

Navigation of Automatic Vehicle by Using AI Technologies

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Abstract--In the field of mobile robot navigation have been studied as important task for the new generation of mobile robot i.e. Corobot. For this mobile robot navigation has been viewed for unknown environment. We consider the 4-wheeled vehicle (Corobot) for Path Planning, an autonomous robot and an obstacle and collision avoidance to be used in sensor based robot. We propose that the predefined distance from the robot to target and make the robot follow the target at this distance and improve the trajectory tracking characteristics. The robot will then navigate among these obstacles without hitting the mand reach the specified goal point. For these goal achieving we use different techniques radial basis function and back-propagation algorithm under the study of neural network. In this Corobot a robotic arm are assembled and the kinematic analyses of Corobot arm and help of Phidget Control Panel a wheeled to be moved in both forward and reverse direction by 2-motor controller have to be done. Under kinematic analysis propose the relationships between the positions and orientation of the links of a manipulator. In these studies an artificial techniques and their control strategy are shown with potential applications in the fields of industry, security, defense, investigation, and others. Here finally, the simulation result using the webot neural network has been done and this result is compared with experimental data for different training pattern.

Index Terms — Corobot, Phidget Control Panel, kinematic analysis, Robot

1. INTRODUCTION

Experimental Result Of Manipulator

The Corobot arm has four servo s motors (0,1,2&3) position which are controlled through the use of phidgets control panel. The arm is very user friendly because of the computer interface developed by us. They could lift objects upto weight of 8oz. The robotic arm can be designed to perform any desired task such as welding, gripping, spinning etc. depending on the application. The robot arms can be autonomous or manually controlled and can be used to perform a variety of tasks with great accuracy. Under Phidget Servo, Phidget Moter controller and a Phidgets servo controller are to be studied.



FIG 1 :COROBOT VIEW IN LAB



FIG 2 :ARM POSITION & ORIENTATION

Control of the robot arm may be separated into shoulder; elbow, wrist and gripper are shown in the figure 9. In arm 4 motors are there in phidgets control panel these motor are numbered by 0, 1, 2 & 3 with respect to shoulder, elbow, wrist and gripper respectively are

In this study first set the servo motor number (like 0, 1, 2 or 3) then target position are to be set. Also velocity & acceleration are maintained though the required position and motion speed then select the engaged option so arm has to move. Shoulders and elbow moves in the up and down direction but wrist are rotate in either clockwise or anticlockwise direction and also gripper is open or closed.

Service motor No	Minimum Position (degree)	Maximu Position (degree)	Set Target position
0	0	180	77.429
1	0	180	87.491
2	0	180	135
3	0	180	113.65

Table 1: Experiment Result of Manipulator



Figure 3 : Target Position of Corobot Manipulator using Phidget Control

NEURAL NETWORK /WEBOT / COROBOT

Corobot study for path navigation using a technique Neural Network (NN) and with the help of Webot. NN methods works on the principle of the neurons present in a normal human brain which are the basically data transfer element. In this neural network, we propose a methodology for training a new model of artificial neural network called the generalized radial basis function (GRBF) neural network. The inputs to the proposed neural controller consist of left, right, and front obstacle distance with respect to its position and target angle. The output of the neural network is steering angle. A four layer neural networks has been designed to solve the path and time optimization problem of mobile robots that deals with the cognitive tasks such as learning, adaptation, generalization and optimization. Back propagation algorithm is used to train the network. The training of the neural nets and the control performances analysis of the neural network has been done in a real experimental setup. This approach can be used very intelligently in autonomous robotic

control in industrial, mining or exploration, military operation, space exploration, search and rescue in unstructured environments, rapid construction of arbitrary tools under space, etc. Before starting the main parts of this chapter first we introduce about robot overview because this vehicle is also a robot.

2. COROBOT

Corobot is Coroware based company of Kirkland WA. The corobot and explorer both is mobile robot, which are four wheeled robotic expansion platforms. "The corobot is a 4 wheeled robot with an on-board PC. It has wheel encoders, a webcam, IR range sensors and an optional 4 degree of freedom arm with gripper. It is a standard platform robot which is meant to be customized for research application." Corobot was generated to minimize the complexity of robot development. Through

combining a powerful PC-class platform with a robust, object-oriented development system, the Corobot empowers to rapidly deploy and develop robotics results. The corobot also supports the hardware developer with additional physical mounting space, ports, sensors and communication devices.

