International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 5, Issue 04, April-2019

Design of Compact Low Power Autonomous Vehicle for Multi-Purpose using NI my RIO

B V N R. Siva Kumar, G. Krishna Kaladhar, N. Naveen Kumar, C. Sai Pavan, R. Sai Surya

Department of Electronics and Communication Engineering
LakiReddy Bali Reddy College of Engineering, Mylavaram
521230, Krishna District, Andhra Pradesh, India

Abstract----- Autonomous vehicle is a vital assistive device for many industrial purposes and individuals. Manual vehicles deliver a relatively low cost solution to the mobility needs of such individuals. However, these vehicles have a gross loss of mechanical efficiency, and thus the risk of user fatigue and upper limb injury is increased. Electric-powered vehicles reduce the risk of injury and provide a more convenient means of transportation. However, they are of large physical size and quite expensive. Accordingly, the present study utilizes a quality function deployment method to develop a vehicle with a user-selectable manual/electric mode. The basis of developing these devices includes low cost, low power and user friendly operation. Moreover, the autonomous vehicles have a modular design and can be disassembled or can be folded for ease of transportation or storage. Overall, the present results suggest that the proposed autonomous vehicle provides an effective and convenient means of meeting the mobility needs of individuals with mobility difficulties. This whole process has been developed using NI myRIO.

Keywords-- LabVIEW; myRIO; FPGA; Low Cost; Autonomous Vehicle; Multi-purpose; Low Power.

I. INTRODUCTION

Automated Vehicle (AV) [5] has been applied for the flexible Manufacturing system. Numerous specialists developed and designed it in order to a suite with their applications which are related to the main problem of the factory. Automated Vehicle works on a predefined guideline. Steering control of the mobile robot is done using manual and autonomous based on mobile location. Our objective here is to develop a prototype of an AV and building such a vehicle will supply prominent challenges in electrical, control and mechanical area to examine the implementation of use and skills of the myRIO device and virtual instrument environment software LabVIEW.

In today's world robotics is becoming an emerging field. The application of robots in every field is rapidly increasing because of the demands and flexibility in this technology. Although this technology mostly employs arduino [1], over a few decades National Instruments have been efficiently developing its software and hardware to create virtual instruments. LabVIEW helps in controlling many mechatronics systems through the reliable acquisition of data using devices myDAQ, compactRIO, myRIO [4] etc.

myRIO provides economical and reliable acquisition of signals from many sources. Nowadays myRIO is also being used as the main control system in many projects and applications especially due to its versatility and the possibility to use both Real-Time System and FPGA programming. It can also support a large number of connections on a single board which includes analog, digital, PWM, UART, Wi-Fi etc.

In this project, we will present and discuss the challenges that are being faced by the vendors in the railways by developing a vending assistant vehicle which can carry huge loads.

II. RELATED STUDY

Our study includes the number of possible ways in which a robot can be designed using the onboard peripherals of myRIO in the best possible and the cheapest way which consumes less power and provides more efficient transmission and processing of the acquired data. We also studied the methods involved in path planning based on the obstacle to avoiding conditions. We have also studied the advantages of using myRIO over Arduino [6] for implementation of autonomous vehicle applications. We have also studied the working of Automated Vehicles for vending applications and also regarding the positioning of sensors, external devices to get the accurate and reliable acquisition of the signals from the surroundings.

III. PROPOSED MODEL

A. STRUCTURE

Our proposed model aims at reducing the risks and challenges faced by the vending teams in railways. We have developed the structure shown below for monitoring the environment. Our proposed structure has dimensions of 3ft. x

2.5ft. x 1.25ft. The dimensions of the model can be further modified which helps in the efficient navigation of the robot inside the arena.

