Unmanned Ground Vehicle with NI LabVIEW using myRIO

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Abstract

This project is based on LabVIEW software using NI-myRIO and it is meant for low cost, small size and light weight unmanned ground vehicle .It is specialized in wheel structure and camera courage .the typical wheel design is used to cross the obstacles present in the path of vehicle and the camera is rotated with respect to the wheel direction .the camera provides image of the place. The gas sensor is mounted in the vehicle which is used to detect the gas in particular place. The arm is connected with the vehicle which is used to collect the sample in the particular place. It is used in military operations, surveillance and also photography .It is a modified vehicle so we can connect any instruments with NI-myRIO based upon the application.
Keywords- NI-myRIO, gas sensor, camera, arm, LabVIEW

I. INTRODUCTION

The unmanned ground vehicle (UGV) is a prototype model of rover which is used to research in astronomical bodies. The major problem in all type of UGV is overweight, high cost and low suspensions. Those problems are rectified in this project by applying less weight and low cost materials. It is more specifically a mini rover to move across the small surface of a particular area like rock gap and small caves where the normal rover cannot go in it. And it can also capture pictures and analyze the gas molecules from collected samples.

The Chang'e-3 (CE-3) lander and rover mission to the Moon was an intermediate step in China's lunar exploration program, which will be followed by a sample return mission. The lander was equipped with a number of remote-sensing instruments including a pair of cameras (Landing Camera and Terrain Camera) for recording the landing process and surveying terrain, an extreme ultraviolet camera for monitoring activities in the Earth's plasma sphere, and a first-ever Moon-based ultraviolet telescope for astronomical observations. The Yutu rover successfully carried out close-up observations with the Panoramic Camera, mineralogical investigations with the VIS-NIR imaging spectrometer, study of elemental abundances with the active particle-induced X-ray spectrometer, and pioneering measurements of the Lunar Subsurface with Lunar Penetrating Radar. This special issue provides a collection of key information on the instrumental designs, calibration methods and data processing procedures used by these experiments with a perspective of facilitating further analyses of scientific data from CE-3 in preparation for future missions [1].

With the reference of NASA's MARS Curiosity Rover, this project is meant for a low cost, lightweight and small size unmanned ground vehicle (UGV) which is controlled by NI-myRIO a hardware component of National Instruments can be used for surveying and determining the natural conditions for the place. This motors which are to be connected with the help of NI-MYRIO through NI-LabVIEW software. NI-MYRIO with Analog and Digital signal Ports. The myRIO provide the necessary voltage and current to give a minimum/high voltage dc or ac circuit. Unmanned Guided Vehicles (UGV) is emerging technology in current situation. UGV is used as advanced technology to help in the process of automations such as monitoring purpose and military applications. The rover provides the image of the place by wireless camera. The gas sensor used to detect the gas in particular place [2]

II. BLOCK DIAGRAM

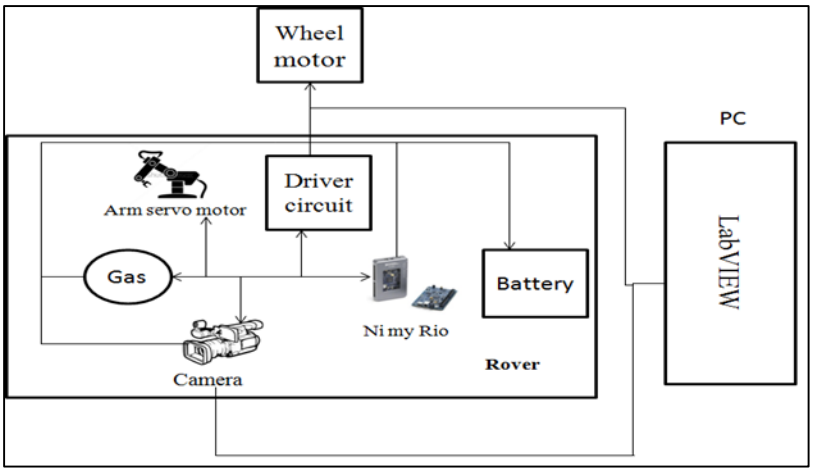

Fig. 1: Block diagram of UGV

The fig 1 shows the block diagram of UGV, the wheel motors are connected with driver circuit for even voltage distribution for wheels. The camera is connected with the TV card for image acquisition the computer is used as display device. .This UGV can operate under both auto and manual mode .The vehicle working by wireless module. The NI myrio is used to interconnect the vehicle and the computer. The labview software is used to control the vehicle. The arm servo motors are connected with NI my rio and each servo motor has its separate control.