3. OVERVIEW & INITIAL SETUP

CARRYING THE COROBOT:-

The Corobot arrives fully assembled and after a few initial setup steps, the Corobot is ready for use. To hold the Corobot securely with two hands placed between the wheels holding the upper and lower decks.



Fig 4 : Carrying the Corobot

4. ENVIRONMENTAL CONCERNS:-

The Corobot is designed for easy entrance, disassembly, and reassembly for the

adding and changing of hardware and parts. Due to the uncluttered design, the Corobot is sensitive to debris. Light outdoor operation should pose no problems to the Corobot; on the other hand, water and dirt will cause damage. The unit is not water proof. Most indoor environment poses no problems for the Corobot.

5. FRONT OF COROBOT

The front of the Corobot has the primary sensor (a laser range finder, pan-tilt camera, and/or fixed camera) and the robotic arm.



FIG 5: FRONT VIEW OF COROBOT

6. BUMPER SENSORS

The Corobot comes standard with a front bumper sensor. If selected a 4-wheel drive Corobot, then have received a rear bumper. This sensor detects positive pressure collisions with obstacles using two feelers on each bumper.



FIG 6 :VIEW OF BUMPER SENSOR

7. SIDES OF COROBOT

The Corobot has a power switch and jacks for battery charging and tether on one side, and push buttons for turning on and resetting the on-board

CPU on the other. The 2 wheel, differential drive base has the power switch and jacks on the left side of the robot and the CPU power and reset buttons on the right. The 4 wheel, skid steer base has the power switch and jacks on the right side of the robot and the CPU power and reset buttons on the left.



FIG 7 : LEFT SIDE OF COROBOT VIEW

For both cases, the power Selector Switch is the three position switch in the centre.

- Up: Operate off tethered power and enable battery charging
- Centre: Off and disable battery charging
- Bottom: Run off battery power (no charge)



FIG 8 : RIGHT SIDE OF COROBOT VIEW

The other side of the Corobot contains two buttons.

1. Power button – Press this button to turn on the robot's on-board CPU. Once on, pressing the button once will signal the OS to start shutting down cleanly. Pressing the button continuously for 5

seconds will power the CPU immediately off.

2. Reset button – Press this button to reset the robot's on-board CPU.

8. REAR OF COROBOT

2 wheel differential drive Corobots have a caster at the rear of the robot for balance. The 4 wheel skid steer base is steadied by all four wheels, and so does not need a caster for balance. Rear connection ports are located on the upper deck in between the batteries.



FIG 9 : REAR VIEW OF COROBOT

Rear Connection Ports

1. Mouse (green)
2. Keyboard (purple)
3. Serial connection (top)
4. Monitor connection (bottom)
5. Ethernet jack (top)
6. USB board (bottom)
7. PCMCIA slot (Wireless Card Inserted)
8. S-video output (black)
9. RCA-video output (yellow)
10. Line out (green)
11. Line in (blue)
12. Microphone (pink)
13. Firewire

Servo Control-

A servo motor mainly consists of a DC motor, gear system, a sensor which is mostly a potentiometer, and control electronics system. The DC motors is connected with a gear mechanism which provides feedback to a position sensor which is mostly a potentiometer. From the gear box, the motor output is delivered via servo spline to the servo arm.

Phidget- Phidgets are a system of low-cost electronic components and sensors that are controlled by a personal computer. Using the universal Serial Bus (USB) as the basis for all pidgets, the complexity is managed behind an Application programming Interface (API). Their usage is primarily focused to allow exploration of different physical computer interaction systems, but have most especially been adopted by robotic supporters as they greatly simplify PC-Robot interaction systems, but have most notably been adopted by robotic enthusiasts as they greatly simplify PC-Robot interaction.

Example of Phidgets-

Servo – Allows control of up to 4 servo motors. Each servo can be addressed individually where it can have its position read and set.

Phidget Accelerometer – The accelerometer senses acceleration in 2 and 3 dimensions.

