Real Time Navigation of Robot Using Path Memorizing Algorithm

B. Pranv reddy[1], V. Tejaswi[2], B. Ganesha[3], M. Saiteja Goud[4], M.Hemanth[5]

[2]*Assistant Professoer, Electronics and Communication Engineering HITAM College Hyderabad, India*

[1,3,4,5]*Electronics and Communication Engineering HITAM College Hyderabad, India*

Abstract - The real-time navigation of robots with a path memorizing algorithm is a crucial aspect of autonomous robotics. This study introduces an innovative approach to enhance robot navigation by incorporating a dynamic path memorization algorithm. Unlike traditional methods, this algorithm adapts to changing environments in real-time, allowing the robot to efficiently navigate through dynamic terrains. The core of the proposed algorithm lies in the robot's ability to memorize and update its path as it encounters new obstacles or alterations in the surroundings. This adaptability ensures that the robot can respond promptly to unforeseen challenges, making it suitable for applications in diverse and unpredictable environments. By continuously updating its path memory, the robot optimizes its trajectory based on real-time data, resulting in improved efficiency and safety. The algorithm utilizes sensor data, such as LiDAR and camera inputs, to perceive the environment and make informed decisions. Machine learning techniques are integrated to enhance the robot's ability to recognize and memorize complex patterns in the surroundings. This amalgamation of real-time data processing and machine learning empowers the robot to navigate seamlessly through intricate environments. The experimental results demonstrate the effectiveness of the proposed approach, showcasing superior performance compared to traditional navigation methods. The robot successfully adapts to dynamic scenarios, efficiently avoiding obstacles while reaching its destination. This research contributes to the advancement of autonomous robotics, providing a foundation for the development of intelligent and adaptable robotic systems capable of real-time navigation in complex environments.

Key Words: Automated Robot, Path Memorizing, Differential Drive, Ackerman's Principle, IR remote.

1. INREODUCTION

In the realm of robotics, achieving efficient and adaptable real-time navigation is a fundamental challenge with far-reaching implications for various applications. This study delves into the development of a novel approach that combines robotics, real-time data processing, and machine learning to enhance the navigation capabilities of autonomous robots. At its core, the focus lies on a path memorization algorithm designed to dynamically adapt to changing environments.

Traditional robot navigation systems often struggle when confronted with dynamic terrains and unforeseen obstacles. The introduced algorithm addresses this limitation by enabling robots to continuously update their path memory, allowing them to respond promptly to real-time changes in their surroundings. This adaptability is crucial for applications where unpredictable elements play a significant role, such as in search and rescue missions or exploration of unknown environments.

Through extensive experimentation, the study demonstrates the superior performance of the proposed algorithm in comparison to traditional navigation methods. The robot, equipped with this innovative approach, showcases a remarkable ability to adapt to dynamic scenarios, efficiently avoiding obstacles while successfully reaching its destination. This research lays the foundation for the advancement of autonomous robotics, offering a glimpse into the future of intelligent and adaptable robotic systems capable of navigating complex environments in real-time.

1.1 Block Diagram

A block diagram is a visual representation of a system or process using blocks to represent different components or stages, and lines to indicate the connections and flow of information. In the context of the real-time navigation of a robot with a path memorizing algorithm.

In summary, this block diagram illustrates the flow of information and decision-making processes involved in real-time navigation with a path memorizing algorithm, from sensor input to robot movement, with a focus on adaptability and dynamic path optimization.

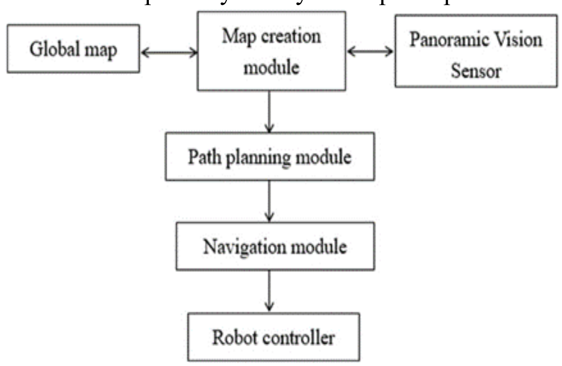

Fig 1.1 Block Diagram

2. FIRST PHASE

2.1 Differential Drive:

Understanding the principles of differential drive is crucial for designing and controlling mobile robots, and it serves as a foundation for various robotic applications, from small educational robots to larger automated vehicles.

