Projects in Mechatronics

November '03 to January '04

Vehicle for ***I***ndividual ***P***erception of ***E***nvironments ***R***obot [VIPER]

Duration: *Three months.*
Development Site: *Institute of Control Engg, Siegen, Germany*

Goal

Our objective is to design a navigational robot, navigating through obstacles and achieving a target.

Problem specification

The problem space is simplified by using a fixed target, a light source, and fixed obstacle of definite size so that it can be easily detected by the sensor used for this purpose. All the uncertainties that may exist in a real world are ruled out to make the task more simple, for example, uncertainty of the target, which is a light source, may turned off during the operation which may lead to No-Target situation for the robot, the uncertainty of the ground being flat, etc.

Introduction

About the Robot

The robot consists of a round disc made up of a transparent fiber glass material. It is moved with the help of two wheels mounted to on the disk and is driven by two separate motors with encoders. A small third wheel called trailer wheel is mounted at the back side of the robot for support. This particular configuration of wheels will enable the robot to spin around one particular place about its own axis. The robot is also provided with a Microcontroller - Infenion C167CR-LM, to control whole process. This Microcontroller has to be programmed using a C-compiler. More information about the hardware used can be obtained by clicking here.

Operation

The complete operation of the robot is depicted with the help of the flow chart shown in **Fig. 1**. The target detection sensor, a photo diode, issues information about the orientation of the target to the controller, sees **Fig. 3**. Then the controller gives command to the robot to moves forward in that direction towards the target. If there is no obstacle in the path then the robot continues to move in that direction until it is under the target,

which is kept at certain height above the ground. There is one more sensor, also a photo diode, which is exactly at the top of the robot which gives information to the controller whether the target is just above the robot or not, i.e. whether the target is achieved or not. When the target is achieved, robot stops at that position, see **Fig. 3**.

If there is an obstacle in the path of the robot, any of the three ultrasonic sensors mounted on the robot will sense this obstacle and informs the controller that there is an obstacle in the path and hence stop here, see **Fig. 4**. Then the robot maneuvers its path and avoids the obstacle consequently by choosing a different route.

Change in the course of path of the robot due to obstacle may result in the loss of target. The controller has to give command to the robot to search the target again before moving further in any direction. Thus, the whole process repeats again as illustrated above.

There might be a possibility for the robot that it may not find target from a particular place. The target may be behind some obstacle and the robot cannot see it from its place. In this case, robot can move to some random position and can search for the target until he finds it.

