**Different Methodologies of a Navigation of Autonomous Mobile Robot for Unknown Environment**

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In this paper, different techniques/methodologies/strategies that are used in the field of mobile robot navigation have been reviewed for unknown environment is an important task for the new generation of several mobile robots. We consider the wheeled mobile robots for Path Planning, an autonomous robot and an obstacle and collision avoidance to be used in sensor based robots. We propose that drives the robot to the predefined distance from the target and makes the robot follow the target at this distance and improve the trajectory tracking characteristics. We report on research into navigation along 3D sensing of basic geometrical features of the surrounding environment. In landmark-based navigation systems for mobile robots, sensory perceptions (e.g., laser or sonar scans) are used to identify the robot's current location. The robot will then navigate among these obstacles without hitting them and reach the specified goal point.

**Keywords:** Autonomous Mobile Robot, Sensor, Path Planning, Obstacle/Collision Avoidance

**INTRODUCTION**

In a new proposal to solve the problem of path planning and obstacle avoidance for mobile robots and the study in the field of navigation of mobile robot gained an extensive interest among the researchers and scientists since last few decades. Nowadays, robotics is an important part in manufacturing practices and atomization. About mobile robots, autonomous navigation involves a great task. A mobile robot (MR) can be very beneficial in different circumstances where humans could be in risk or when they are not able to reach positive goals because of terrain environments. Like Examples of everyday tasks of driving in city traffic, parking a car, and house cleaning. In accomplishment such familiar tasks, humans use observations of time, distance, speed, shape, and other aspects of physical and mental things. For any autonomous robot obstacle avoidance is the primary requirement. Many sensors and actuators are required for integration and coordination for designing a robot.

Matveeva & Teimoori[1] considered the difficulty of navigation and guidance of a wheeled mobile robot towards a target based on the measurements concerning only the distance from the robot to the target. They have proposed a controller that drives the robot to the predefined distance from the target and makes the robot follow the target at that distance. Mohareri et al. [2] presented the design and operation of an adaptive path tracking controller for a wheeled mobile robot (WMR) with unknown parameters and uncertain dynamics. The learning ability of neural networks is used to design a robust adaptive back stepping controller that does not require the knowledge of the robot dynamics. Systems are found in different applications ranging from unicycles and car-like vehicles, possibly equipped with trailers, to systems like rolling spheres, snake-like robots, snake boards, roller racers, and wheel-chairs. A wheeled mobile robot (WMR) is one of the well-known systems with nonholonomic constraints, and has addressed its tracking control problem. Kanda et al. [3] show the various mechanisms have recently been developed that combine linkage tools and wheels. In exact, the combination of passive linkage mechanisms and small wheels is a main research trend because standard wheeled mobile mechanisms finds it difficult to move on rough terrain. We propose an environment recognition system for a wheeled mobile robot that consists of multiple organization analyses to make the robot more adaptive to various environments by selecting a suitable system such as decision making, navigation and controller using the effect of the environment recognition system. In environment recognition system, image data, laser scanner data, GPS and Inertial Navigation System (INS) are often used for self-localization and mapping.

Sekmen et al. [5] dealt with the advances in technologies to create ever more sophisticated robots is outpacing our understanding of how such robots and humans successfully interact to complete specific responsibilities.
specific, it is now possible for humans to control the navigation of certain classes of robots via the Internet. The World Wide Web (WWW) provides an inexpensive and widely accessible means for teleoperation. Both computer and Internet technology are improving at an amazing speed and some robotics researches have begun exploring tele-presence applications. In fact, the only information the human operator may have about the “terrain” is the information available through the robot control interface. Sebastian Thrun [6] defined autonomous robots must be able to learn and maintain models of their environments. To efficiently carry out complex missions in indoor environments, autonomous mobile robots must be capable to secure and maintain of their environments. Deepak et al. [7, 8] have presented mobile robots which are widely used in various fields such as domestic fields, industries, security environments etc. because of their movement nature. So motion planning is one of the vital issues in the field of mobile robots. In which, the robot should adapt the behaviour learning from the sensory information without continuous human interference. The main objective of a navigational controller of an autonomous mobile robot is to generate collision free trajectories within its workspace. For mobile, autonomous robots the capability to purpose in, and interact with, a dynamic, changing environment is of key importance. Ming et al. [9] have used incorporation of an integration procedure is becoming an increasing necessity for autonomous robotic vehicles capable of moving along in the industrial environment. This is due to a change in the kind of application required from robotics. Usually these new applications have the same basic features: a mobile robot that moves in a partially unknown industrial environment, trying to reach a target, and an articulated arm joined to the vehicle which is devoted to carrying out the required tasks.

