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A Remote observation of Tank Robot using myRIO & LabVIEW

Ashok Chocha
Department of EC, DDIT, Dharmsinh Desai University, Nadiad, Gujarat.
Email - ashokchocha@yahoo.com

Abstract: *This research effort aims at investigating real-time implementation of software and hardware for Guidance, Navigation and Control (GNC) algorithms for an Unmanned Ground Vehicle (UGV). A GNC algorithm was previously developed for a skid-steered tracked UGV to go through assigned waypoints based on encoder counts. This algorithm was implemented using Matlab/Simulink-based model running on a mini computer, interfacing with the electric motors and encoders through a specialty control board. Implementation of GNC algorithm for the same UGV, but using LabVIEW is current effort in this research. The LabVIEW and NI-myRIO solutions are found to be user-friendly and very effective and reliable for the purpose of realtime implementation of GNC algorithms. There are two different modes of controlling the robot. They are Voice control mode & Keyboard control mode, while going through these modes of techniques, we have to suffer from problems such as the system failure in providing high data rates, the processors used in this system have low computational capabilities and low processing speed. To overcome these disadvantages FPGA based system is proposed. There is one on board computer NI myRIO, which receives command from command center control for controlling the motors, wireless data acquisition, and target detection. The command center control computer allows the remote user to view the direct video stream and control the various features of the UTR, using a GUI.*

Key Words: *LabVIEW, myRIO, Sonar, DC Motors, Web camera, Unmanned vehicle system.*

1. INTRODUCTION:

An UNMANNED TANK ROBOT (UTR) is a military robot used to augment the soldier's capability. Generally these types of robots are capable of operating outdoors and functioning in place of humans. Unmanned robotics is actively being developed for both civilian and military use to perform dull, dirty, and dangerous activities. The unmanned vehicle systems and their application range has been expanding over the years. The development of unmanned ground vehicle dates back to the 1930s where a tank armed with a machine gun was controlled by radio from another tank, and the most recent being the Google car. It has a wide range of applications areas which include agricultural monitoring, military purpose, and disaster management.

Unmanned vehicle system (UVS) include aircrafts, ground vehicles like cars, tanks, underwater and water surface vehicles. For the TELE-CONTROL operation of UVS, they should be equipped with a GNC (Guidance, Navigation and Control) algorithm. The GNC is designed to control the UVS motion, collect data and obey the commands given by operator to perform required task. The main motivation of this research effort is to investigate and experiments alternative programming and hardware development environments for the realtime implementation of guidance, navigation and control algorithms for unmanned ground vehicle systems in academic setting. The specific focus of this research is on the use of LabVIEW to create the GNC algorithm and use a myRIO board to run the LabVIEW flow diagram real time on an Unmanned Ground Vehicle (UGV).

2. Block Diagram

The UTR is a vehicle which is capable to operate without any presence of human in the ground vehicle, but the overall control of the vehicle will be in the hands of the operator through medium wireless from the operator base station.

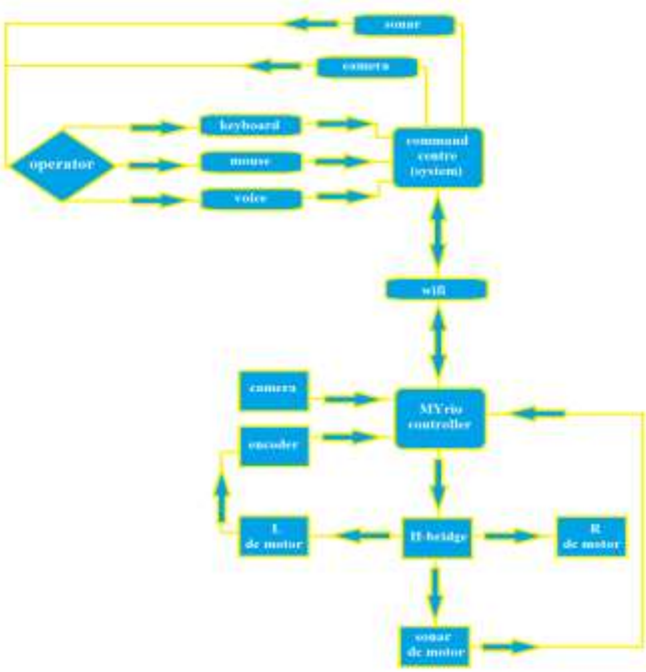


Figure 1, block diagram

The vehicle is mounted with number of sensors to gather information from the environment numerical and digital values etc.. at the base station, further the operator will take decision for the vehicle's position, based upon the analysis of the data information on the screen. Here, two different modes are being used to control the robot. They are

2.1. Voice control mode: In this mode, mic is referred as the ear's for the command control system and with the help of software support provides navigation commands based on processing the speech input given by the operator.

