

Gesture Controlled Robot using LabVIEW

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Abstract: In few years ROBOTS are going to decree the cosmos. Man supremacy is abridged by replacing robots. In the existing system, human hand movements is sensed by the robot through sensors and it imitates the same, but this is made probable by placing the sensor in the accelerometer and which is to be carried by the person(user's hand). As the person moves his/her hand, the accelerometer also moves accordingly which in turn displaces the sensor and this sensor senses the constraints according to the position of hand and this sensed constraints are given to the sensors placed in robotic arm which makes the movements of robot arm accordingly. Hand gestures and even the intact body posture play a very vital role in human communication. The intention of this paper primarily is to generate a script in vision assistant and real time image through the vision acquisition acquired. The acquired image is to be transformed into digital signal using image processing in LabVIEW. Interfacing the robot with LabVIEW is processed through DAQ. The digital indication of the robot is made to control by several hand gestures and drive the robot in different direction.

Keywords: Gesture, Lab VIEW, DAQ, Acquisition.

I. INTRODUCTION

Computer analysis of hand gestures has become a key research spot in the Human Computer Interface (HCI), which is not restricted to the keyboard, mouse or some other direct input devices. Ubiquitous Computing, Smart Rooms, Virtual Reality and many other important technical fields include gestures as a way of communication; therefore, research on computer analysis of hand gestures and body posture has significant scientific value [1]. IMAQ vision toolbox presents a comprehensive set of digital image processing and acquisition functions that improve the efficiency of the projects and diminish the programming effort of the users obtaining better results in shorter time [2]. A vision based hand gesture interface, where by hand states (open/close) and a class of hand postures in a taxonomy of grass types can be detected and recognized with a single passive camera. Inferring the full articulations of the fingers form a single camera is an exigent problem due to the complexity of the hand articulations, the occlusions of the fingers, and complications in segmentation of the hand from the background image. In the past, several researchers have developed hand pose estimation methods for vision-based gesture interfaces [3]. Using the captured data, several methods have been proposed for the robot to classify human emotions or to follow a human teacher's instruction [4]. In this project we used the technique of edge detection in the vision assistant. The edges of the images are detected by the change in contrast of the image. diverse hand gestures are taken for the faultless recognition of the images. these gestures are progression to acquire the analog voltage through daq from the nielvis and interfacing it with the robot.

II. PROCESS DESCRIPTION

The distinct hand gestures are exposed before the web camera. The web camera is worn to acquire the image from the real time.

These real time images are acquired into the simulation and processed.

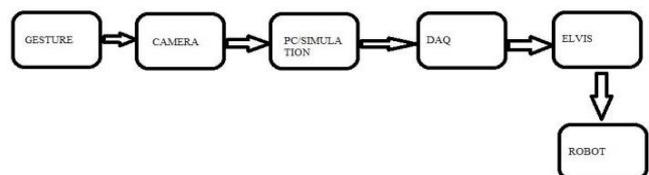


Figure1: Block diagram of the Model

The digital signal of the images are processed and converted in to the analog signal. The analog signals are taken out using the DAQ and NI-ELVIS. These signals are given to the dc gear motor to move the robot.

III. LABVIEW TOOLS

a) Vision Assistant

The NI Vision Development Module is designed develop and deploy machine vision applications. It includes hundreds of functions to acquire images from a multitude of cameras and to process images by enhancing them, checking for presence, locating features, identifying objects, and measuring parts. Vision Assistant is a tool for prototyping and testing image processing applications. To prototype an image processing application, build custom algorithms with the Vision Assistant scripting feature. The scripting feature records every step of the processing algorithm. After completing the algorithm, you can test it on other images to make sure it works.

The algorithm is recorded in a Builder file, which is an ASCII text file that lists the processing functions and relevant parameters for an algorithm prototype in Vision Assistant. Using the LabVIEW VI Creation Wizard, you can create a LabVIEW VI that performs the prototype which has been created in Vision Assistant.

Vision Assistant offers three types of image acquisitions: snap, grab, and sequence. A snap acquires and displays a single image. A grab acquires and displays a continuous set of images. A sequence acquires images according to settings that you specify and sends the images to the Image Browser. Using Vision Assistant, we can acquire images with various National Instruments digital and analog IMAQ devices, such as the PCI-1428, PXI/PCI-1409, PXI/PCI-1411, and so on. Vision Assistant provides specific support for several Sony, JAI, and IEEE 1394 cameras. We can also simulate an acquired image if you do not have an IMAQ device. Vision Assistant allows you to simulate the acquisition process by displaying a sequence of images. We can stop the sequence at any frame, capture the image and send the image to the Image Browser for processing.

b) Data Acquisition

Data acquisition (DAQ) is the process of measuring an electrical or physical phenomenon such as voltage, current, temperature, pressure, or sound with a computer. A DAQ system consists of sensors, DAQ measurement hardware, and a computer with programmable software. Compared to traditional measurement systems, PC-based DAQ systems exploit the processing power, productivity, display, and connectivity capabilities of industry-standard computers providing a more powerful, flexible, and cost-effective measurement solution.