Kerstin [10] defined autonomous robots are integrated into human people, interacting and cooperative both with humans and with each other. This goal is to suggest that these ideas should also find their way into the sciences of the artificial. Andrzej &Skrzypczynski [11] have studied the autonomy of mobile robots directly depends upon the availability of the adequate model of the environment, which can be used to back up the robot tasks at hand. In the case of robots operating in industrial environments the map could be provided in advance.

Ulrich et al. [12, 13] have defined the following three properties are foundations of robust robot navigation: (i) the use of landmarks (ii) the use of undisputed paths, and (iii) the use of topological rather than geometrical maps. Navigation is a key for any mobile robot in its most predictable form; the navigation problem can be stated as follows: given that a robot is at a unknown location in a unknown environment, how does it go about success a goal location. Danny & Phillip [14] shows navigation an outdoor robot, one of the problems of navigating robots is that many electronic sensing systems do not produce this rich sensor data. A second problem is that the sensors that yield rich information are not yet able to reliably perceive objects. This limitation of robot sensing and perception places severe constraints on the ability of a mobile robot to navigate.

Fua et al. [15] show for miniaturized mobile robots that aim at travelling unknown environments, contact 3D sensing of basic geometrical features of the surrounding environment is one of the most important capabilities for survival and the mission. Range sensors are usually used for non-contact exploration of the surrounding environment and for the purpose of robot dynamic navigation, and they include passive sensors and active sensors. Compared with passive sensors, active sensors, which include infrared sensors, ultrasonic sensors, and laser sensors, offer more reliable range sensing. Infrared sensors are simple, small and cheap; however, they have rather shorter sensing range and less range resolution compared to other optical sensors. In addition, because an infrared sensor only measures a range distance from the sensor coordinate frame to the target point at a time, so it needs to be scanned two dimensionally for 3D sensing. Thrun [18] states that, a mobile robot, equipped with optical, ultrasonic and laser sensors, learns to servo to a designated target object. In less time operation, the robot is able to navigate to a marked target object in an unknown environment. MohdNazri & Saad [4] have stated Person detection and tracking systems are important capabilities for applications as a service robot in different environment. This work presents a simple method that able to visually detect and track specific person using a single camera based on hybridization method of image information. This method is applied to estimate the position and orientation of a moving target person in crowded environment. The range between the target person and the mobile robot can be computed in real-time using a set of markers so that the robot can control its speed and direction to follow the target person as closely as possible.
Thrun [6] has said that the sensors are not capable of directly measuring the mass of interest. Example, like cameras measure colour, brightness and capacity of light, whereas for navigation one might be interested in statements such as “there is a door in front of the robot.” One of the robots (AMELIA) is similarly fitted out with a laser range finder, which measures closeness of nearby objects with higher 3-D resolution. Wenfeng & Weiming [16] have stated wireless sensor network (WSN) nodes can closely sense their surroundings in a convenient and distributed way so that they can be considered as nerve terminals connected to a network such as the Internet. Recently, due to their great application potential, a trend has emerged that combines wireless sensor networks (WSN) and multi-mobile robots (MMR). Interesting applications can be found in disaster emergency response, military, communication, transport, and plant automation.

Nippun & Sudarshan [17] have stated that, video capturing is one more approach is used to teach the robot. In robot will follow a human demonstrator and simultaneously gathers information of the environment. Initially, a robot is controlled by a human operator who manually guides the robot through a desired path. Weckesser & Dillmann [19] have defined robots are supposed to operate in dynamic and changing environments together with human beings and other static or dynamics objects. Sensors that are capable of providing the quality of information that is required for the described scenario are optical sensors like digital cameras and laser scanners. A multi-sensor system supports the vehicle with odometric, sonar, and visual and laser scanner information.

The goal of this work is making robot navigation safer, faster, more reliable and more stable under changing environmental.