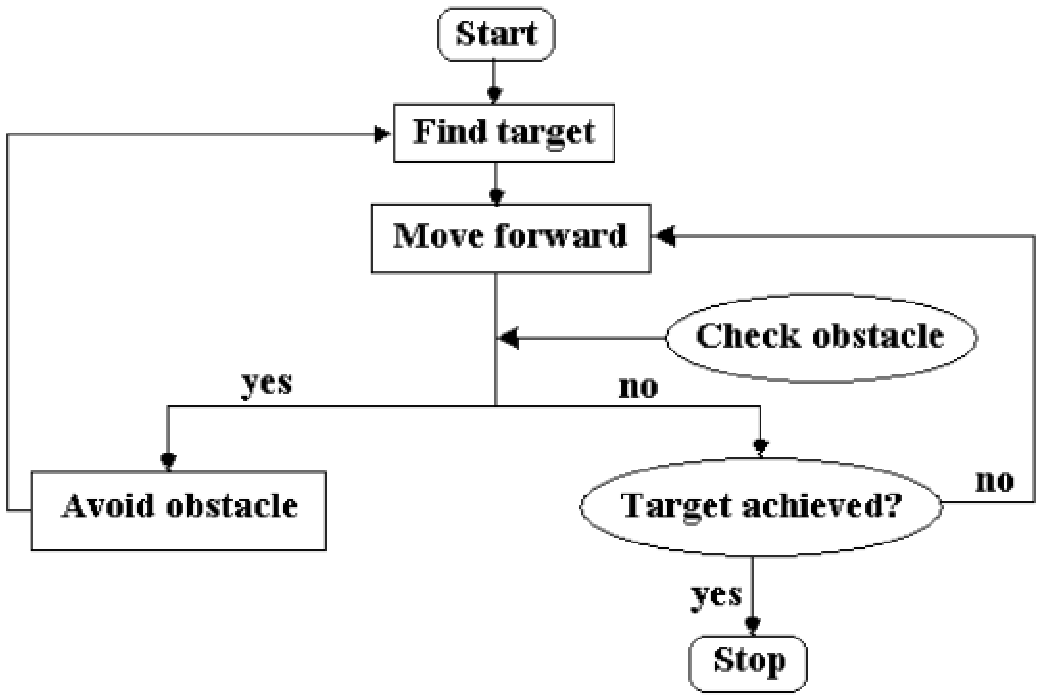


Fig. 1

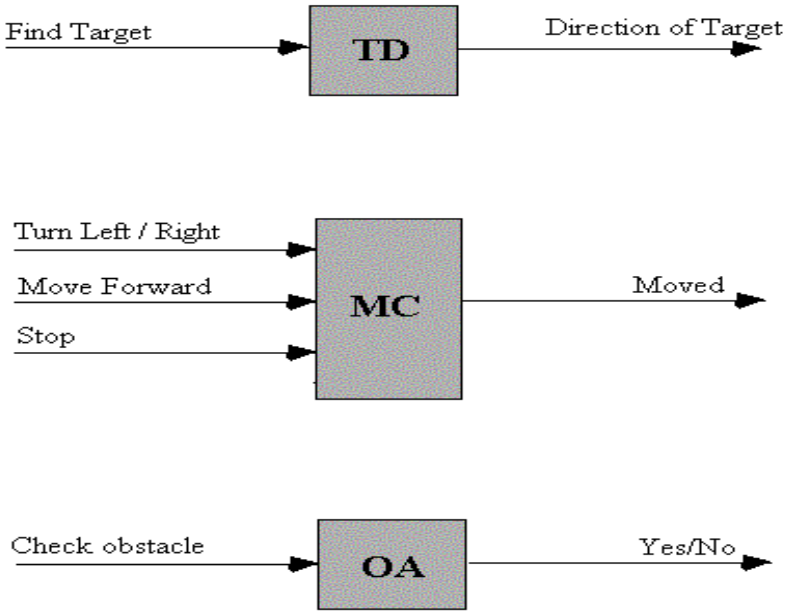
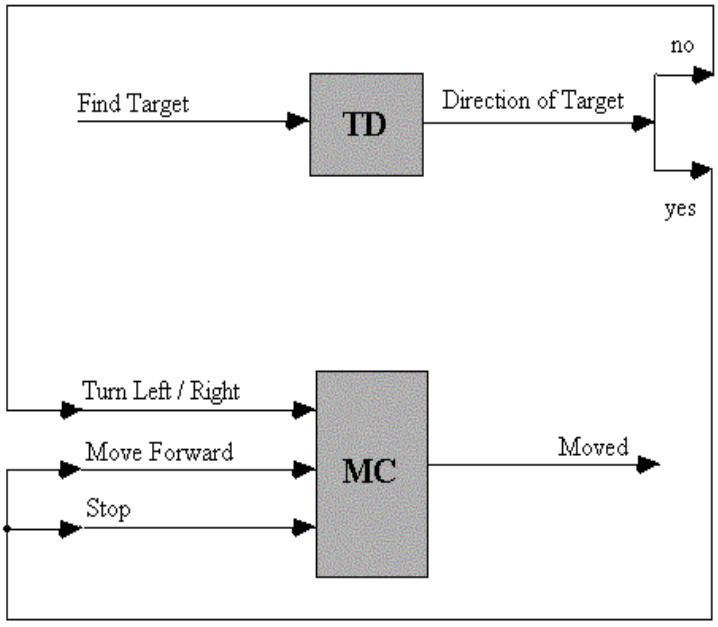
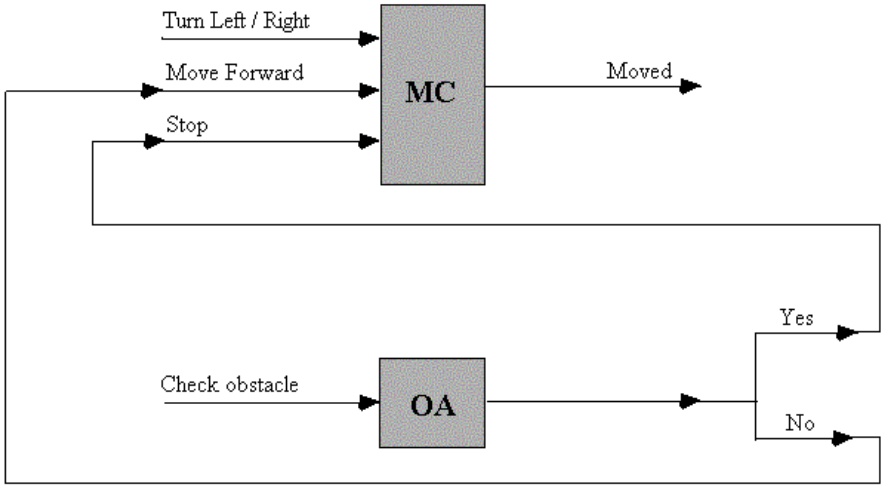