2.2. Keyboard control mode: In this mode, keypad is referred as skin / body (feel) for the controlling system and with the help of software support provides navigation commands based on processing the key pressed by the operator.

While going through these modes of techniques we have to suffer from problems such as the system failure in providing high data rates, the processors used in this system have low computational capabilities and low processing speed. To overcome these disadvantages FPGA based system is proposed.

The above figure 1, shows the block diagram of unmanned tank robot. Divided into two parts, upper part is the base station control and lower part is remote vehicle.

3. Lower Division - Physical Tank Robot

The lower part of block diagram is the actual remote vehicle blocks, which are controlled by myRIO controller. The heart of the entire system is myRIO. It is interfaced with a number of sensors and actuator. myRIO is featured with inbuilt memory, WIFI, accelerometer, USB port, PWM and both analog and digital I/O pins to interact with external world.

The input modules are camera, max sonar, and accelerometer sensor interfaced to myRIO and the output module H-Bridge, powers the DC gear motors. The images and live video captured by the camera is pre-processed before they are sent to base station, along with sonar analog output which is input to the myRIO is converted into distance before sending it to base station. Sonar has maximum distance tracking of 255 inches is being mounted on dc motor shaft which can revolve sonar full 360' to cover the entire surrounding with reference to horizontal ground to the vehicle.

3.1Communication

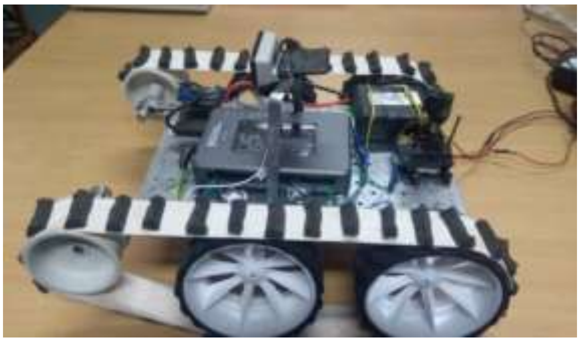
WIFI serves as communication medium between base station and myRIO controller mounted on the robot vehicle.

4. Upper Division – Base Station

The upper portion of the block diagram is the base station, where the feedback information such as and at the same point it is also displays on the computer screen in the form of graphs, images current status and orientation of the vehicle is displayed in graphical form as well as in digital and analog readings on computer screen, with the help of this information on the screen, further the operator will make decisions for navigation. The command input by the operator is fed in two different modes, one is voice controlled mode where speech is reorganized and convert this speech into commands, another way is through keyboard and mouse controlled mode, here the commands are with the help of accessories - keypad and mouse.

5. Vehicle Platform:

UTR platform used in this research is a Wild thumper, all-terrain six wheeled with terrain belt being mounted through three wheels on both sides, and with metal robot chassis. The four wheels of diameter 10cm, two of four on either side and other two small wheels of diameter 5 cm is used one in both sides to build the vehicle platform. The vehicle dimensions are



17 inches 12 inches 6.5 inches as shown in the Figure 2

Figure 2, vehicle platform

Platform has six wheels, four motors, two of small diameter wheels fitted with axial support without motor on front end of the chassis. The chassis top has 4 mm holes punched every 10 mm far throughout the chassis for mounting sensors modules and other hardware.

6. GNC Algorithm

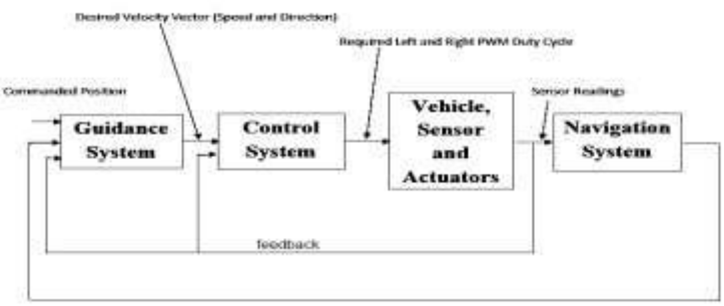


Figure 3, GNC algorithm of UTR

The GNC algorithm has three main sections with specific roles, as depicted in Figure 3, The detailed working of each module are discussed in the following sections.

