Neural Path planning For Mobile Robots

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***Abstract*—** Navigation is a major challenge for autonomous, mobile robots. The problem can basically be divided into positioning and path planning. The proposed path finding strategy is designed in a known static environments. The proposed method starts from an initial point to a target point establishing a control nodes neural networks for which connections are made to determine the form of the path. This algorithm provides the robot the possibility to move from the initial position to the final position (target). The robot moves within the unknown environment by sensing and avoiding the obstacles coming across its way towards the target. The proposed algorithm can deal with any shape obstacles even if it is the case of circular obstacles. This case is the hardest one in any navigation problem. The problem is solved by proposing neural networks navigation systems. Indeed, NNs are well adapted in appropriate form when knowledge based systems are involved. Since the network is able to take into account and respond to new constraints and data related to the external environments, the adaptation here is largely related to the learning capacity. Besides, Networks of neurons can achieve complex classification based on the elementary capability of each neuron to distinguish classes its activation function. Some useful solutions are proposed for each situation. For any proposed environment, the robot succeeds to reach its target without collisions. The results are satisfactory to see the great number of environments treated The simulation results display the ability of the neural networks based approach providing autonomous mobile robots with capability to intelligently navigate in several environments.

***Keywords*—** Intelligent Autonomous Mobile Robot, Path Planning, Navigation, Neural Networks, Autonomy Requirements.

I. Introduction

Several approaches have been proposed to address the problem of motion planning of a mobile robot. It is often decomposed into path planning and trajectory planning. Path planning is to generate a collision free path in an environment with obstacles and optimize it with respect to some criterion. Trajectory planning is to schedule the movement of a mobile robot along the planned path. If the environment is a known static terrain and it generates a path in advance it said to be off-line algorithm. It is said to be on-line if it is capable of producing a new path in response to environmental changes.

The history of autonomous mobile robotics research has largely been a story of closely supervised, isolated experiments on platforms which do not lat long beyond the end of the experiment. There is no universally accepted definition of the term robot. Typical definitions encompass notion of mobility, programmability, and the use sensory feedback in determining subsequent behaviour.

A robot is a device that responds to sensory input by running a program automatically without human intervention. Typically, a robot is endowed with some artificial intelligence so that it can react to different situations it may encounter. According to some authors, robot is referred to be all bodies that are modelled geometrically and are controllable via a motion plan

A robotic vehicle is an intelligent mobile machine of autonomous operation in structured and Unstructured environment; it must be able of sensing (perceiving its environment) thinking (Planning, reasoning) and acting (moving and manipulating).

Such technological changes have affected the concept of robots and created a whole new science of Robotics, new developments in robotics are brought about scientists using mathematical and physical Principles in new way

The intelligent autonomous systems motion planning problem has been studied thoroughly by the robotics research community over the last years. The basic feature of an autonomous mobile robot is its capability to operate independently in unknown or partially known environments. The autonomy implies that the robot is capable of reacting to static obstacles and unpredictable dynamic events that may impede the successful execution of a task. To achieve this level of robustness, methods need to be developed to provide solutions to localization, map building, planning and control [1,2,3,4,5].

Industrial robots used for manipulations of goods; typically consist of one or two arms and a controller. The term controller is used in at least two different ways. In this context, we mean the computer system used to control the robot, often called a *robot work-station* controller. The controller may be programmed to operate the robot in a number of way; thus distinguishing it from hard automation. The controller is also responsible for the monitoring of auxiliary sensor that detect the presence, distance, velocity, shape, weight, or other properties of objects. Robots may be equipped with vision systems, depending on the application for which they are used. Most often, industrial robot are stationary, and work is transported to them by conveyer or robot carts, which are often called autonomous guided vehicles (AGV). Autonomous guided vehicles are becoming increasingly used in industry for materials transport. Most frequently, these vehicles use a sensor to follow a wire in the factory floor. Some systems employ an arm mounted on an AGV.

Robot programmability provides major advantages over hard automation. If there are to be many models or options on a product, programmability allows the variations to be handled easily. If product models change frequently; as in the automotive industry, it is generally far less costly to reprogram a robot than to rework hard automation. A robot workstation may be programmed to perform several tasks in succession rather than just a single step on a line. This makes it easy to accommodate fluctuations in product volume by adding or removing workstations. Also; because robots may be reprogrammed to do different tasks; it is often possible to amortize their first cost over several products. Robots can also perform many applications that are poorly suited to human abilities. These include manipulation of small and a large object like electronic parts and turbine blades, respectively. Another of these applications is work in unusual environments like clean rooms, furnaces, high-radiation areas, and space. Japan has led the world in the use of robots in manufacturing. The two sectors making heaviest use of robots are the automotive and electronics industries. Interest in legged locomotion has been stimulated by application in traversing rough terrain and in unmanned exploration of unknown environment. Aside from electronic motivation, there are many unanswered scientific.