A. Ni myRIO

MyRIO Student Embedded Device—The myRIO1900 is a tool you can use to teach and implement multiple design concepts with one reconfigurable I/O (RIO) device. Featuring I/O on both sides of the device in the form of MXP and MSP connectors, it includes 10 analog inputs, six analog outputs, 40 digital I/O lines, Wi-Fi, LEDs, a push button, an onboard accelerometer, a Xilinx FPGA, and a dual-core ARM Cortex A9 processor.

Fig. 2: myRIO

Fig.2 shows the myRIO, the word "RIO" stands for Reconfigurable Input Output. NI-myRIO is one of the best products of National Instruments which can able to do the process of Image Processing programs, Hardware interfacing programs such as motors, gears and levers etc. NI-MYRIO has Xilinx which is thereby a combination of Dual Core ARM Cortex A-9 Processor and FPGA embedded on it. It has Integrated WIFI, Analog I/O ports and Digital I/O ports and many others as described in the following figure.

B. Motor Driver IC L293D

L293D is a typical motor driver or motor driver IC which allows DC motor to drive on either direction. L293D is a 16 Pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motors with a single L293D IC. Dual H-bridge motor driver integrated circuit (IC). The L293D can drive small and quite big motors as well. It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction. Hence-bridge IC are idle for driving a DC motors. In a single L293D chip, there are two H-bridge circuits inside the IC which can rotate two DC motors independently. Due to its size it is very much used in robotic applications for controlling DC motors.

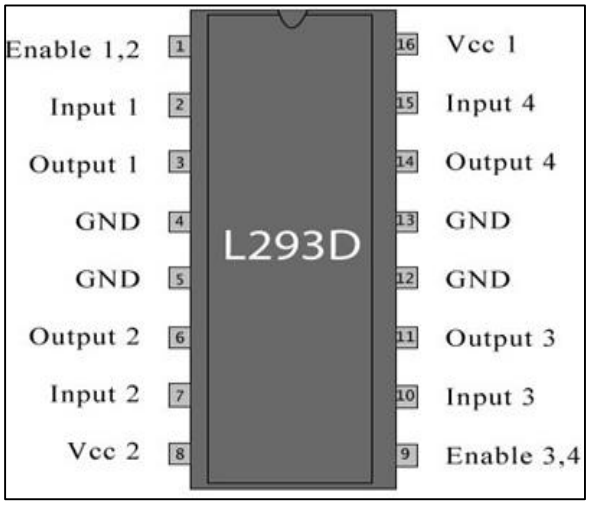

Fig. 3: Diagram of L293D IC

These days many IC manufacturers have H-bridge motor driver available in the market like L293D is most usable driver IC. H-bridge can also be made with the help of transistors and MOSFETs etc., rather of being cheap, the only increase the size of the design board, which is sometimes not, required so, using a small 16 Pin IC is preferred for the purpose.

C. DC Gear Motor

Geared DC motors can be defined as an extension of DC motor. A geared DC motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as rpm. The DC motor works over a fair range of voltage. The higher the input voltage more is the rpm (rotation per minute) of the robot. For example, if the motor works in the range of 6-12V, it will have the least rpm at 6V and maximum at 12. In terms of voltage, we can put the equation as:

$$RPM=K1*V \qquad (1)$$

Where,
K1=induced voltage constant
V=voltage applied

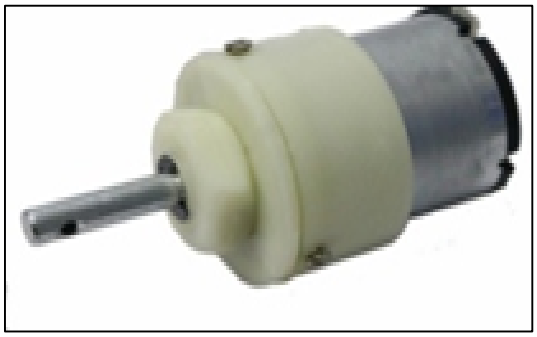

Fig. 4: 12v motor

Fig.4 shows the 12v motor, the working of the gear is interesting to know. It can be explained by the principle of conservation of angular momentum. The gear having smaller radius will cover more rpm than the one with larger radius. However, the larger gear will give more torque to the smaller gear than vice versa. The comparison of angular velocity between input gear (the one that transfer energy) to output gear gives the gear ratio. When multiple gears are connected together, conservation of energy is also followed. The direction in which the other gears rotate is always the opposite of the gear adjacent to it. In any DC motor, rpm and torque are inversely proportional. Hence, the gear having more torque will provide a lesser rpm and converse.