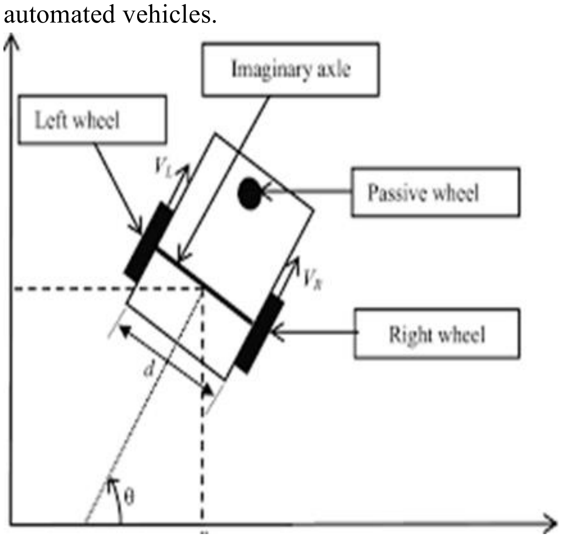

Fig 2.1 : Differential Drive

To manually control a differential drive robot, you can use the following formulas to determine the wheel speeds based on linear and angular velocities:

1. Linear Velocity (V):

V = (V_right} + V_left)/2

2. Angular Velocity (ω):

ω= (V_right - V_left)/L

To convert linear and angular velocities into wheel speeds, you can rearrange the equations:

V_right = V +(L. ω/2)

V_left= V -(L. ω/2)

These formulas help in determining the required wheel speeds for a differential drive robot based on desired motion characteristics.

2.2 Application in project:

Real-time navigation of a robot with a path memorizing algorithm using a differential drive system can find applications in various fields.

Implementing this system in warehouses can enhance the efficiency of material handling robots, allowing them to navigate dynamically in real-time while memorizing optimal paths for future tasks. Applying the algorithm to autonomous vehicles with a differential drive can improve their ability to navigate complex environments, adapting to real-time changes in traffic or road conditions.

Robots equipped with this navigation system can explore disaster-stricken areas, memorizing safe paths as they navigate in real-time to locate and rescue survivors .In the agricultural sector, robotic platforms can use this technology to navigate through fields, optimizing routes for tasks like planting, spraying, or harvesting crops.

Autonomous robots in hospitals can ensuring timely and efficient delivery of medical supplies to different departments while learning optimal routes.

Implementing the algorithm in home service robots enables them to navigate through dynamic indoor environments, avoiding obstacles, and remembering efficient paths for routine tasks. Implementing the algorithm in home service robots enables them to navigate through dynamic indoor environments, avoiding obstacles, and remembering efficient paths for routine tasks.

Unmanned ground vehicles (UGVs) with differential drive system for surveillance purposes, patrolling areas while memorizing optimal paths for effective monitoring. Robots with real-time navigation capabilities can assist in event management, guiding attendees and memorizing pathways in crowded venues.

2.3 :Ackerman’s Principle:

When a vehicle turns, all wheels should follow paths that intersect at a common point, typically the center of the turning circle. This helps prevent tire scrubbing and improves the vehicle's maneuverability.

The inner and outer wheels of a turning vehicle travel along different paths. The inner wheel follows a tighter radius than the outer wheel, but both should meet at the common center point.To achieve the Ackermann geometry, the steering angles for the left and right wheels are set in a way that allows for the proper turning dynamics. The angle of the inner wheel is typically greater than that of the outer wheel.

Ackermann steering minimizes tire scrubbing during turns, which helps reduce tire wear and improves the overall efficiency of the steering system.

Properly implementing the Ackermann principle contributes to the stability of a vehicle during turns, enhancing it's handling characteristics .Ackermann steering is commonly used in traditional automobile steering systems, ensuring smooth and efficient turning while maintaining optimal tire traction. Understanding and applying the Ackermann steering principle is crucial for designing effective steering systems, especially in vehicles with differential drive configurations, to achieve optimal turning performance and minimize tire wear