In mobile robotics, we care not only about the robot's ability to reach the required final configurations but also about *how* it gets there. Consider the issue of a robot's ability to follow paths: in the best case, a robot should be able to trace any path through its workspace of poses. Clearly, any omnidirectional robot can do this because it is holonomic in a three dimensional

Workspace. Unfortunately, omni directional robots must use unconstrained wheels, limiting the choice of wheels to Swedish wheels, castor wheels, and spherical wheels. These wheels have not yet been incorporated into designs allowing far larger amounts of ground clearance and suspensions. Although powerful from a path space point of view, they are thus much less common than fixed and steerable standard wheels, mainly because their design and fabrication are somewhat complex and expensive.

To discuss this ideal clearly, additionally nonholonomic constraints might drastically improve stability of movements. Consider an omnidirectional vehicle driving at high speed on a curve with constant diameter. During such a movement the vehicle will be exposed to a non-negligible centripetal force.

This lateral force pushing the vehicle out of the curve has to be counteracted by the motor torque of the omnidirectional wheels. In case of motor or control failure, the vehicle will be thrown out of the curve. However, for a car-like robot with kinematic constraints, the lateral forces are passively counteracted through the sliding constraints, mitigating the demands on motor torque. But recall an earlier example of high maneuverability using standard wheels: the bicycle on which both wheels are steerable, often called the *two-steer.*

Furthermore, mobile roboticists will often plan under the further assumption that the robot is simply a *point*. Thus we can further reduce the configuration space for mobile robot path planning to a 2D representation with just - and -axes. The result of all this simplification is that the configuration space looks essentially identical to a 2D (i.e., flat) version of the physical space, with one important difference. Because we have reduced the robot to a point, we must inflate each obstacle by the size of the robot's radius to compensate. With this new, simplified configuration space in mind, we can now introduce common techniques for mobile robot path planning.

The robot's environment representation can range from a continuous geometric description to a decomposition-based geometric map or even a topological map. The first step of any path-planning system is to transform this possibly continuous environmental model into a discrete map suitable for the chosen path-planning algorithm. Path planners differ as to how they effect this discrete decomposition. We can identify three general strategies for decomposition:

1. Road map: identify a set of routes within the free space.
2. Cell decomposition: discriminate between free and occupied cells.
3. Potential field: impose a mathematical function over the space.

This section presents common instantiations of the road map and cell decomposition path-planning techniques, noting in each case whether completeness is sacrificed by the particular representation Road map approaches capture the connectivity of the robot's free space in a network of 1D curves or lines, called *road maps*. Once a road map is constructed, it is used as a network of road (path) segments for robot motion planning. Path planning is thus reduced to connecting the initial and goal positions of the robot to the road network, then searching for a series of roads from the initial robot position to its goal position. The road map is a decomposition of the robot's configuration space based specifically on obstacle geometry. The challenge is to construct a set of roads that together enable the robot to go anywhere in its free space, while minimizing the number of total roads.

Generally, completeness is preserved in such decompositions as long as the true degrees of freedom of the robot have been captured with appropriate fidelity. We describe two road map approaches below that achieve this result with dramatically different types of roads. In the case of the *visibility graph*, roads come as close as possible to obstacles and resulting paths are minimum-length solutions.

Motion planning is one of the important tasks in intelligent control of an autonomous mobile robot. It is often decomposed into path planning and trajectory planning. Path planning is to generate a collision free path in an environment with obstacles and optimize it with respect to some criterion. Trajectory planning is to schedule the movement of a mobile robot along the planned path. A wide variety of approaches have been considered, but these can broadly be categorized into on-line and off-line techniques. However, few algorithms have been developed for on-line motion planning in a time-varying or unknown [9].

The major task for path-planning for single mobile robot is to search a collision –free path. The work in path planning has led into issues of map representation for a real world. Therefore, this problem considered as one of challenges in the field of mobile robots because of its direct effect for having a simple and computationally efficient path planning strategy. For path planning areas, it is sufficient for the robot to use a topological map that represents only the different areas without details such as office rooms. The possibility to use topological maps with different abstraction levels helps to save processing time. The static aspect of topological maps enables rather the creation of paths without information that is relevant at runtime. The created schedule, which is based on a topological map, holds nothing about objects which occupy the path. In that case it is not possible to perform the schedule. To get further actual information, the schedule should be enriched by the use of more up-to date plans like egocentric maps.