D. Wireless Camera Module

Wireless security cameras transmitter a video and audio signal to a wireless receiver through a radio band. Analog wireless is the transmission of audio and video signals using radio frequencies. Typically, analog wireless has a transmission range of around 300 feet (91 meters) in open space; walls, doors, and furniture will reduce this range. Analog wireless is found in three frequencies: 900 MHz, 2.4 GHz, and 5.8 GHz frequency. Most household routers, cordless phones, video games controllers, and microwaves operate on the 2.4GHz frequency and may cause interference with your wireless security camera. 900 MHz is known as Wi-Fi friendly because it will not interfere with the internet signal of your wireless network.

Fig. 5: wireless camera with receiver

Fig.5.shows the wireless camera with receiver, this type of camera is connected with the vehicle for obtained the images of the particular place. The camera is mounted with the servo to cover all the places and the camera adjusted up and down based upon the wheel position.

E. Gas Sensor

Gas Sensor applies SnO_2 which has a lower conductivity in the clear air as a gas-sensing material. In an atmosphere where there may be CO_2 gas, the conductivity of the gas sensor raises along with the concentration of the CO_2 gas increases. It performs a good detection to smoke and other harmful gas, especially sensitive to ammonia, sulfide and benzene steam. Its ability to detect various harmful gas and lower cost make MQ-135 an ideal choice of different applications of gas detection.

F. Lab View

Laboratory virtual instrument engineering workbench is a system design platform and development environment for a visual programming language from National Instruments. The graphical language is named "G" (not to be confused with G-code). Originally released for the apple Macintosh in 1986, LABVIEW is commonly used for the data acquisition, instrument control & industrial automation on a variety of platforms including Microsoft windows, various versions of Unix, Linux and OS -X. The latest version of LABVIEW is LABVIEW - 2017 is released in May 2017.

III. DESIGN AND SIMULATION

The design and working represents the required programming that has been used in our work. The UGV design consists of geared motor, acryllic sheet is used as suspension in this UGV, an arm mechanism has been implanted by the four servo motors. The camera used here will also work under the servo mechanism.