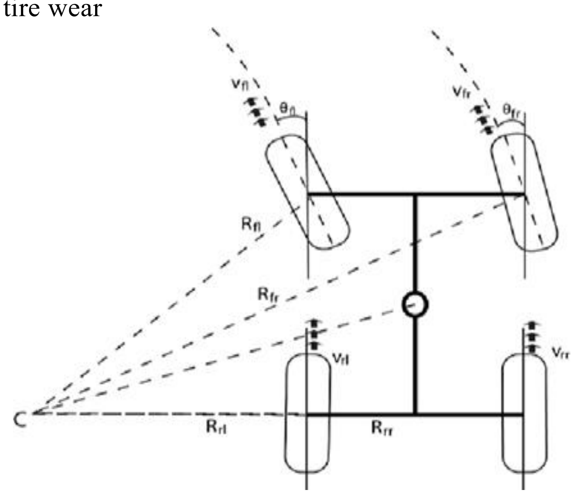

Fig 2.3 : Ackerman's Principle

2.4 Communication of Arduino IDE software:

Communication within an Integrated Development Environment (IDE) software involves various aspects to facilitate collaboration and streamline the development process.

IDEs often integrate with version control systems (e.g., Git) to enable collaborative coding. Developers can commit changes, merge code, and resolve conflicts directly within the IDE. Some IDEs provide real-time collaboration features, allowing multiple developers to work on the same code simultaneously. This can include shared editing sessions and instant updates. IDEs typically support commenting directly within the code. Developers can add comments to explain code sections, discuss changes, or provide documentation. This aids in communication within the codebase.

Some modern IDEs include chat or messaging features to facilitate communication among team members. This can be especially useful for discussing specific code blocks or seeking clarification. IDEs often integrate with code review tools, enabling developers to review each other's code efficiently. Integration with issue tracking systems (e.g., Jira, Trello) allows developers to link code changes to specific tasks or issues. This ensures that the development work aligns with project requirements. IDEs may provide notifications for various events, such as code changes, pull requests, or comments.

2.5 Manual Mode

The manual mode of this project is based on the path storing with the use of human effort.

Fig 2.5 : Manual Mode

In the manual mode of real-time navigation for a robot equipped with a path memorization algorithm, an operator takes direct control of the robot's movement. The operator uses an interface, which could be a physical remote control or a software-based control panel, to guide the robot through its environment. As

the robot navigates, the path memorization algorithm records key waypoints and information about the route. During manual operation, the algorithm captures data related to the robot's movements, turns, and any obstacles encountered. This data is then processed and stored for future reference. The path memorization algorithm is designed to learn and adapt to the operator's manual inputs, creating an efficient representation of the traversed path. This recorded path data can later be utilized in autonomous or semi-autonomous modes
where the robot leverages the memorized information to navigate intelligently without direct operator control. This manual mode serves as a training phase, allowing the robot to learn and store valuable spatial information for subsequent autonomous operations.

2.6 Auto Mode:
The auto mode of real-time navigation for a robot equipped with a path memorizing algorithm in a 2-3 paragraph description involves the seamless integration of advanced technologies to enable efficient and autonomous movement. In this mode, the robot utilizes its differential drive system and sensors to navigate through its environment in real-time. The path memorizing algorithm plays a crucial role by allowing the robot to learn and remember optimal routes as it explores different areas.

As the robot moves, its sensors collect data about the surroundings, identifying obstacles and mapping the terrain. The path memorizing algorithm processes this information, determining the most efficient paths based on factors like distance, obstacles, and terrain conditions. In auto mode, the robot autonomously follows these learned paths, making dynamic decisions to adapt to changes in the environment. This could include avoiding obstacles, recalculating routes in real-time, and optimizing its trajectory for efficiency. The integration of real-time navigation and path memorization in auto mode enhances the robot's ability to operate autonomously in diverse and dynamic environments, making it well-suited for applications in fields such as logistics, surveillance, and exploration.

