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ANALYZING KINEMATIC & NAVIGATION TECHNIQUES IN MOBILE ROBOT

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ABSTRACT

Obstacle avoidance and steering control are crucial aspects of autonomous vehicles to ensure safe and efficient navigation in complex environments. This paper proposes a novel approach for obstacle avoidance and steering control using an Adaptive Neuro-Fuzzy Inference System (ANFIS). ANFIS combines the strengths of artificial neural networks and fuzzy logic to create a robust and adaptable control system. The proposed ANFIS-based approach employs sensor data from various sources, such as LiDAR, radar, and cameras, to perceive the surrounding environment and detect potential obstacles. The sensor data is then processed and fed into the ANFIS, which has been trained using a combination of supervised and reinforcement learning techniques. The ANFIS utilizes fuzzy logic to model the relationship between the sensor inputs and the appropriate steering actions, allowing the vehicle to navigate around obstacles while maintaining a smooth and stable trajectory.

Keywords: - Avoidance, Fuzzy, Autonomous, System, Mobile Robot's

I. INTRODUCTION

Autonomous behavior and enhanced system performance via interactions with surroundings are already possible in today's robotic systems. Mobile robots are the kind of robots that can move about, get information about their surroundings, and act accordingly, allowing them to complete tasks and explore new areas with little human oversight. One of the most difficult challenges in robotics is the planning and control of a mobile robot's path in an unknown environment. There are many potential uses for mobile robots in fields as diverse as industry, medicine, the military, space travel, housekeeping, and agriculture. It is expected that as the development of robotics continues at a rapid pace, the mobile robotic system will become more prevalent in everyday life. Therefore, mobile robots need to be able to carry out a variety of activities independently, avoiding obstacles and other mobile robots.

The following ingredients make up the mobile robot's autonomous navigation problem:

- Localization
- Path planning
- Map building

The first step is map construction, which is necessary since the mobile robot has only a partial understanding of the surroundings. Second, erroneous localization calls for an environment model that accounts for the limitations of its sensors. In the end, the mobile robot's autonomy depends on its ability to harvest environmental data online while also planning its movements based on the little knowledge it has about its surroundings. The route planning algorithm for a mobile robot is constructed using the aforementioned three essential elements, and it can locate the best collision-free path from the source point to the destination point in a specified environment. There are three broad categories for describing environmental conditions: the known or structured setting, the semi-structured setting, and the unknown setting. Figure 1 depicts the various components of the motion control strategy for the mobile robot.

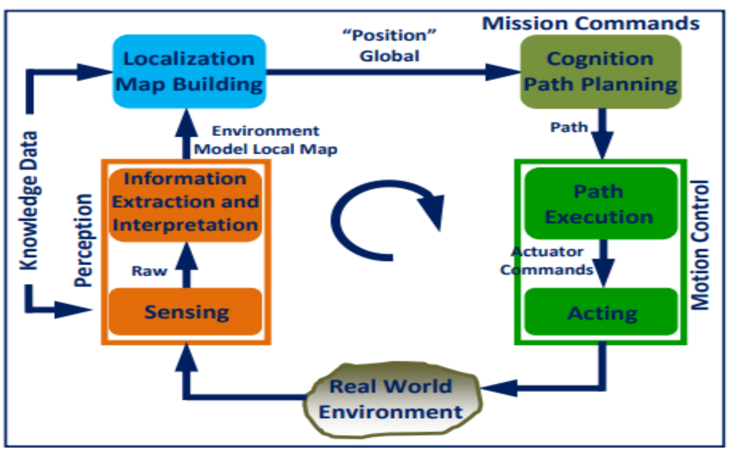

Figure 1 A block scheme of the navigation system.

Many scholars have spent the better part of the last two decades studying the route planning or navigation issue of the mobile robot. Whether or not the location of the surroundings and obstacles is known in advance is what makes the route planning issue so challenging. If the surroundings and the location of the barriers are known in advance, the path planner must search for the ideal route. Global route planning, often called off-line path planning, refers to such strategies. These techniques are computationally costly and hence seldom used in the actual world.

II. KINEMATIC ANALYSIS OF WHEELED MOBILE ROBOTS

Wheel Locomotion

Locomotion mechanisms for a mobile robot range from regular walking to sliding, sprinting, leaping, and more. Humans, snakes, four-legged creatures, and even the kangaroo serve as biological inspiration for these systems. The success of biological activities in a variety of contexts is a major factor in their selection as locomotion mechanisms. Mechanical complexity, the utilization of biological energy storage systems like those employed by animals, and the difficulty of mathematical analysis are only a few of the challenges inherent in the artificial creation of biological processes. These challenges have led to widespread adoption of the most basic biological systems, characterized by a smaller number of articulated legs.

Motion Control Analysis for Differential Mobile Robot

Researchers have been focusing on motion control for no holonomic mobile robots in recent years. Several algorithms have been put out as potential solutions to the issue of motion control. In , we learn about an innovative adaptive trajectory controller for the nonholonomic mobile robot. Two motion control methods based on localisation of mobile robots have been suggested by Slusny et al.

III. NAVIGATION TECHNIQUES USED FOR MOBILE ROBOTS

Researchers have focused extensively over the last couple decades on developing new navigational strategies for the command of mobile robots. Below is a synopsis of the various mobile robot navigational approaches.

Classical Approaches

Researchers use a wide variety of traditional approaches to the route planning issue for mobile robots. The next images illustrate the traditional reviews.

Computational Intelligence (CI) Approaches

Instead of using traditional methods, many researchers and engineers now simulate mobile robots' navigation systems using knowledge-based or computational intelligence methodologies. Some of them, along with their applications and some examples, are detailed in the following section.

IV. CONCLUSION

In conclusion, the analysis of kinematic and navigation techniques in mobile robots has provided valuable insights into the field of robotics and its practical applications. By studying the ways in which robots move and navigate through their environment, researchers and engineers can develop more efficient and effective robotic systems.

Kinematics, which focuses on the motion of objects without considering the forces that cause them, has been instrumental in understanding the range of motion and capabilities of mobile robots. By applying mathematical models and principles, researchers have been able to analyze the constraints and limitations of robot movements, enabling them to optimize robot design and control algorithms.

Navigation techniques, on the other hand, are concerned with how robots perceive and interact with their environment to autonomously move and reach their desired destinations. Through the integration of sensors, such as cameras, LiDAR, and inertial measurement units, robots can gather data about their surroundings and make informed decisions about their movements. Various algorithms, including simultaneous localization and mapping (SLAM) and path planning algorithms, have been developed to enable robots to navigate complex and dynamic environments.

The analysis of kinematic and navigation techniques in mobile robots has led to significant advancements in various fields, including industrial automation, logistics, search and rescue, and space exploration. Mobile robots are now capable of performing intricate tasks with precision, efficiency, and safety, leading to increased productivity, reduced costs, and improved overall performance.

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