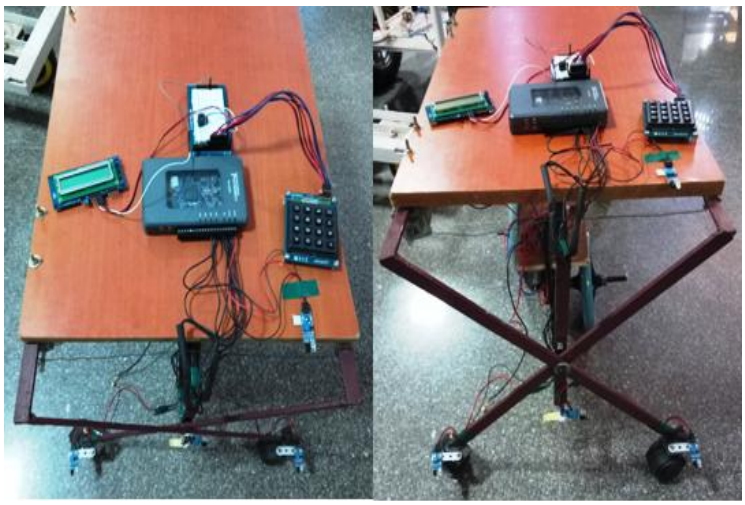

Fig 1: Our Proposed Model

B. MOTOR CONTROL

Motor control is mainly achieved using an L298N driver circuit which acts as a current amplifier providing an output voltage of 12V. Our proposed structure consists of 1 DC Wiper Motor. Each motor has a rotation speed of 45rpm when terminals are supplied with a voltage of 12V with each motor drawing a current of 0.8A when no-load, 1.2A with the load. The motors are driven using digital pins of myRIO connected to control pins of the driver board. The speed of rotation can be varied by varying the input voltage at the different terminals of the wiper motor.

C. IR SENSOR

The data acquisition from IR sensors is divided into 2 phases. In the first phase primary IR sensor indicates whether the vehicle has to be operated in data entry mode (indicates vending) or in autonomous mode. In the second phase includes the detection of obstacles using 3 IR sensors which gives a digital output that is operated in negative logic. The outputs from these three IR sensors give rise to 8 combinations based on which the robot navigates in a specified direction. In addition to the 3 IR sensors, we have equipped the structure with another 2 IR sensors in the back to indicate whether the vehicle has crossed the obstacle or not. The IR sensor consists of LM358 chipset and can detect obstacles in the range of 2-30cm.

D. KEYPAD

In our model, we are using PmodKYPD as an input device, to operate the vehicle in manual operation and also to select the operations that have to be performed in the data entry mode. The PmodKYPD is a 16-button keypad organized in hexadecimal format (0-F). By digitally driving a column line to a logic low level and digitally scanning each of the rows, users can determine which button is currently pressed.

E. FOLDING MOTOR

Folding of the vehicle is achieved by stacking 3 12V 10RPM DC Motors. These 3 motors are connected in parallel and given to the L298N motor driver board.

F. DISPLAY

In our design, we are utilising PmodCLS to display the operation which is running in the myRIO. It is a 16x2 LCD display which contains wide range of instructions. Users can display up to 32 user definable characters by communicating via SPI, I2C or UART.

G. ADDITIONAL FEATURES

Buzzer is used as an indication when the vehicle stops. 4 LED's on the myRIO board is used to display the status of the program.

IV. ARCHITECTURE OF OUR MODEL

Our proposed model outline can be seen effectively through the accompanying block diagram.

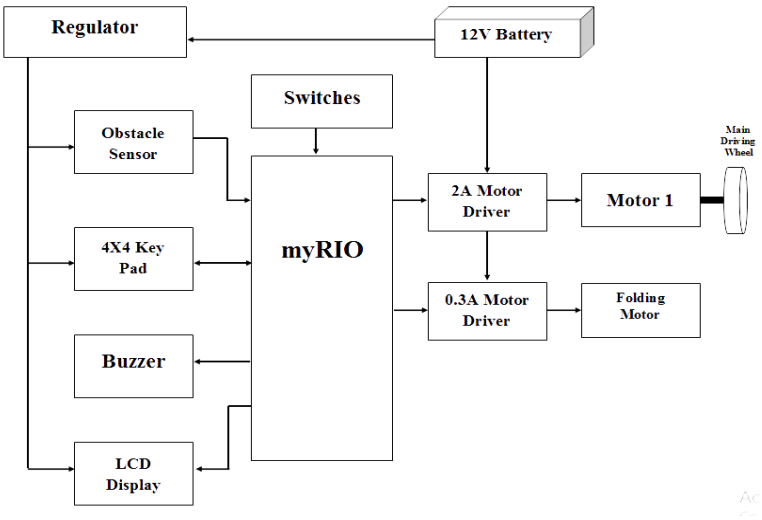

Fig 2: Overview of Our Model

All the 3 IR sensors are connected to DIO pins of channel-C of myRIO. The 4X4 Keypad, LCD Display, Buzzer are connected to DIO pins of channel-A. The main motor and the folding motor are controlled by the DIO pins of channel-C of myRIO. The motor driver board is driven by the 12V battery. Since myRIO operates in the range of 6-16V, it is connected to 12V battery via the regulator.