Danny & McKerrow [14] have shown Titan is a mobile robot built for outdoor navigation research. Titan measures its location relative to the path edge with a continuous transmission frequency modulated (CTFM) ultrasonic sensor and steers to follow a trajectory relative to the edge. Miikkulainen et al. [20] dealt about path-planning, it decides continuous from discretized places and describes procedures applicable when the implementation of a plan fails. It maintains for an integrated conception of such procedures, which must be tightly designer to the specific robot that is used, notably to the abilities and limitations of its sensory-motor tools. Path-planning, which is the process of selecting a course of actions to reach an aim, given the current location? Garcia et al. [21] defined in the Motion Planning investigation field and a method has demonstrated to outperform classical approaches gaining popularity in the last 35 years. This presents a proposal to solve the problem of path planning for mobile robots based on Simple Ant Colony Optimization Meta-Heuristic (SACO-MH). The new method is called SACOdm, where d stands for distance and m for memory. The path planner application has two operating modes, one is for effective environments, and the second one works with an actual mobile robot using wireless communication. Both operating modes are overall planners for plain terrain and support static and dynamic obstacle avoidance.

Marsland et al. [22] have stated that in landmark-based navigation systems for mobile robots, sensory perceptions (e.g., laser or sonar scans) are used to identify the robot’s current location or to construct internal demonstrations, plans, of the robot’s environment. Presence based on an outdoor structure of reference landmark-based robot navigation systems are now widely used in mobile robot applications. The problem that has concerned most attention to date in landmark-based navigation research is the question of how to deal with perceptual aliasing, i.e., perceptual uncertainties. In difference, what constitutes a good landmark, or how to select landmarks? The usual method of landmark selection is to map observations at regular intervals, which has the problem of being inefficient and possibly disappeared ‘good’ landmarks that lie between sampling points. Fua et al. [15] defined based on different working principles laser sensors can be categorized into time-of-flight (TOF) and triangulation. The TOF laser scanners have the advantages of a wide measuring range and high relative accuracy at a long distance; however, they are expensive, high power consumption and heavy. Commercial TOF laser scanners such as the HOKUYO URG-04 LX and the Swiss Ranger SR4000 are still too large to be used on centimetre-scale miniature mobile robots.

Boubaker & Tarek [23] have stated that the advantage of redundant serial robot manipulators in real applications is their dexterity and ability to avoid obstacles. This is due to the fact that they have more degrees of freedom than required to achieve desired tasks by their end-effector. However, redundancy generates complexity of the dynamic controller synthesis which can be considered as a challenge in automatic control,
mainly if the robot is in the presence of mechanical constraints and mobile obstacles. A new controller approach applied to fire robot manipulators forced by mobile obstacles. The controller is constructed in task space by using optimization strategy, in order to achieve a good trajectory tracing of the end effector even if the obstacles are fixed or mobile. Abiye et al. [24] have stated obstacle avoidance is the primary requirement for any autonomous robot. Designing a robot requires the integration and coordination of many sensors and actuators. In general, the robot acquires information about its surrounding through various sensors fixed on the robot. Generally, multiple sensors, such as infrared sensor, ultrasonic sensor, laser range finder, touch sensor and camera can be used to detect the presence of obstacles.

Guoqiang & Arianna [15] dealt in addition, because an infrared sensor only measures distance from the sensor coordinate frame to the target point at a time, so it needs to be scanned two dimensionally for 3D sensing. Ultrasonic sensors have the advantages of simple implementation and fast obstacle detection, but they are not accurate and reliable when detected obstacles have a complicated 3D shape, thus they are normally used for object detection and avoidance. Ming et al. [9] have dealt the control system designed allow a mobile semiautonomous robot to avoid unexpected obstacles in a partially unknown environment. In order for the robot to perform these tasks correctly, it must be able with some sensory system. There exist many areas of industrial application that can benefit from automated obstacle avoidance technology, for example, mobile robots that can roam freely and safely in a factory environment. Lee [25] shows an intelligent approach to robot navigation by landmark tracking using computer visualization is proposed. This approach is based on the concept that a human can reach the destination by tracking the specific landmark in an earlier environment. Only a monocular image of the landmark taken by the robot is required.