Recent research on intelligent autonomous systems has pointed out a promising direction for future research in mobile robotics where real-time, autonomy and intelligence have received considerably more weight then, for instance, optimality and completeness. Many navigation approaches have dropped the explicit knowledge representation for an implicit one based on acquisitions of intelligent behaviours that enable the robot to interact effectively with its environment, they have to orient themselves, explore their environments autonomously, recover from failure, and perform whole families of tasks in real-time.

The goal of the navigation process of mobile robots is to move the robot to a defined, undefined or partially defined place in a known, unknown or partially known environment. In most practical situations, the mobile robot can not take the most direct path from the start to the goal point. So , path planning techniques must be used in this situation, and the simplified kinds of planning mission involve going from the start point to the goal point while minimizing some cost such as time spent, chance of detection, or fuel consumption.

Therefore, the major main work for path planning for autonomous mobile robot is to search a collision free path. Many works on this topic have been carried out for the path planning of autonomous mobile robot. A key prerequisite for a truly autonomous robot is that it can navigate safely within its environment. For an autonomous mobile robot the questions like "how can I get my goal?", "where is the target position?", " what is my position and where I am situated in this environment?", refer to the tasks of self-localization, map building, and path planning. The difficulty of this problem depends on the characteristics of the robot's environment, the characteristics of its sensors, and the map representation required by the application at the same time.

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Even before the advent of affordable mobile robots, the field of path-planning was heavily studied because of its applications in the area of industrial manipulator robotics. Interestingly, the path planning problem for a manipulator with, for instance, six degrees of freedom is far more complex than that of a differential-drive robot operating in a flat environment.

Therefore, although we can take inspiration from the techniques invented for manipulation, the path-planning algorithms used by mobile robots tend to be simpler approximations owing to the greatly reduced degrees of freedom. Furthermore, industrial robots often operate at the fastest possible speed because of the economic impact of high throughput on a factory line. So, the dynamics and not just the kinematics of their motions are significant, further complicating path planning and execution. In contrast, a number of mobile robots operate at such low speeds that dynamics are rarely considered during path planning, further simplifying the mobile robot instantiation of the problem.

Path planning for manipulator robots and, indeed, even for most mobile robots, is formally done in a representation called *configuration space*. Suppose that a robot arm has degrees of freedom. Every state or configuration of the robot can be described with real values: , …, . The k-values can be regarded as point in a -dimensional space called the configuration space of the robot.

Now consider the robot arm moving in an environment where the workspace (i.e., its physical space) contains known obstacles. The goal of path planning is to find a path in the Physical space (a) and configuration space (b): physical space from the initial position of the arm to the goal position, avoiding all collisions with the obstacles. This is a difficult problem to visualize and solve in the physical space, particularly as grows large. But in configuration space the problem is straightforward. If we define the *configuration space obstacle* as the subspace of where the robot arm bumps into something, we can compute the free space in which the robot can move safely.

It is important that algorithms for navigation control in cluttered environments not be too computationally expensive as this would result in a sluggish response. It has been acknowledged that the traditional Plan-Sense-Model-Act approaches are not effective in such environments; instead, local navigation strategies that tightly couple the sensor information to the control actions must be used for the robot to successfully achieve its mission [1,2,3].

The planner's approximation of the configuration space is a direct function of the configuration space samples that the planner observes. Consequently, sampling is the search for the set of samples that provide enough information to construct a sufficient approximation of configuration space connectivity. For every configuration space, there are an optimal number of samples that must be selected to construct a sufficient approximation of configuration space connectivity.

Local planners impose an artificial potential field function on top of the configuration space. This potential field function is sloped so that its minimum is at the goal configuration. The artificial potential field is also influenced by configuration space obstacles. Configuration space obstacles have high artificial potentials that decline gradually with distance from the obstacle. At any instance, the robot calculates the derivative of the potential function and descends the maximal downward gradient in an effort to reach the minimum at the goal position. This calculation quickly determines the motion to take next.

Several others guided sampling strategies use information obtained from previous experience to guide their behaviour. Entropy-guided sampling adapts sampling to find configurations that offer maximal information gain given the current state of the planner. The measure of information gain can be mathematically proven to converge (in the limit) on the desired state. Reinforcement learning achieves a similar outcome at a higher level.