V. STRUCTURAL DESIGN

The conventional version of any vehicle contains four motors, which are used for the power delivery to the four wheels. In our design, we are using a single motor for driving the vehicle ad we have used four freewheels. The total weight of the vehicle lies on those four wheels so that no extra power is used to drive those flexible wheels.



Fig 3: Side View of our Design

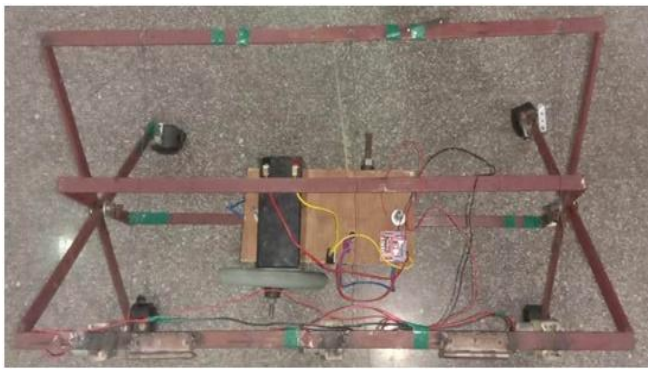

Fig 4: Top View of our Design

The second key feature of our model is to adjust its shape of the vehicle while passing through passages where width of the passage is less compared to width of the vehicle. In a snap, the vehicle has to be fold accordingly to the width of the passage. This mechanism is achieved by using 3-10RPM DC Motors. When the sensors detect the condition of folding these 3 DC motors activates and folds the vehicle. The arrangement of these 3 DC motors is shown in the figure 5.

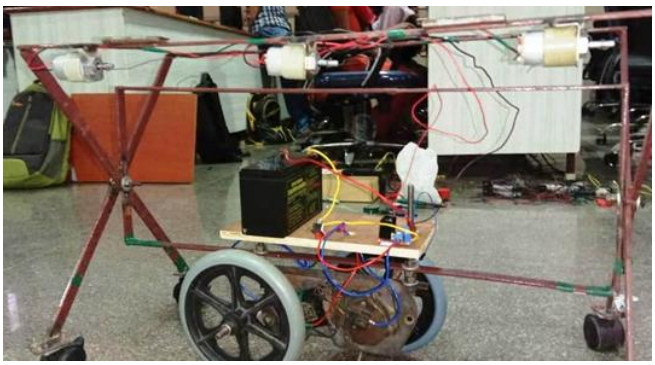

Fig 5: Arrangement of Folding Motors

VI. DESIGN METHODOLOGY

The tasks performed by the vehicle are controlled by a sequence of instructions created in the LabVIEW. The software architecture is mainly divided into two categories which include both the autonomous nature of the vehicle and for storing the data (vending operation). The figure shown below depicts the view of our front panel contains the Boolean, numeric, string controls and indicators and a table to store the data of the passengers. The whole process can be terminated by clicking the stop button created as a control.

The LabVIEW programming is divided into 5 phases which includes the following:

- Automatic mode.
- Data entry mode.
- Main motor and folding motor control.
- Acquiring data from Keypad.
- PmodCLS.

The automatic mode of implementation is obtained by taking the signals from the 3 different IR sensors which are placed at front side of the vehicle one at the centre and the remaining two are at the left and right extremes. The output of the IR sensor is a digital value that is either 1 or 0. The IR sensor works on negative logic means when an obstacle detects it transmits 0 and when an obstacle is not detected it transmits 1 to the microcontroller.

The main application of our project is to use in railways as a vending vehicle for the vendors. In the long run trains vendors collect the money from the customers at once before the customer step out of the train. To do so we have created a mini database in our application this can store character data in form of table row represents seat number and column represents coach number of the customer.