**DISCUSSIONS**

Navigation in mobile robotic is a methodology that allows guiding an MR to accomplish a mission through an unknown environment with obstacles in a good and safe way. The two basic responsibilities involved in navigation are the environment observation and path following. The navigation problem of an MR can be shared in different sub-problems:

- **Path planning** uses the structures to create an ordered sequence of objective points that the robot must reach.
- **Path generation** is the goal to obtain a path through the sequence of objective points.
- **Path tracking** it is in duty of controlling that the MR follows a path.
- **Obstacle avoidance** when the robot is very close to the target, the striking force between the robot and the target bases the robot seeking towards the target. Similarly when the robot is very close to an obstacle, because of disgusting force developed between the robot and the obstacle the robot must change its speed and angle to avoid the obstacle.
- **Localization strategies** Here we consider that a complete plan of the environment is delivered to the robot. We will be giving different localization strategies and the way they incorporate the information.
- **Sensing** The robot must define its orientation (position and heading) as well as information regarding the environment nearby it. Sensors often are not accomplished directly computing the quantity of interest. Like example, cameras measure colour, brightness and capacity of light, whereas for navigation one might be interested in statements such as “there is a door in front of the robot.”

**Principle of Navigation Strategies in an Unknown Environment**

In a totally unknown environment, navigation is completely done in a reactive manner. Indeed, a classical method such as artificial potential field can be used. Though, it is known that this method suffers from local minima problems that principal to obstructive conditions. A solution has been based on the automatic tuning of attractive and repulsive forces coefficient using fuzzy rules. But, some alternation problems remain in particularly fine environment pathways, which are very constraining for dedicated indoor utility robotics.
Local Navigation Method

A local navigation method (LNM) with obstacle avoidance is considered for mobile robots in which the dynamics of the robot are taken into account. The goal is known but the geometry and the location of the obstacles are unknown. The mobile robot position is represented by the Cartesian coordinates and can move in three directions, forward, left or right. The starting point and goal points of robot are given. Using these points the directional angle of robot is determined. There may be obstacles in the plane of motion and the objective is to navigate the robot to the goal avoiding the obstacles.

Landmark Finding Strategy

The overall structure of the proposed navigation method consists mainly of three components.

1. Landmark Finding.
2. Landmark Localization.
3. Landmark Understanding.

The Landmark Finding detects each landmark in a mobile robot’s workstation. Further specifically, for a monocular image taken by the robot, image pre-processing such as edge detection, thinning, and boundary tracing are used to extract the contour of the landmark and its content (symbols depicting the information to the destination). If there are multiple landmarks in the grabbed image, image segmentation techniques must first be performed to separate each landmark. The Landmark Localization determines the relative location of the detected landmark with respect to the robot and provides the necessary geometrical information for inverse perspective transformation which is required for symbol recognition. Usually, in a typical office building, door plates containing office numbers and/or name are common observed landmarks.

The obstacles can be situated at any place on the plan except at the starting point and at the destination point.

Distance and Position Estimation

The robot orientation and the distance from robot to the targeted object are often used as feature parameters for tracking. This method has also suggested measured the distance from the target object to robot by using laser which can track the target continuously when there are no obstacles in the tracking path. Also calculate the distance from the robot to a target object by using two un-calibrated independently moving cameras. Stereo cameras are also popular for tracking, but this method requires complex computation.

CONCLUSION

In this paper, we present a new mobile robot navigation strategy based on the WMR with unknown environment towards the proposed controller drives robot ultimately target at the required distance with the given speed. The aim was to obtain robust robot control suitable for real-time requirements and a laser scanner on a movable part actuated by a motor for indoor navigation of mobile robots. Obstacle avoidance and gateway detection can be implemented using proper navigation strategies according to measurement results. The method suggested can be applied to the robot manipulators with a mobile obstacle obstructing the motion of the mobile robot, show the effectiveness of the proposed approach.

There is good indication that uses local landmarks such as projecting trees, rocks, forest edges, etc., as well as situation landmarks such as sun, stars and magnetic senses to navigate effectively. It is also observed that in order to navigate between two known locations seem to prefer well defined and constant paths, even if this means longer travel distances. A method of detection and tracking a specific person based on colour camera has been implemented use of combining colour features and shape information of objects. This system points out several different modelling services, and enhances a lot the robot autonomy and efficiency. Finally, we must improve the robot speed by enhancements on the global system performance. To solve the problems of landmark
tracking and understanding a techniques of image processing and pattern recognition are integrated. Some robotic applications require a widespread coverage algorithm to agreement that the robot’s path covers the whole obstacle-free part.

References