Fig. 2



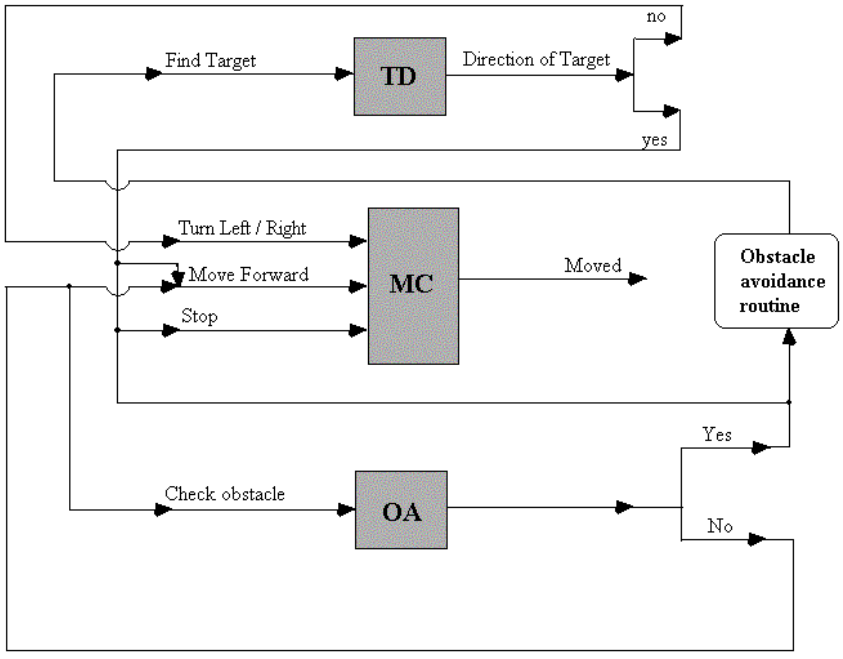
Interdependency between Target Detection block and Motion Control Block.

Fig. 3



Interdependency among the three divisions Target Detection, Motion Control and the Obstacle Avoidance.

Fig. 4



Interdependency among the three divisions Target Detection, Motion Control and the Obstacle Avoidance.

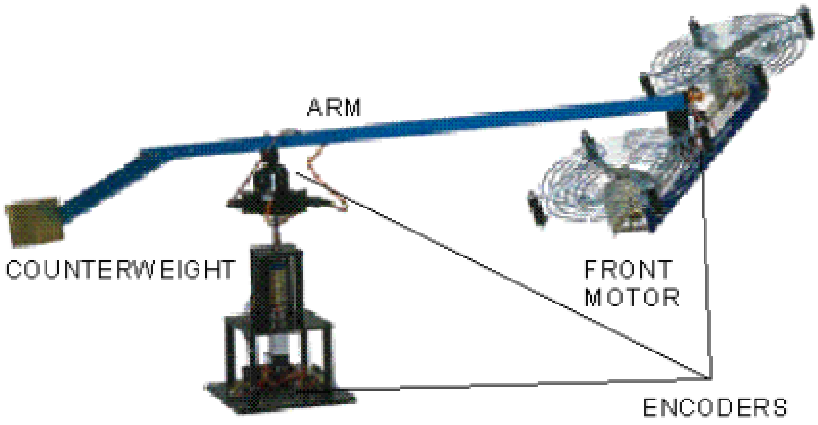
Fig. 5

February '04

3D Helicopter System (with active disturbance control)

Duration: *One month.*
Development Site: *Institute of Control Engg, Siegen, Germany*

The 3D Helicopter consists of a base upon which an arm is mounted. The arm carries the helicopter body on one end and a counterweight on the other. The arm can pitch about an "elevation" axis as well as swivel about a vertical (travel) axis. Encoders mounted on these axes allow for measuring the elevation and travel of the arm. The helicopter body is mounted at the end of the arm. The helicopter body is free to swivel about a "pitch" axis. The pitch angle is measured via a third encoder. Two motors with propellers mounted on the helicopter body can generate a force proportional to the voltage applied to the motors. The force generated by the propellers can cause the helicopter body to lift off the ground. The purpose of the counterweight is to reduce the power requirements on the motors. The counterweight is adjusted such that applying about 1.5 volts to each motor result in hover. All electrical signals to and from the arm are transmitted via a slip ring thus eliminating the possibility of tangled wires and reducing the amount of friction and loading about the moving axes.



System Description

Base: Arm, have counter weight, to reduce the power requirements on the front and rare motors. Voltage applied proportional to a force. (1.5 Volt)
Axes: we have 3 axes namely:
Elevation Travel Pitch
Every axes have encoders for measuring the quantities and the signals transmitted via a "slipping".
Purpose this experiment: to design a controller to achieve desired elevation and desired travel rate.