The robots are compelling not for reasons of mobility but because of their *autonomy*, and so their ability to maintain a sense of position and to navigate without human intervention is paramount. For example, AGV (autonomous guided vehicle) robots autonomously deliver parts between various assembly stations by following special electrical guide wires using a custom sensor. The Helpmate service robot transports food and medication throughout hospitals by tracking the position of ceiling lights, which are manually specified to the robot beforehand. Several companies have developed autonomous cleaning robots, mainly for large buildings. One such cleaning robot is in use at the Paris Metro. Other specialized cleaning robots take advantage of the regular geometric pattern of aisles in supermarkets to facilitate the localization and navigation tasks [15,16,17].

The environment complexity is a specific problem to solve since this environment can be imprecise, vast, dynamical and partially or not structured. Robots must then be able to understand the structure of this environment. To reach the goal without collisions, these robots must be endowed with perception, data processing, recognition, learning, reasoning, interpreting, decision-making, and actions capacities [4,5,6,7,8].

To take the best decision and to react intelligibly, neural networks are the wishes to understand principles leading in some manner to the comprehension of the human brain functions and to build machines that are able to perform complex tasks requiring massively parallel computation.

Neural Networks deal with cognitive tasks such as learning, adaptation generalization and they are well appropriate when knowledge based systems are involved. In general Neural Networks deal with cognitive tasks such as learning, adaptation generalization and they are well appropriate when knowledge based systems are involved.

To solve navigation problems, neural networks prove interesting to deal with the behaviour of autonomous mobile robots near the human being in reasoning. This paper deals with an algorithm for two dimensional (2D) path planning to a target for mobile robot in unknown environment. The objective is to find a collision free path from an unknown initial position to an unknown target point. A complete path planning algorithm should guarantee that the robot can reach the target if possible, or prove that the target cannot be reached. A few path planning algorithms are described here followed by the aim work of research in detail.

The proposed algorithm is able to achieve these tasks: avoiding obstacles, taking a suitable decision, and attending the target which are the main factors to be realized of autonomy requirements. The algorithm returns the best response of any entering map parameters.

The simulation results illustrate the generalization and adaptation capabilities of neural networks. An interesting alternative for future work is the generalization of this approach by increasing the number of possible robot directions. In this paper we discuss clearly the proposed neural networks navigation for autonomous mobile robots.

II. The Proposed Navigation Approach Based on the Neural Networks

A. *Navigation And Motion Planning problem*

Navigation is the ability to move and on being self-sufficient. The autonomous mobile robots must be able to achieve these tasks: to avoid obstacles, and to make one way towards their target. In fact, recognition, learning, decision-making, and action constitute principal problem of the navigation. One of the specific characteristic of mobile robot is the complexity of their environment. Therefore, one of the critical problems for the mobile robots is path planning, which is still an open one to be studying extensively. Accordingly, one of the key issues in the design of an autonomous robot is navigation, for which, the navigation planning is one of the most vital aspect of an autonomous robot [11,12,13,14].

Several autonomy requirements must be satisfied to well perform the tasks of AMR such as: Thermal, Energy, Communication Management, Mechanical design, etc. The development of such techniques for autonomous robot navigation is one of the major trends in current robotics research. Though there are many skills that are necessary for a robot to achieve in general. The autonomy is one of the most significant problems that a remains largely unsolved is the dexterous physical manipulation of objects in the world. Without the ability to interact with physical objects in a variety of sophisticated ways, robots can never be truly autonomous. Additionally, there are many practical robotic tasks, from elder care to building construction that require physical manipulation of the world. Human beings manipulate their world in a myriad of sophisticated ways on a daily basis. On any given day, entering the computer science building and attending to tasks at my desk requires a large number of sophisticated manipulations of physical objects.

Navigation is the science (or art) of directing the course of a mobile robot as the robot traverses the environment. Inherent in any navigation scheme is the desire to reach a destination without getting lost or crashing into any objects. The goal of the navigation system of mobile robots is to move the robot to a named place in a known, unknown, or partially known environment.

Several models have been applied for environment where the principle of navigation is applied to do path planning. For example, a grid model has been adopted by many researchers, where the robot environment is dividing into many line squares and indicated to the presence of an object or not in each square. On line encountered unknown obstacle are modelled by piece of “wall”, where each piece of “wall” is a straight-line and represented by the list of its two end points. This representation is consistent with the representation of known objects, while it also accommodates the fact the only partial information about an unknown obstacle can be obtained from sensing at a particular location.