Interface Kit – Allows input/output interface to analog and digital sensors and switches.

9. COROBOT SPECIFICATION

Dimensions	12 x 13 x 10 in (16in w/ arm)
CPU	1.5 Ghz
RAM	1 GB
Disk Space/ROM	80 GB
Battery/Life	10 AH / 2.5 Hours
Base Type/Steering	4 WD skid steer
Max. Speed	1.5 ft. per second
Wheel Encoders	Yes
Camera	640x480 Color, 2 Megapixel
Digital Inputs	8
Digital Outputs	8
Bumper Sensors	Front (standard) and Back (optional)
Voltage Sensor	Yes
Arm Size	14 in long
Arm DOF	4
Gripper Span	1.3 in
Gripper Sensor	Yes
Arm Payload Capacity	8 oz
Base Payload Capacity	5 lbs
Windows	XP Supporting C-Language API
Linux	Ubuntu, supporting C-Language API
Optional Pan/Tilt Camera	Yes
Optional AMD Processor	Yes

FIG 10 : COROBOT SPECIFICATION

10. COROBOT INSTALLATION

COROBOT WINDOWS INSTALLATION:-

When powering up for first use, the user will be prompted to complete the last few steps to install windows. The default windows installation is recommended. In this Corobot a standard PC located on the lower deck. During the installation process, the user will be required to attach the monitor, keyboard, mouse, and feasibly the Ethernet connection.

Complete the following steps to install Windows:

1. Ensure that the Corobot is elevated on blocks such that the wheels do not come into contact with the ground surface.
2. Plug the tethered power card into the electrical outlet and then into the Corobot.
3. Attach the battery charger unit to the Corobot.
4. Attach the monitor, keyboard, mouse and Ethernet connection.
5. Press the power button and wait for the Corobot to fully power up.

6. The Welcome to Microsoft Windows screen will be displayed.

7. Click Next.

8. Read End User License Agreement then accepts the agreement, click Next.

9. Enter the Windows Product Key.

10. At the Help protect PC screen, we will not enable the firewall right now. Click Next when done.

11. Choose a computer name for the CoroBot's on-board computer. Click Next when

12. Select an Administrator password. Enter the password and click Next.

13. Set user accounts. These accounts will not be used by the robot, however, Microsoft Windows requires at least one account to be created. Click Next. The Welcome to Microsoft Windows screen will be displayed.

14. Windows will complete the boot-up process. At the log-on screen, select the "robot" account.

15. Click the start button, and select "Run". In the dialog box enter "control userpasswords2"

16. A dialog box prompting for the account automatically logging then Click the OK button.

17. Shut down Windows.

18. When the computer has powered down, press the Corobot power button again to reboot the computer.

19. Verify that the Corobot automatically logs into the "robot" account, and runs its services

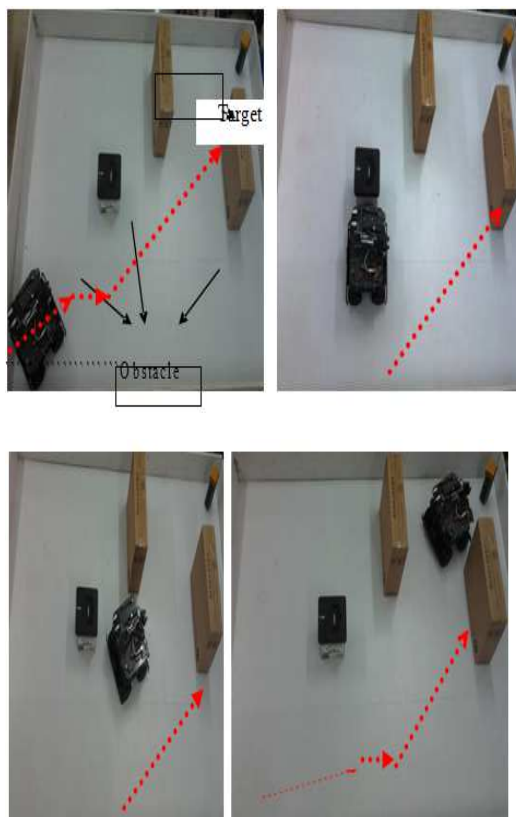
20. Shut down Windows

21. Disconnect the keyboard, monitor, mouse and Ethernet.

11. EXPERIMENT RESULT

To perform the experimental test of mobile robot the developed software by Phidget Control panel is loaded into the Corobot. To control the functionalities of the robot (motors,

sensors etc.), a set of command are implemented in the control protocol.