Navigation in this context is to estimate the position and orientation of the UTR. It is a method of advancing position based on known or estimated speed over elapsed time. The accelerometer helps in detecting overow and underow. The vehicle required power for motors calculation is done with the help of accelerometer tilt value. When an over/underow is detected, the feedback analog signal is fed to input of the PID controller which compares the feedback value with setpoint to generate the error signal which is processed by PID controller to set the PWM value to compensate the error.

Guidance algorithm generates the speed and heading commands for the vehicles based on the current position and orientation of the UTR to go through a given set of waypoints with a specified speed. It is estimated by the operator upon the feedback information and make a decision based on the position and immediate command is fed by operator which inturn computed as the guidance of the direct line from the current position to the position of the waypoint. In addition to the orientation, it uses the distance formula to determine its distance of the vehicle from the surrounding target. It inputs the signal to maintain the distance so that the vehicle is free from surrounding enemies. The distance of the target is compared with the threshold constant value, which is the radius of the circle around the vehicle. Once the UTR reaches the threshold, it brings to the notice of the operator. So necessary actions can be taken. The commanded/desired velocity of the vehicle is also calculated depending on the combination of accelerometer tilt angle and the input from operator. Based upon the tilt of the vehicle in forward and backward direction with respect to normal velocity increases and decreases, this change in speed is modulated by the Proportional, Integral and Derivative control algorithm used in the Control section by varying the PWM signal.

Control module is to generate the right and left wheels speed by commands given, the current speed and heading of the vehicle and the commanded speed and the heading coming from the guidance module. The PID controllers are used to compute the mean wheel speed and differential wheel speed commands. Since the mean wheel speed is related with the speed of the vehicle platform, the mean speed PID controller is fed with the error in tilt with reference.

The differential speed is related with the angle of elevation or depression of the vehicle, and thus the differential tilt PID is fed with the error in heading, i.e., the difference between the current and the desired tilt. From the mean and differential lilt, the desired PWM for the lilt is computed. Hence related with the relative wheel speed the duty cycles supplied to motor is computed.

7. Results and Discussion:

7.1 Speech Recognition

The below figures numbered from 4A to 4E shows the output results of speech recognition for voice input left, right, forward, backward, stop commands by the operator respectively. The word spelled/command by the operator is heard by the mic and is processed; the pitch is also displayed along with utterance and energy signal.

