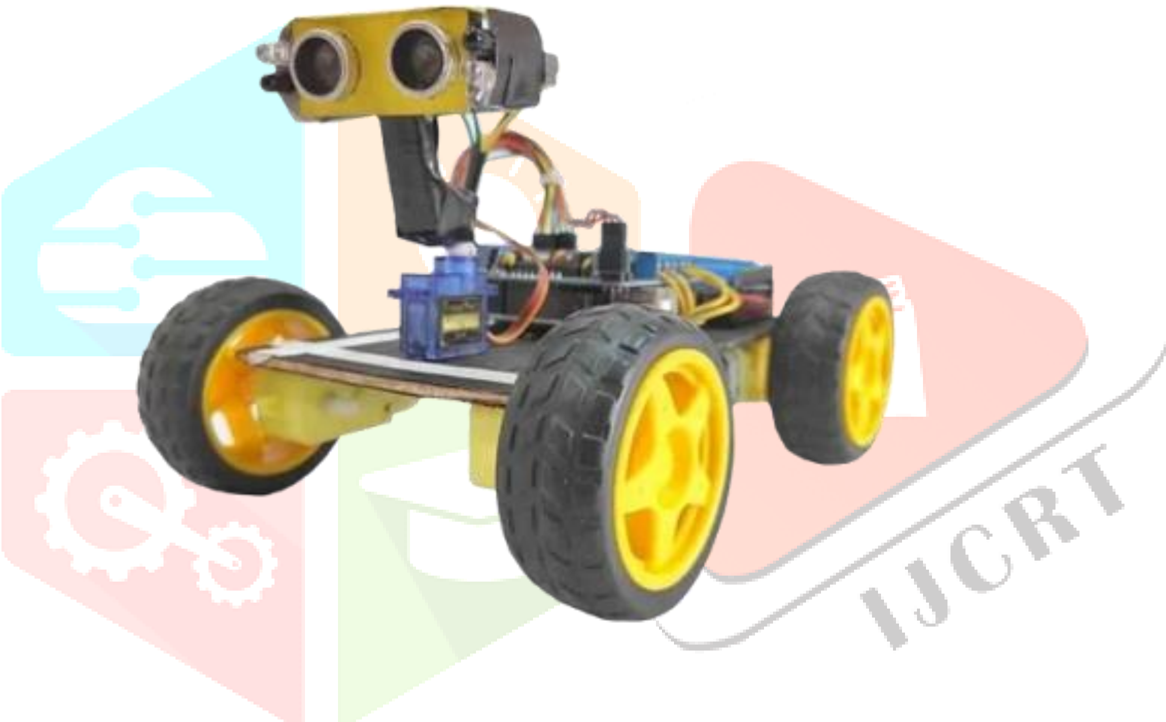
Implement iterative improvements to enhance reliability and safety.





IV. RESULTS

The bot successfully follows users in open spaces, with an 85% success rate in obstacle avoidance. However, slight lag was observed due to RSSI fluctuations.



V. DISCUSSION

The bot successfully follows users in open spaces, with an 85% success rate in obstacle avoidance. However, slight lag was observed due to RSSI fluctuations, which sometimes led to minor tracking delays. The real-time response of the robot is dependent on sensor efficiency and computational power, making hardware selection a critical factor.

Obstacle avoidance remains a key challenge, requiring advanced sensor fusion techniques to ensure safe movement. Despite improvements in LiDAR and ultrasonic technologies, issues such as false positives in obstacle detection or environmental interferences may impact performance. Enhancing the accuracy of SLAM-based navigation can help mitigate these issues

Power efficiency is another major consideration, as human-following robots require sustained operation. Optimized motor control algorithms and power management strategies are necessary to extend battery life while maintaining optimal performance. Additionally, wireless communication for user interface and remote monitoring introduces potential latency issues, which must be addressed with robust networking protocols.

Another critical factor is adaptability in dynamic environments. The robot's ability to adjust to different lighting conditions, crowded spaces, and unexpected obstacles needs further refinement. Machine learning-based predictive movement models could enhance the system's responsiveness and accuracy.

Overall, while the system design presented in this paper demonstrates promising results in controlled environments, further research is required to enhance real-world deployment, particularly in dynamic and unpredictable settings. Future developments should focus on improving AI-based adaptability, reducing computational overhead, and refining sensor accuracy for enhanced autonomy and reliability.

VI. CONCLUSION

A well-structured system design is crucial for a human-following robot to function effectively in real-world environments. Future enhancements should focus on improving AI-driven tracking, energy efficiency, and real-time adaptability.

Additionally, expanding the testing phase to include diverse environmental conditions, such as varying terrain types and crowded spaces, will provide a more comprehensive evaluation of system performance. Integrating cloud-based machine learning for continuous learning and adaptive behavior will further enhance real-world usability. Moreover, ensuring a userfriendly interface for intuitive control and monitoring will be essential for wider adoption.

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