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Analysis of Various Methodologies and Sensors used for Navigational Control of Various Types of Robots in Today's World

Dayal R. Parhi[1], M. K. Muni[2], A K Kashyap[3], Saroj Kumar[4] and Vikas[5]

Department of Mechanical Engineering, NIT Rourkela, Odisha, 769008, India

Abstract

Navigational control of various robots describes the capability of the robot to allocate its own location and afterward to outline a route to reach the defined target. It comprised of two fundamental elements, these elements are planning and localization, with the ability to guide a robot in assigned terrain. Localization coordinated a real situation to a position within a tracery; precisely, every position in the tracery alludes to the real location in the terrain. Planning is described as observing the terrain, locating the optimum collision-free path between the start and the target. For every robot, the capability to explore the terrain and navigate along the target is significant. Keeping away from the hazardous circumstances, such as collision with obstacles, uneven surfaces is the primary action to take care. Robots find a distinct location in the terrain to obtain the safe route to reach the target using the navigational control. Intelligent navigational controls are necessary to design an autonomous robot. The demands of these autonomous robots are happening in different approaches, for example, research laboratories, defense operations, automobile assembly, etc. The robots powered with intelligent navigational control are capable of performing various jobs efficiently like, machining, handling costumers in restaurants, disaster relief. For these reasons, an intelligent navigational control is a necessity for a robot to travel in static and dynamic terrains. The pincipal point in robot navigation is to obtain the optimal route to the target for regularizing and secure path planning in complicated terrains. In reference to these issues, a few control methods are investigated by several researchers for the navigation of robots. This paper gives a review analysis of various methodologies and sensors used for navigational control of different types of mobile robots during the past few decades.

The navigational control methods are mainly classified into model-based techniques and sensor-based techniques. The categorization is done on the basis of predefined input provided to the robot in reference to the location of obstacles, start point and target point in the assigned terrain. In the model-based techniques, the information regarding the assigned terrain is provided to the robot before the initialization of the tasks. It is also termed as global navigation. Whereas, in sensor-based technique, which is also termed as local navigation, the location of obstacles is unknown, and the robots need to execute online path planning on the basis of unpredicted terrain situations. The global navigation techniques appear to be less complicated while dealing with complicated terrains, but the local navigation techniques approximate the real-life structure. It reaches very close to the target and obtains the shortest path. The global navigation techniques, on the other hand, takes lesser time to make the decisions.

Altogether, it can be registered that the navigation control is the most dispute domain of analysis. More precisely, it should be noted that the navigation of each robot is different from others. For example, the design

navigational control technique for mobile robots varies from the design of humanoid robots. The complexity of navigation in humanoid robots increases due to its tree-like structure. It consists of a free-floating base, which makes it a little difficult to handle. In brief, it should be explained that different robots require the different structures of navigational control techniques. For the review analysis, various methodologies such as fuzzy logic, ant colony, swarm intelligence, dayani, daykun-bip, bacteria foraging, genetic algorithm, artificial immune system, neural network, gravitational search and other AI techniques for robot navigational control have been undertaken.

In recent years, various researches have been endeavored on navigational control techniques for various types of robots. Depending upon the strategy in solving the task assigned, it is classified into conventional techniques and artificial intelligent techniques. Although the conventional techniques are acquired from essential statistical approaches, artificial intelligence techniques are generally motivated by nature. The conventional techniques are well known to provide converged results in minimal time, and artificial intelligent techniques are considered to resolve the tasks efficiently in reference to accuracy. But it demands additional time to converge towards the optimal results. The elementary path planning techniques have been created to design a robot that can achieve the target set by the performers for various tasks. Although the versatile method must be hybridized with a specific methodology. Moreover, every type of navigational control techniques have few limitations and to eliminate it, hybridization of different navigational control technique become necessary in the current scenario. By hybridizing, the results obtained would be accurate and converged. It can solve the problem in lesser time and would not get trapped in the local minima. Various hybrid techniques, for example, Regression Analysis-Adaptive Ant colony optimization, Regression-Fuzzy Logic Controller, Fuzzy-Genetic Algorithm, Ant Colony Optimization-Genetic Algorithm, etc. have been proposed by various researchers till date. The hybridized navigational techniques are applied in various robots, and it provides optimized result in reference to travel length and travel time. These techniques provide better results than many singly used techniques.

Discussion and analysis of Ultrasonic, Infrared, Vision, Laser, Touch, IMU, Pressure and other sensors used for navigational control of robots have been carried out. While conducting the navigation for robots, sensors are often utilized for getting the positions of start point, obstacles and target, and avoiding obstacles. The sensors are classified as relative and absolute on the basis of positioning. The relative sensor incorporates odometry and inertial path planning strategies which quantify the robot location in reference to its start point and its motion. Particularly, absolute sensors perceive structures in the terrain in which location is familiar. It permits the robot to calculate its own location. Odometry is the most accessible path planning framework because of its ingeniousness, the normal accessibility of encoders, minimal effort, and minimum cost. The reading provided by the compass speaks to one of the most significant parameters for robot path planning. In spite of that, metallic design and various conductors show there impacts on the metallic compasses. Another arrangement of sensors for path planning is the active beacons. It comprises of sonic and visual signals. They give absolute localization of robots via data referred by using various active beacons. The location of the robot is evaluated using the triangulation method. This review analysis focuses on navigational control of wheeled robots, humanoid robots, legged robots, underwater robots, areal robots, and other types of robots. This paper gives an overall knowledge in the field of robotics to date to the engineering and scientific communities around the world.