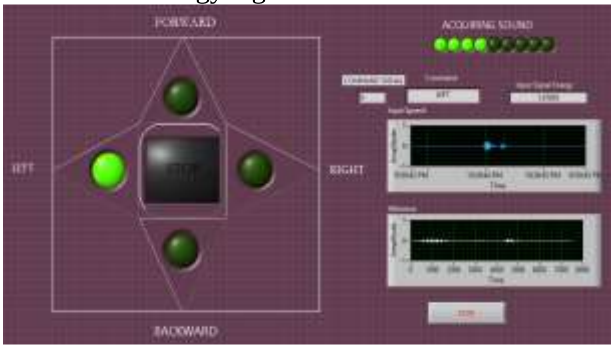


Figure 4A, voice left command

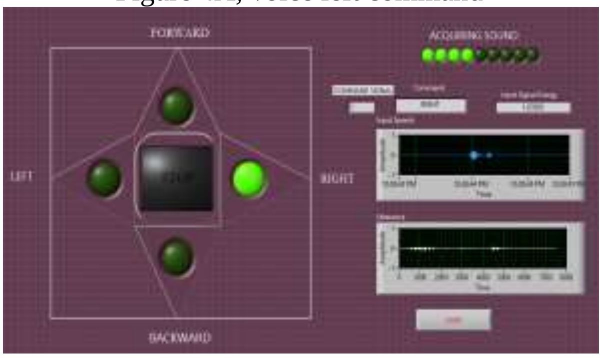


Figure 4B, voice right command

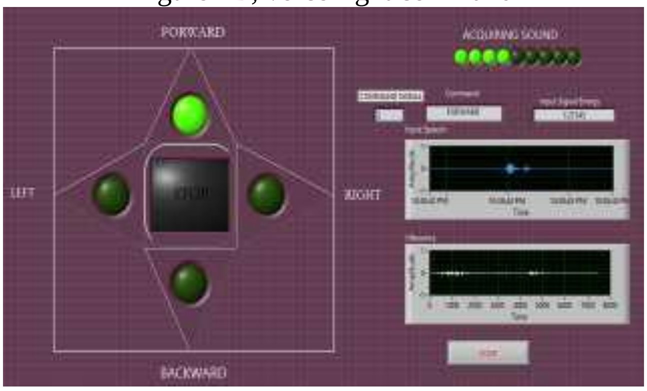


Figure 4C, voice forward command

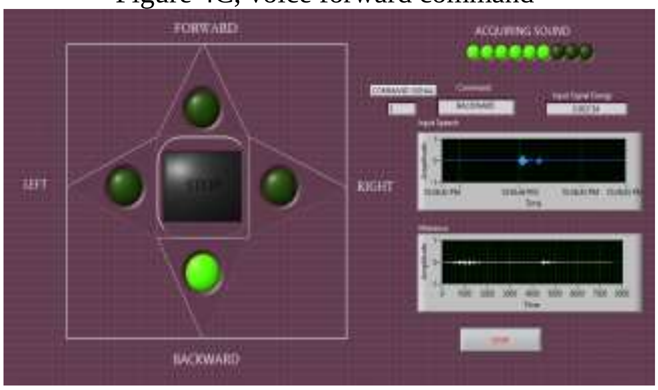


Figure 4D, voice backward command

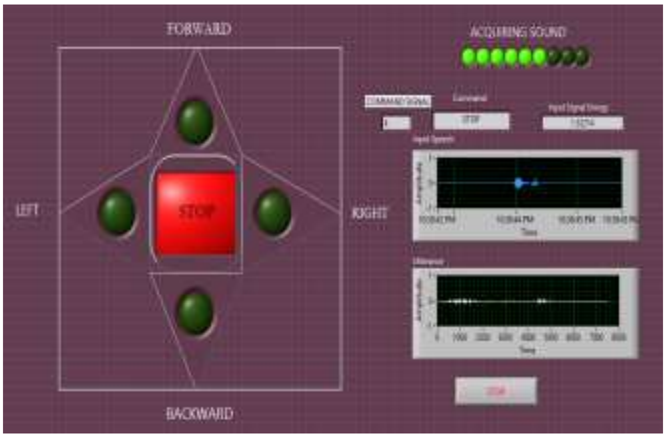


Figure 4E, voice stop command

7.2 Accelerometer

Figure 5, shows the output of accelerometer in xy plot. In this plot the robot orientation in forward, backward, right and left lean. If the lean/tilt in forward motion is 45' then the X pointer on the graph will shift from 0 to 0.5 in y positive direction and vise versa for backward tilt 45' the pointer shifts in -0.5 direction in y axis similarly for right and left tilt also.

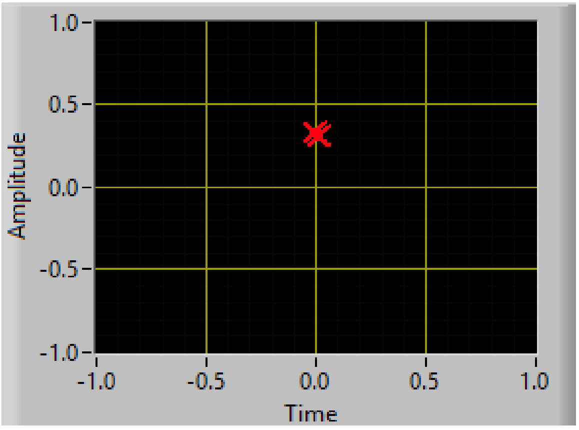


Figure 5, orientation of the vehicle

7.3 Sonar

Figure 5, shows the target detection of full 360' surrounding using sonar, the red colored vertical strips on 1st graph in-between green strips shows that the target is within threshold distance. And where there are no red strips ie green vertical strips indicates that the vehicle is free from enemy targets. The Y axis is the angle. Comparing the red strip amplitude with y axis values shows the target at that angle reference to the vehicle. The 2nd graph, the red horizontal line is threshold and green variations above and below is the distance of the target from the vehicle. The below graph shows the radar output in circular plot. The length of needle from the center is the distance from vehicle to the target and needle rotates about its centre axis to cover full 360' surrounding simultaneously.