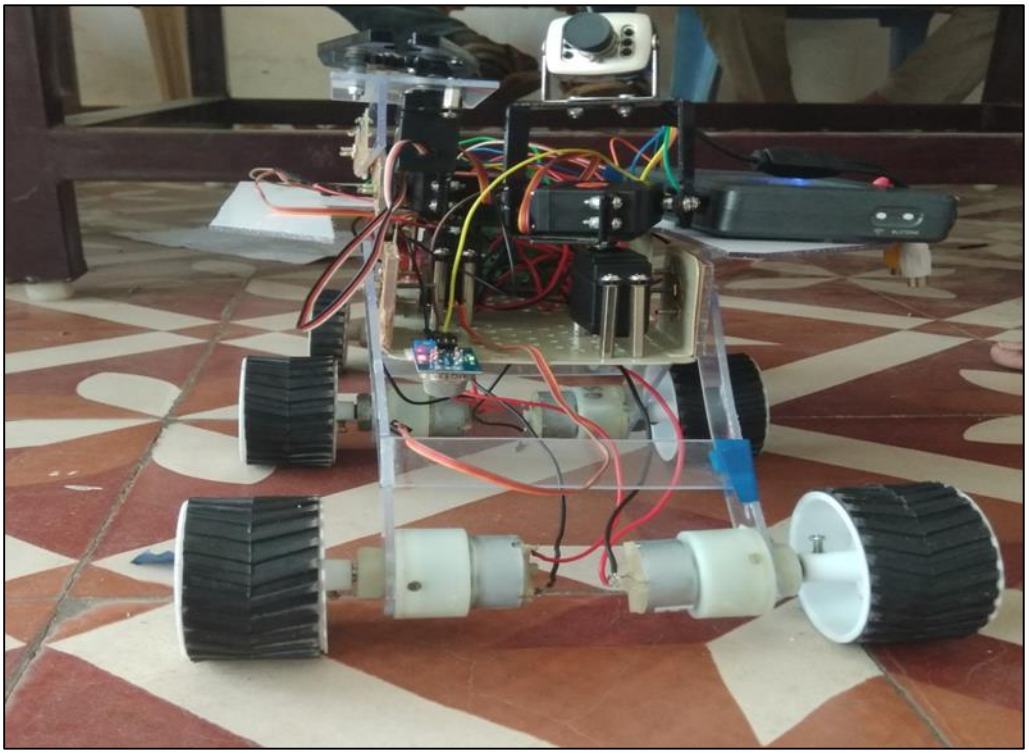

Fig. 6: over all setup of the UGV

The fig 6 shows the overall view of our UGV system. The rover basically consists of hardware components like wheels, suspension system, myRIO camera and gas sensor and driver circuit. The suspension has been used in order to avoid obstacles of up to 15cm height. The geared motor used here will be of high torque and low speed. The motor used here is DC geared motor of 15v.The wireless camera used for acquiring images and video from the particular area where the rover is used. The gas sensor is used to detect the gas samples in the particular area. The gas sensor output is displayed in chart with percentage. With the help of the camera sample place is detected and the sample can be picked up by the gripper. The gripper is been controlled by the LABVIEW program. The gripper has been programmed and the object is been picked up with the help of gripper.

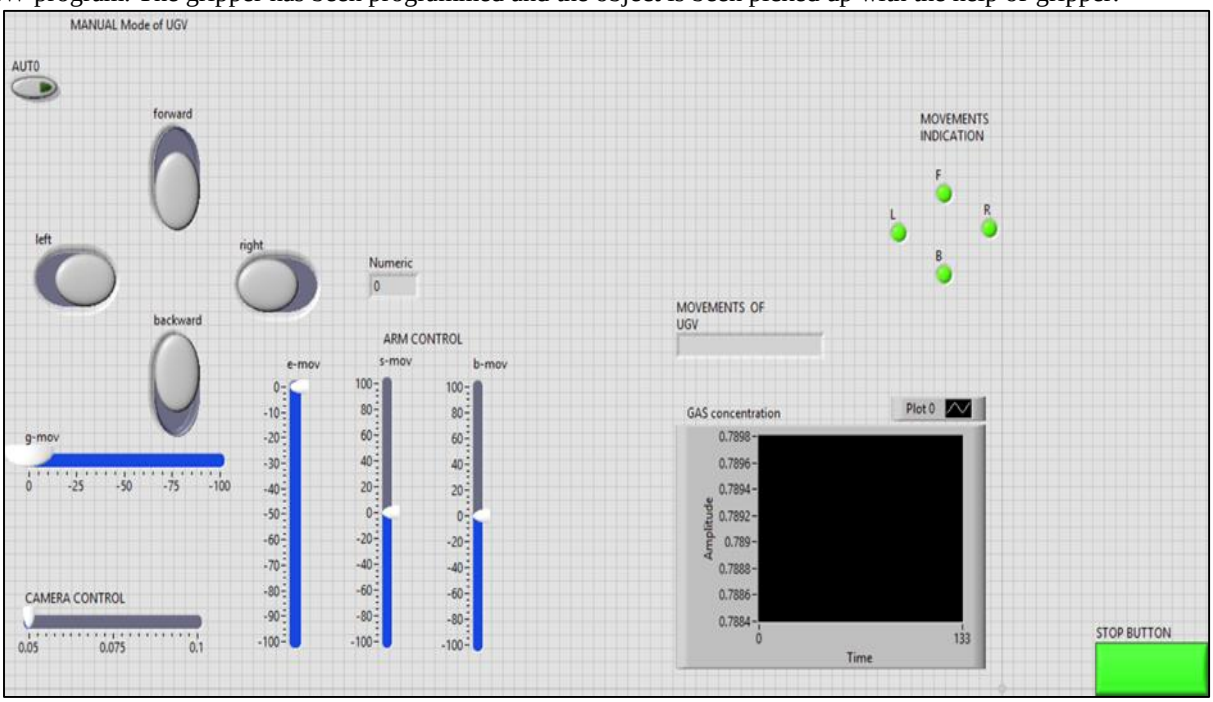

Fig. 7: over all simulation of UGV

The fig 7 shows the overall simulation of the UGV system. Here the front panel of the LABVIEW programming has been showed by which the whole UGV system is been controlled. The wheels are controlled by the pushbuttons in manual mode. In auto mode the wheels are controlled based up on the given time delay. The chart gives the output of gas sensor in percentage. The arm gripper and camera directions are controlled by the manual mode. The wheel direction is displayed in the front panel. The operating mode is also displayed in front panel. The stop button is provided for stop the overall simulation suddenly if any errors occurred in the simulation.