Experiment Setup of Corobot with avoiding obstacle to seeking the target The assumptions about the mechanical structure and the motion of a mobile robot to which our proposed method is applied as mobile robot moves on lab specified floor area and the wheel of a mobile robot rolls on the floor without any translational slip. For this wheel

two motor are used one are in left side and other are right side of Corobot. And wheel is moves in both forward and reverse direction at specified given velocity and acceleration. This Corobot achieves the target in around 20 sec to 5-8 m distance.

12. DISCUSSION OF RESULT

The project can be implemented in different area like kinematic analysis of robotic arm, run the wheel encoders, etc. and neural network, webot simulation of Corobot. The first part of the result was done by used the servos to move the robot arm. To interface a robot arm with a computer and set into operation and to control the motion of robot arm by computer keyboard input. This goal was achieved by Phidgets and Servo-Motor Controller. The arm parts operate to move the

shoulders, elbow, wrist and gripper joint of the robot with 4-DOF in either up, down or to be rotate.

The kinematic design is a basic part of the mobile robot system. Improved mechanical designs and mobility control systems will enable the mobile robot to navigate in no marked paths and for autonomous operation. A kinematic methodology is the first step towards achieving these goals. In addition to avoiding static obstacles, path planning we must include under neural network method radial basis function and back-propagation algorithm. Also we discuss the result of Corobot with webot simulation and their experimental data. To illustrate this, we consider the case in which the robot can reach the target in this way. At the beginning of the simulation robot moves along a substantial path and cause a rapid change of neural activities and the direction.

In this study, we proposed the BP learning for the development of autonomous robots with proximal and distal evaluation scores of behavior, and described results of its application to a real mobile robot Corobot. The training data set was obtained in free movement in an environment, and selected in accordance with an evaluation function which represented the consequence of behavior in the near and distant future. Corobot learned to navigate in an environment with obstacles faster than that with one evaluation score, and also faster than the conventional evolution. The results of the proposed trajectory planner are discussed through simulations on Corobot using Webots robotics simulator. The Webots simulator is based on ODE (open dynamic engine), open source physics. The presented results prove that the proposed method can produce accurate collision free paths by using simple and cheap sensors. Furthermore, the robustness and the effectiveness of the method are established. We observe that both the simulator and the real robot achieve the same final position and that, moreover, the trajectory described by both, from the initial position to the final position, is practically identical.

S. N O.	Path length of robot during simulation	Path length of robot during Experiment using	Time taken during Simulation (sec)	Time taken during Simulation (sec)	Deviation %

	n using NN (m)	NN (m)			L E N G T H	T I M E
1	4.5	5	17	19	10	10.5 2
2	6.4	7	22.5	25	9.28	10
3	8.2	9	28.2	31	8.89	9.0 3
4	10	11	34.5	38	9.09	9.2 1

$$\text{Deviation (\%)} = [(\text{Experimental} - \text{Simulation}) / \text{Experimental}] \times 100$$

13. CONCLUSION

In this thesis report, from the literature review we conclude that 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 navigation of mobile robots. Obstacle avoidance and gateway detection can be implemented using proper navigation strategies. 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. 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 object 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 wide spread coverage algorithm to agreement that the robot's path

covers the whole obstacle-free part.

Validation of theoretical and work has been done by simulation and a real world tests by a COROBOT simulation has been developed.

14. FUTURE WORK

There are a number of interesting directions to pursue as future work. In future the Corobot comes with a C-language API. This C-API code allows to runs the Corobot autonomously. And recommendation, this robot can be equipped with a view and display at

the monitor screen by achieves a target by both local & global navigation. And further development of the techniques may be required for the avoidance of moving obstacles other than the robots. In these navigational techniques may be carried out so that the robots can not only detect dynamic targets but also reach them using an optimum path. There is in future 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.

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