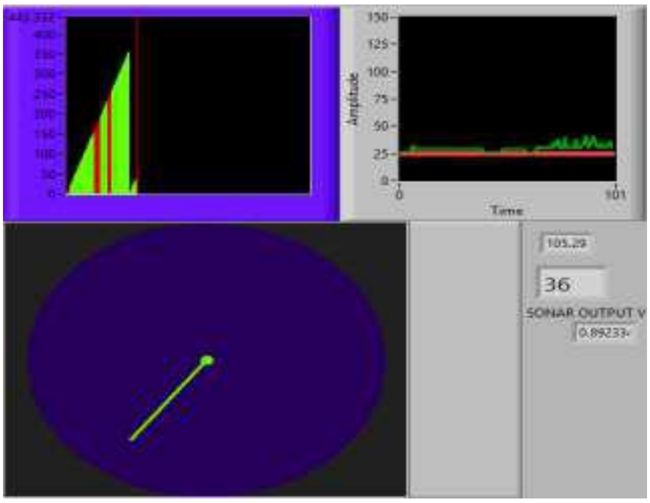


Figure 5, target detection from 0 till 360 surrounding PID Controller Output Response For Vehicle For Dc Motor

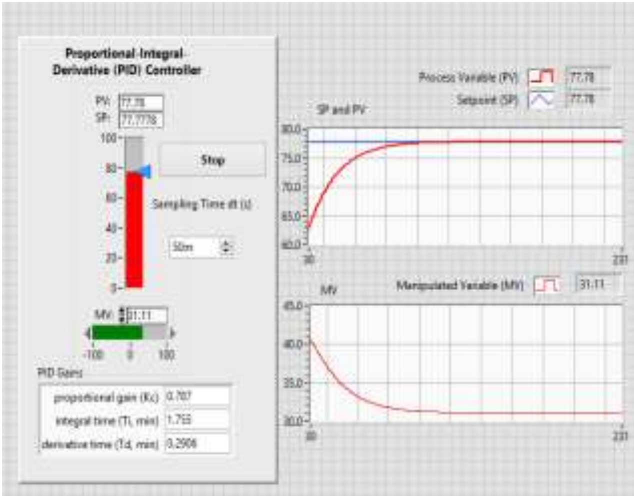


Figure 6, PID controller output response for DC motor

8. Conclusions :

LabVIEW was adequate to build a block diagram representation of a GNC (Guidance, Navigation, and Control), originally developed in MATLAB/Simulink for a UTR (Unmanned Tank Robot), based on accelerometer readings and PWM signals controlling the speed of the electric motors driving the wheels. For the development and testing of this GNC algorithm in simulation before hardware implementation, a model of the mobile platform of the UTR is also developed in LabVIEW.

9. Future Work

TeamViewer is the solution for easy and friendly desktop sharing. can remote access a partner's desktop to give online assistance. which gives control access of unmanned vehicle anywhere in the world through IOT based access.

REFERENCES:

1. Sourangsu Banerji, (2013), Design and Implementation of an Unmanned Vehicle using a GSM Network with Microcontrollers, *IJSETR*, Vol.2, Issue 2.
2. Sourangsu Banerji, (2014), Design and Implementation of an Unmanned Vehicle Using A GSM Network without Microcontrollers, *JEE*, vol.14, Issue 1.
3. Amey Kelkar, (2014) Implementation of Unmanned Vehicle using GSM Network with Arduino, *IJARCSSE*, Vol.4, Issue 4.
4. Jen-Hao Teng, Kuo-Yi Hsiao, Shang-Wen Luan, Rong-Ceng Leou and Shun-Yu Chan, (2010), RFID-based Autonomous Mobile Car, *IEEE Conference.*
5. Bishwajit Banik Pathik, A.S.M. Ashraf Ahmed, Labina Alamgir and Abu Nayeem, (2014), Development of a Cell Phone Based Vehicle Remote Control System, *IEEE Conference, Vol. 1.*
6. Shiv Kumar Verma, Parul Jindal and Anju Shri, (2014), Obstacle Detection in Multi UGV Environment Using Trajectory Planning Algorithm,