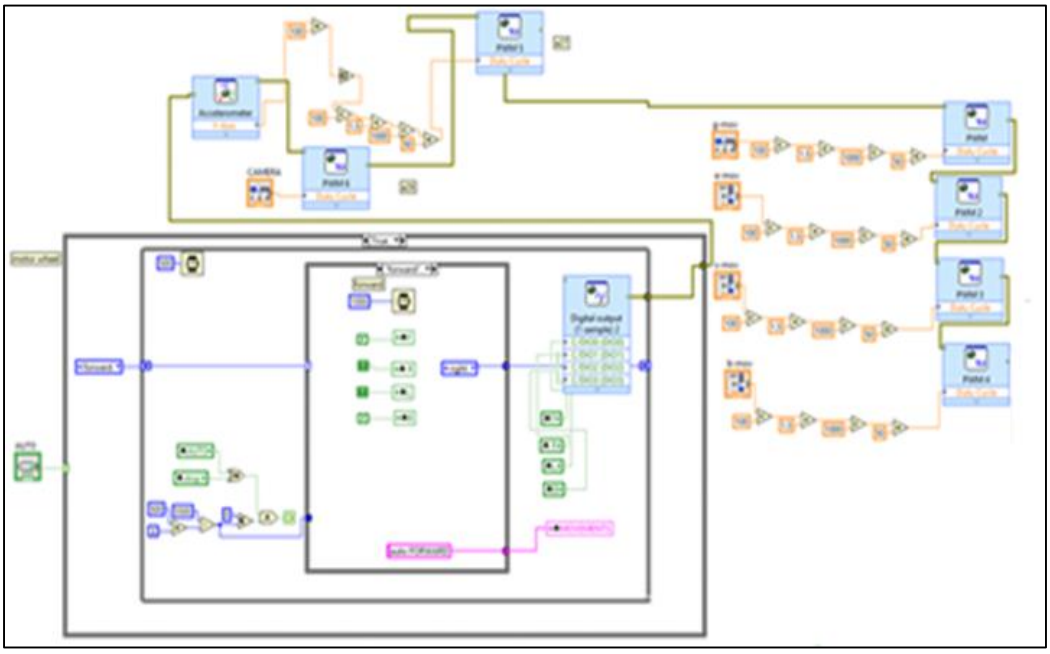

Fig. 8: Overall simulation for the rover

The fig8 shows the overall program for the UGV as well as the simulation for the overall setup. In this program consist of gas sensor, wheels, arm controls and camera control. The camera is operated based up on the accelerometer output. The gas sensor detects the gas in the present area. The output of gas sensor represented in chart. The chart consists of time and concentration of gas in percentage. The wheels are programmed for movement of wheels in four directions. The directions are forward, backward, right turn, left turn. There are four servomotors used to construct the arm. Each servomotor has separate control. The wheels are controlled by the both manual and auto mode. The camera and arm controlled by the manual mode only.

IV. RESULT AND ANALYSIS

In this project our unmanned ground vehicle is crossed the obstacles up to the height of 15 cm by this type of wheel setup. We can collect many photos and gas samples from the particular place. The small things also collected by the arm connected with the vehicle up to the weight 20gms.the vehicle have good suspension so it can be used in hazardous places. The light weight rechargeable Li-Po battery is used as a power source and the vehicle working up to 3 days by the battery source. The gas sensor output is displayed in the chart representation. The chart gives the every change in the present area in percentage of gas concentration.

V. CONCLUSION

In this project, UGV working and components are explained. The LabVIEW software is used to control the movements of overall setup of unmanned ground vehicle. The Li-Po battery is used to increase the distance coverage of vehicle. Hence the concept of rover with high end suspension to be extended over for the purpose of surveillance in man-made disasters area, on board energy source, such as a radioactive module for enormous energy source, with high end camera, it can make an immaculate click of pictures of natures in various inaccessible areas and the Arm, will support the bomb squad for detection and disposal of intelligent bombs in an unmanned nature. It will reduce the cost of human life. The above plans will be implemented as a real time. This will be developed in our near future.

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