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Navigation is one of the most challenging competences required of a mobile robot. Success in navigation requires success at the four building blocks of navigation: *perception,* the robot must interpret its sensors to extract meaningful data; *localization,* the robot must determine its position in the environment ; *cognition,* the robot must decide how to act to achieve its goals; and *motion control*(see the figure 1)*,* the robot must modulate its motor outputs to achieve the desired trajectory. Of these four components, localization has received the greatest research attention in the past decade and, as a result, significant advances have been made on this front (see the figure 2).

The goal of the navigation process of mobile robots is to move the robot to a named place in a known, unknown or partially known environment. In most practical situations, the mobile robot cannot take the most direct path from the start to the goal point. So, path planning techniques must be used in this situation, and the simplified kinds of planning mission involve going from the start point to the goal point while minimizing some cost such as time spent, chance of detection, or fuel consumption.

To plan efficiently despite the proven computational intractability of motion planning, sampling-based methods compute an approximate implicit representation of configuration space connectivity. This representation is constructed by sampling and observing a subset of all points in a particular configuration space. The planner’s approximation of the configuration space is a direct function of the configuration space samples that the planner observes. Consequently, sampling is the search for the set of samples that provide enough information to construct a sufficient approximation of configuration space connectivity.

For every configuration space, there is an optimal number of samples that must be selected to construct a sufficient approximation of configuration space connectivity.

Path planning in spatial representation often requires the integration of several approaches. This can provide efficient, accurate, and consist navigation of a mobile robot. It is sufficient for the robot to use a topological map that represents only the areas of navigation (free areas , occupied areas of obstacles). It is essential the robot has the ability to build and uses models of its environment that enable it to understand the environment’s structure. This is necessary to understand orders, plan and execute paths.

The existing GPS network provides accuracy to within several meters, which is unacceptable for localizing human-scale mobile robots as well as miniature mobile robots such as desk robots and the body-navigating nanorobots of the future. Furthermore, GPS technologies cannot function indoors or in obstructed areas and are thus limited in their workspace.

Furthermore, during the *cognition* step a robot will select a strategy for achieving its goals. If it intends to reach a particular location, then localization may not be enough. The robot may need to acquire or build an environmental model, a *map* that aids it in planning a path to the goal. Once again, localization means more than simply determining an absolute pose in space; it means building a map, then identifying the robot’s position relative to that map.

The problem of representing the environment in which the robot moves is a dual of the problem of representing of the robot’s possible positions. Decisions made regarding the environmental representation can have impact on the choices available for robot position representation. Often the fidelity of the position representation is posed by the fidelity of map. Three relationships are posed here to understand how to choose particular map:

1. The precision of the map must appropriately match the precision with which the robot needs to achieve its goal.
2. The precision of the map and the types of features represented must match the precision and data types returned by robot’s sensors.
3. The complexity of the map representation has direct impact on the computational complexity of reasoning about mapping, localisation, and navigation.

Using these informations, we can construct the *configuration space* of the robot, in terms of which the path planning problem is formulated generally.

B. The Proposed neural Networks Navigation Approach

The environment complexity is a specific problem to solve since this environment can be imprecise, vast, dynamical and partially or not structured. Robots must then be able to understand the structure of this environment.

To solve navigation problems, neural networks prove interesting to deal with the behaviour of autonomous mobile robots near the human being in reasoning. Near this one, Neural Networks are the wish to understand principles leading in some manner to the comprehension of the human brain functions and to build machines that are able to perform complex tasks requiring massively parallel computation.

In general Neural Networks deal with cognitive tasks such as learning, adaptation generalization and they are well appropriate when knowledge based systems are involved.

Thus, several approaches based on neural networks for autonomous mobile robots are oriented to design and achieve robots which simulate the human decision-making in similar way of acquiring some keys of intelligence. The key of intelligence is focused on the manner of: thinking, perceiving, and acting. Networks of neurons can achieve complex classification based on the elementary capability of each neuron to distinguish classes its activation function.

The adaptation is largely related to the learning capacity since the network is able to take into account and respond to new constraints and data related to the external environments.

Just as human being, a neural network relies on previously solved examples to build a system of "neurons" that makes new decisions, classification and forecasts.

In designing a Neural Networks navigation approach, the ability of learning must provide robots with capacities to successfully navigate in the environments like our proposed maze environment. Also, robots must learn during the navigation process, build a map representing the knowledge from sensors, update this one and use it for intelligently planning and controlling the navigation.

The general structure of the proposed Neural Networks navigation is presented as follow:

Knowledge mapping: the model of the external environment plays an important role in the intelligent robot behavior. The human brain is able to create -simple maps of the external environment by compressing the huge amount of received sensory data, while preserving the relationships between important facts.