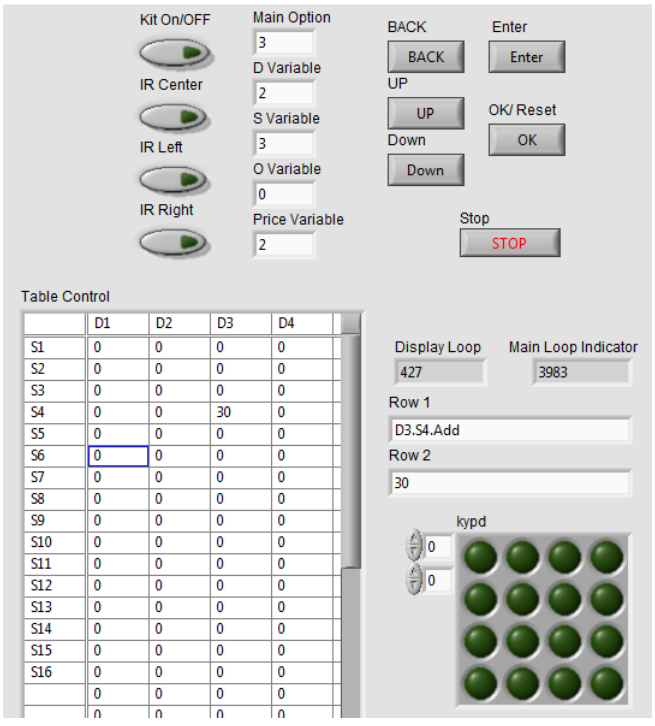

Fig 6: Front Panel of our design

VII. IMPLEMENTATION

The design flow for our proposed model is shown below. The working is better understood by this design flow.

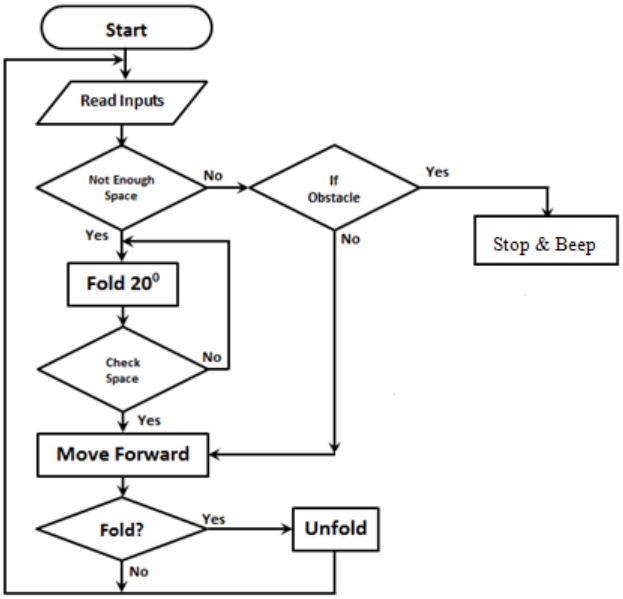

Fig 7: Flow Chart

The IR sensors continuously checks for obstacles which helps the robot to move in a particular direction. If there is no enough space then the vehicle fold otherwise it will be in unfold state. The 4X4 keypad is used to get the instructions for data entry mode, and the corresponding action is displayed on the LCD display.

VIII. RESULTS

Each and every part of the software and hardware is successfully tested and integrated to get the required design as per our proposed model. Our model has done its task of carrying heavy load by avoiding obstacles successfully. Each and every instruction is clearly passed to the myRIO board using keypad and the corresponding actions are displayed accurately on the LED display. The data entry operation is successfully working and the user can enter data for maximum of 4 coaches with each coach containing 78 seats.