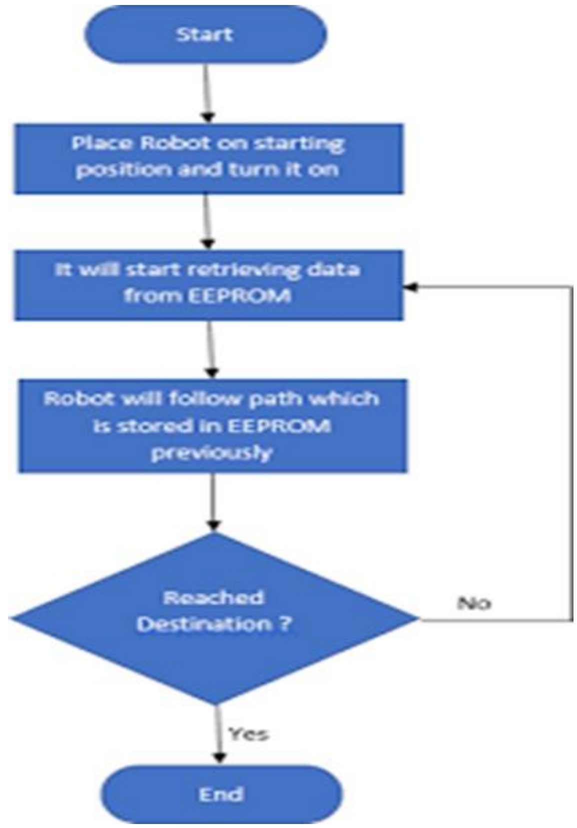

Fig 2.6 :Flow Chart of Auto Mode

3.RESULT

navigation for a robot using a path memorization algorithm depends on the specific algorithm used, the environment in which the robot operates, and the quality of the sensor inputs. Path memorization algorithms are generally designed to allow a robot to remember and navigate through previously traversed paths efficiently. Here are some possible outcomes and considerations

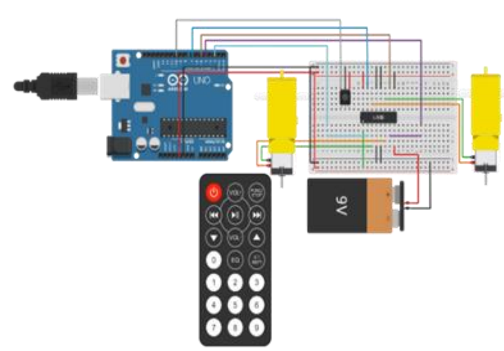

Fig 3.1 : Final Result of IR remote and Robot Connections

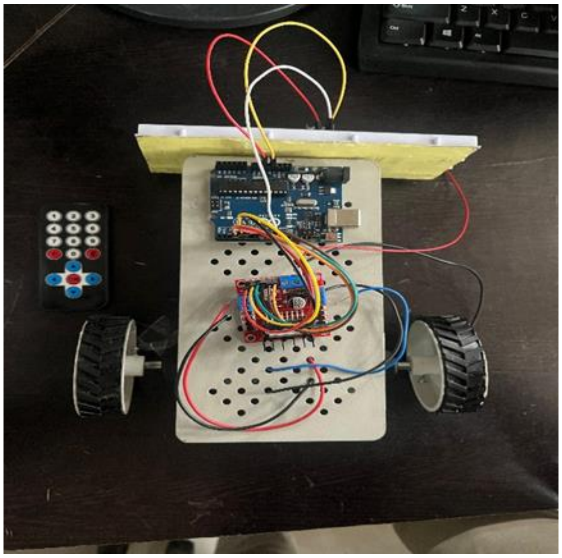

Fig 3.2 : Final output

4.CONCLUSION

The real-time navigation of a robot with a path memorizing algorithm enhances its ability to navigate autonomously by remembering and optimizing paths. This technology minimizes the need for constant re-planning, making the robot more efficient and adaptable in dynamic environments. Overall, it contributes to improved navigation precision and resource utilization, marking a significant advancement in robotics.

4.1 Future Scope:

Path memorizing vehicles, also known as autonomous vehicles or self-driving cars, have a promising future with several potential scopes and advancements. Here are some areas where the future development and application of path memorizing vehicles could be significant promising and spans various fields.

REFERENCE

1. Fahd A and Hajara Syed "Survey on algorithms and techniques for indoor navigation system.", Ieeexplore.org.
2. Giovanni Ulivi and Marilena Vendittell "Real time map building and navigation for autonomous robots in unknown environments.", Ieeexplore.org.
3. Kelvin D'Souza and Steffi Joseph "This paper sheds light on a rather simplicity and basic approach to navigation makes use of algorithms using sensors.", Ieeexplore.org.
4. Priyank Sudhakara and Velapp Ganapathy "Trajectory planning of a mobile robot using Enhanced A-star algorithm.", Ieeexplore.org.
5. Prof. Vishal Vaidya, Narotam Sharma ,Urvi Patel , " Real Time Navigation of Robot with Path Memorizing Algorithm" International Journal of Engineering Research And Technology , volume 08 , Issue08 August 2019
6. Gregory Dudek, Michael Jenkin Computational Principles of Mobile Robotics. Cambridge University Press 2000