Action: the different map sensory informations are classified in several vectors where each component responds to a particular situation. These situations must be associated with the appropriate action taking advantage of the topology-preserving property of the network.

Reinforcement learning: reinforcement learning allows associations between detected sensory situations and appropriate actions trough " trial and error" learning. This one uses only a priori knowledge such as "asked response" is executed. These associations are formed in unsupervised manner, i.e., with no " supervisor or teacher" required.

During the navigation, the robot must localize its target and recognize the environment. The movement of the robot are supposed possible only in four (04) directions and consequently four actions $A=[A_F, A_L, A_R, A_B]$ are defined as action to move Front, action to turn to the Left, action to turn to Right , and action to turn Back (see the figure 3).

The situations of the static target localization are defined by $T=[T_F\ T_L, T_R, T_B]$ while the static obstacle avoidance situations are defined by $O=[O_1,O_2,O_3,\ldots,O_i]$. Three layers constitute the proposed Neural Network structure as shown in the figure 4.

Layer 1: this layer represents the input layer with four (04) input nodes receiving the components of the vector $T=[T_F, T_L, T_R, T_B]$. This layer transmits the inputs to all nodes of the next layer.

Layer 2: this layer represents the hidden layer with i^{eme} nodes. The output of each node is obtained as follows:

$$\gamma_k = f(\sum_i X_i W_{1ki}) \quad (1)$$

Where f is the output sigmoid function, W_1 : the weights of the output layer and $W_1(t+1) = W_1(t) + \Delta W_1$. With $\Delta W_1 = \eta\delta$ y Whereas learning rate is : $0<\eta<1$ and Y : hidden output.

Layer 3: this layer represents the output layer with (j^{eme}) output nodes which are obtained by :

$$T_j = f(\sum_k \gamma_k W2_{jk}) \quad (2)$$

In the proposed approach, the Neural Network is trained to capture the behaviour of a human expert while controlling the obstacle avoidance operation. The network must mimic the input/output mapping of this human expert. This set is trained in order to deduce at the end the best direction to be taken by the robot. The learning of the proposed networks are based on the supervise Gradient Back-Propagation .The training is performed in a learning environment where all situations of vector T and O are represented and only free-collision action is permitted in each situation.