Fig 8: Output action for Main Motor



Fig 9: Output action when folding

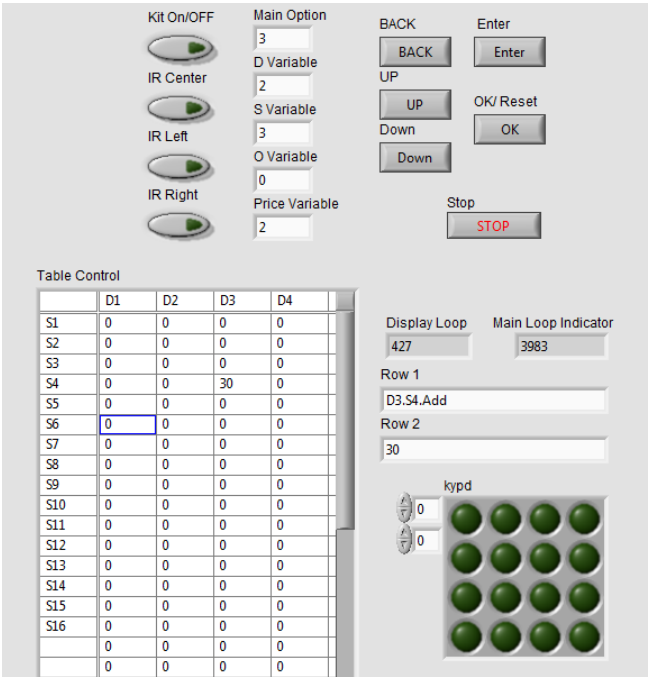

Fig 10: Output Front Panel View of data entry mode



Fig 11: Data Entry Mode in LCD Display

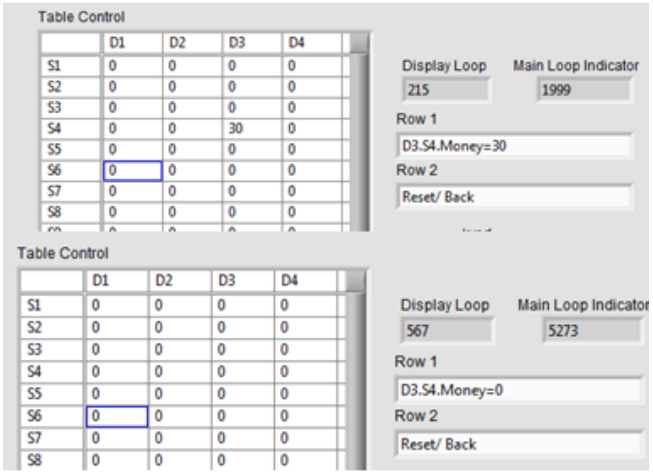

Fig 12: Display and clearing the Data in Front Panel

IX. CONCLUSION

Finally our proposed model can be used as a multi-purpose vehicle in wide range of applications like assistant systems in railways, Domestic purposes, airports and hospitals. The inbuilt Wi-Fi facility is used to transmit the data for monitoring purpose outside the arena. The data acquired by 3 IR sensors, Keypad is processed by the Dual Core ARM A9 processor embedded in the myRIO board. The multi-purpose vehicle has also navigated successfully inside the arena.

REFERENCES

[1] P. Jamieson, "Arduino for teaching embedded systems. Are computer scientists and engineering educators missing the boat?" Proc. FECS, 289-294, 2010.
[2] R. Ouiguini, B. BELLOULOU "Navigation of an Autonomous Wheelchair in a Structured Environment".
[3] Masaaki OHKITA, Ryusuke TAMANAHA, Masaki OKUGUMO, Jun TANAKA, And Makoto OHKI, Akihiko KIMURA "Travelling Control Of The Autonomous Mobile Wheel-chair DREAM-3 Considering Correction Of The Initial Position" .
[4] D. Carnegie, D. Loughnane and S. Hurd "The design of a mobile autonomous robot for indoor security applications," Proc. Instn Mech.Engrs Vol. 218, 2004.
[5] G. Bharathi and P. Reddy, "Design and development of anintelligent dynamic path finding / surveillance automated guidedvehicle using myRIO", International Journal of Research in Engineering and Technology, vol.4, special issue 5, pp. 86-89, May2015.
[6] A. DeSmul and M. Littman "myRIO: Replacing the Arduino for Control Applications", Princeton University Senior Theses, 2014.
[7] J. Borenstein, et al. "Mobile robot positioning sensors and techniques." Naval Command Control and Oce Surveillance Center RDT and E DIV San Diego CA, 1997.
[8] National Instruments, -- http:// forums.ni.com/ t5/LabVIEW