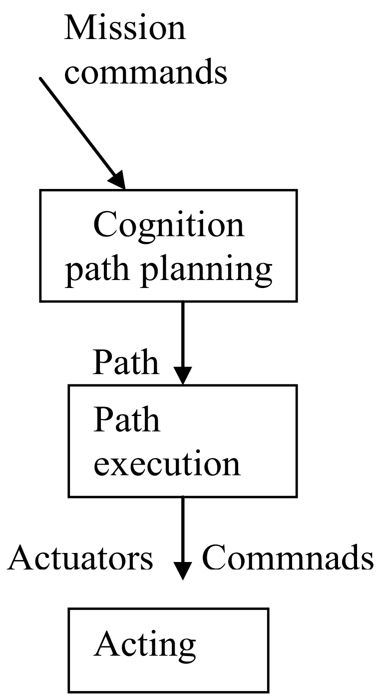

Fig. 1 Motion Control

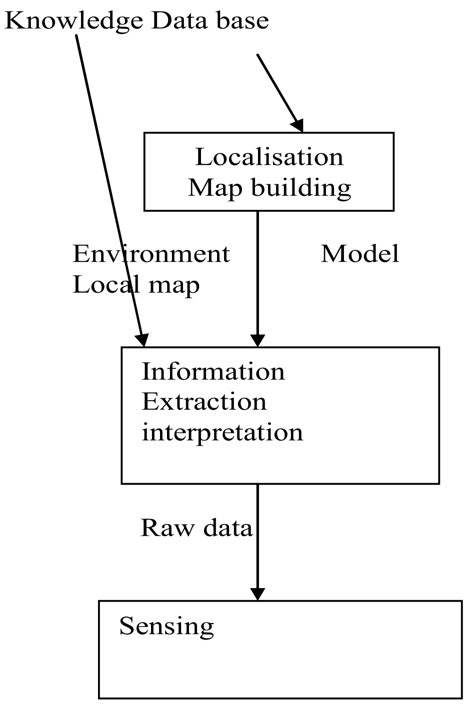

Fig. 2 Perception general view

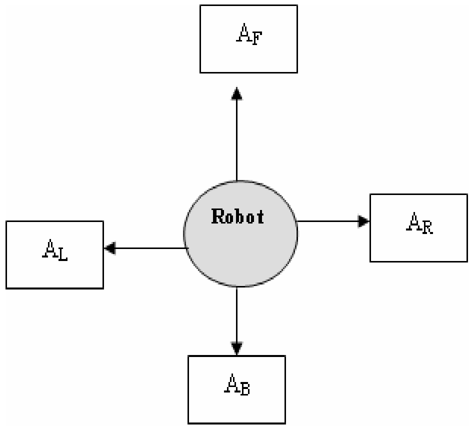

Fig. 3 robot and the four actions

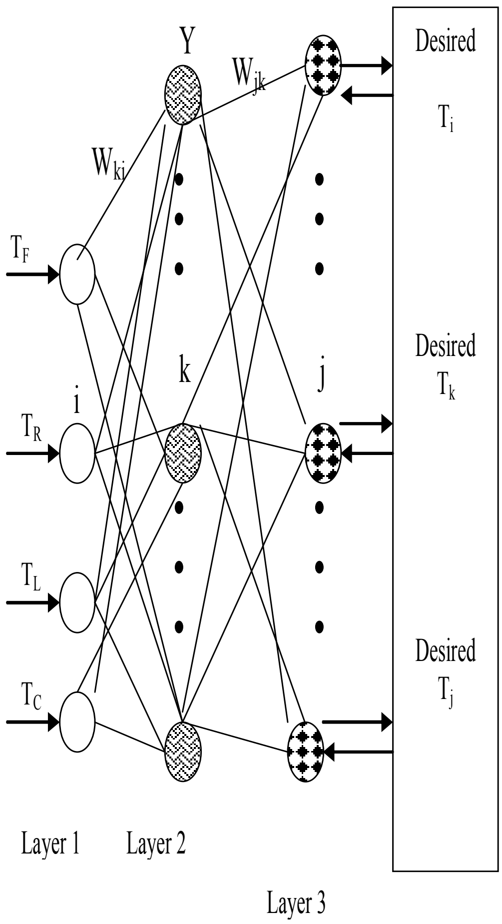

Fig. 4 Target Localization Neural Network

III. Simulation Results

The robot is simulated in different environments. To reflect the robot behavior acquired by learning in the explored environment and in new unvisited environments. The robot reacts in efficient and a satisfactory manner in these environments. As we can see the generalization and adaptation abilities of the system are achieved. The configuration of the environments changes by adding other shapes of static obstacles, in each situation the robot can navigate successfully.

The proposed approach is able to achieve the main task without collisions for every developed or proposed environment. Indeed, the networks grow to represent the problem as it sees fit. After learning, the target location situation is trained in the learning environments. From data obtained by computing distance and orientation of the robot-target, the robot is able to react, understand and achieve its mission perfectly.

The proposed approach can deal a wide number of environments and gives to our robot the autonomous decision of how to avoid obstacles and how to attend the target. More, the path planning procedure covers the environments structure and the propagate distances through free space from the source position. The results are very satisfactory to see the complexity of the principle and the extension versions of generation maps.

In order to evaluate, the average performance of our Neural networks over various environments, we observed simulation of the Neural networks for great number of environments. We can change the position of obstacles so we get other different environments. These environments were randomly generated .

To find a new path after insertion of deletion of an obstacle; we measure the number of generations of candidates. the basic features of the navigation of an autonomous mobile robot simulation have been shown using the NN approach.

In this present work we present a strategy of navigation of autonomous mobile robots based on the principle of neural networks. The proposed path finding strategy is designed in an unknown environments form.

The aim of this work is to develop an algorithm which allows a mobile robot to navigate through static obstacles, and finding the path in order to reach a specified target. We propose an algorithm that provides the robot a trajectory to be followed to move from the initial position to the specified target. We propose scheme for path finding from initial position to goal position. The problem can basically be divided into positioning and path planning.

The simulation part is an approach to the real expected result; this part is done using neural networks. The algorithm is implemented in several static environments; whereby the environment is studied in a two dimensional coordinate system. The algorithm permits the robot to move from the initial position to the desired position following an estimated trajectory.

The figure 5 and the figure 6 clarify more the principle and show how the robot succeeds to reach the goal without collisions according to the configuration of the selected environments.

Taking a suitable action and reacting at the appropriate way, the robot finds its safe way without collisions in efficient manner. If the algorithm does not converge, an error is returned.

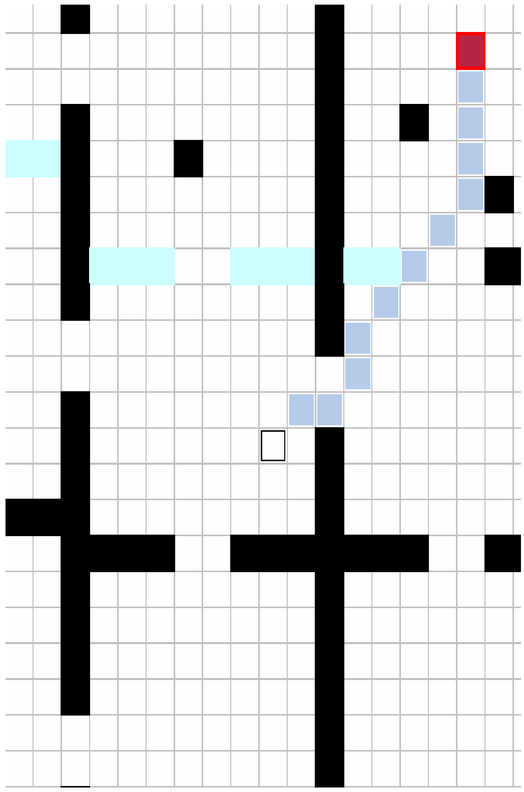

Fig. 5 Neural based navigation set-up1

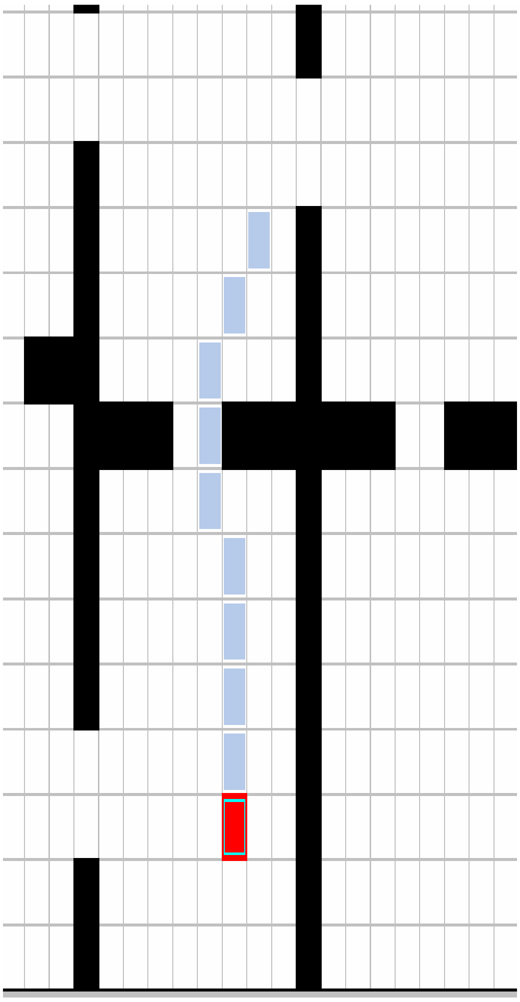

Fig. 6 Neural based navigation set-up2

IV. Conclusion

In this paper we presented an approach for mobile robot positioning and navigation which is based on the principle of the neural networks. Starting out from a start location and orientation in the grid, the mobile robot can autonomously head for destination Cells. On the way it determines its location in the grid using the principle of the neural networks.

We demonstrated how we implemented the underlying algorithm in software. Target location situations are associated with favorable actions in an obstacle-free environment explained in detail in this paper.

We have run our simulation in several environments where the robot succeeds to reach its target in each situation and avoids the obstacles capturing the behaviour of intelligent expert system. The proposed approach can deal a wide number of environments. This navigation approach has an advantage of adaptivity such that the intelligent autonomous mobile robot approach works perfectly even if an environment is unknown.

This proposed approach has made the robot able to achieve these tasks: avoid obstacles, deciding, perception, and recognition and to attend the target which are the main factors to be realized of autonomy requirements. Hence; the results are promising for next future work of this domain. Besides, the proposed approach can deal a wide number of environments.

This system constitutes the knowledge bases of our *approach* allowing recognizing situation of the target localization and obstacle avoidance, respectively. Also, the aim work has demonstrated the basic features of navigation of an autonomous mobile robot simulation. The intelligent behaviour necessary to the navigation, acquired by learning enable the robot to be more autonomous and intelligent.

The simulation results illustrate the generalization and adaptation capabilities of neural networks. An interesting alternative for future work is the generalization of this approach by increasing the number of possible robot directions.

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