c) Parts of a DAQ System

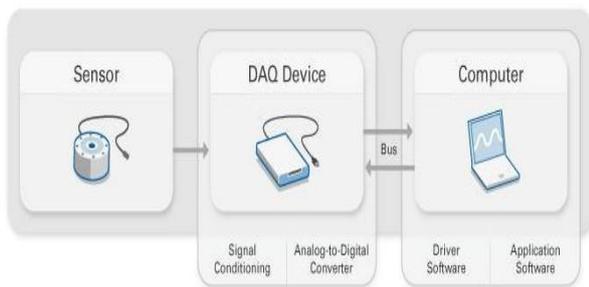


Figure2: DAQ System

d) Signal Conditioning

Signals from sensors or exterior world are noisy or too dangerous to measure directly. Signal conditioning circuitry manipulates a signal into a form that is suitable for input into an ADC. This circuitry includes amplification, attenuation, filtering, and isolation. Some DAQ devices include built-in signal conditioning designed for measuring specific types of sensors.

e) Analog-To-Digital Converter

Analog signals from sensors must be converted into digital before they are manipulated by digital equipment. An ADC (Analog-to Digital Converter) is a chip that provides a digital representation of an analog signal at an instant of time. In practice, analog signals continuously vary over time and an ADC takes periodic “samples” of the signal at a predefined rate. These samples are transferred to a computer over a computer bus where the original signal is reconstructed from the samples in software.

f) Communication Bus

DAQ devices are connected to a computer through a slot or port. The bus serves as the communication interface between the DAQ device and computer for passing instructions and measured data. DAQ devices are offered on the most common computer buses including USB, PCI, PCI Express, and Ethernet. More recently, DAQ devices have become available for 802.11 Wi-Fi for wireless communication. There are many types of buses, and each offers different advantages for different types of applications.

IV. HARDWARE REQUIREMENTS

NI-ELVIS is a hardware which is used as DAQ accessories from which we can be able to get the voltage or we can be able to acquire the signal from the real world. Another hardware used is the dc gear motor. In this episode NI-ELVIS and the working of the motor are explained.

a) NI-ELVIS

The National Instruments Educational Laboratory Virtual Instrumentation Suite (NI ELVIS) is a hands-on design and prototyping platform that integrates the 12 most commonly used instruments – including oscilloscope, digital multimeter, function generator, bode analyzer and more – into a compact form factor ideal for the lab or classroom. It connects to your PC through USB connection, providing quick and easy acquisition and display of measurements. Based on NI LabVIEW graphical system design software, NI ELVIS offers the flexibility of virtual instrumentation and the ability of customizing your application.

NI ELVIS is also an integral part of the NI electronics education platform, combining simulation of circuits and measurements from NI ELVIS instruments inside the NI Multisim capture and simulation environment. Designed with education in mind, NI ELVIS is a comprehensive tool for teaching everything from circuit design, instrumentation, controls, telecommunications, and embedded/MCU theory.

V. COMPUTER INTERFACE

a) Image Acquisition in real time:

The image is acquired in the Lab VIEW via image acquisition from

Vision motion → Vision express → Vision acquisition.

In vision acquisition, camera which has to be used was selected and tested in **select acquisition source**. The type of acquisition was selected whether we want to acquire continuously, single acquisition, finite acquisition with inline processing and finite acquisition with post processing in **select acquisition type**. In **configure acquisition settings** we can change the resolution of the camera, brightness, mode, sharpness, etc. In the next step controls and indicators are selected to get the outputs. To access the camera we need the **ni-imaqdx**.

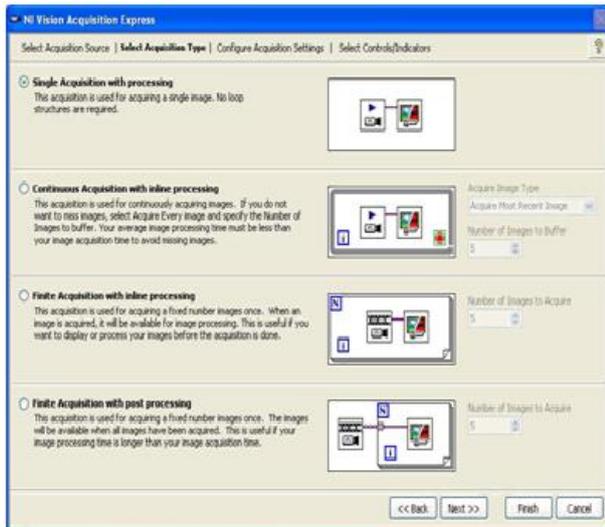


Figure3: Vision acquisition express

b) Vision assistant:

Vision Assistant is a tool for prototyping and testing image processing applications. To prototype an image processing application, build custom algorithms with the Vision Assistant scripting feature. The scripting feature records every step of the processing algorithm. After completing the algorithm, you can test it on other images to make sure it works.

c) Acquiring image:

To create a script on vision assistant the first step is to acquire the image from the camera. The types of acquiring the image are

- Acquires image
- Acquire image (IEEE 1394 or GigE)
- Acquires image (smart camera)
- Acquire image (RT)
- Simulate Acquisition

As we are using the web camera it comes under the type of IEEE 1394 or GigE. On selecting the type of acquiring a window with the icons like **acquire continuous image**, **acquire single image** will be opened. Click on **acquire continuous image** to get a view of the finger and click on **acquire single image**. Keep doing it for getting desired image. After getting the image click the **store acquired image in Browser** to save the images.

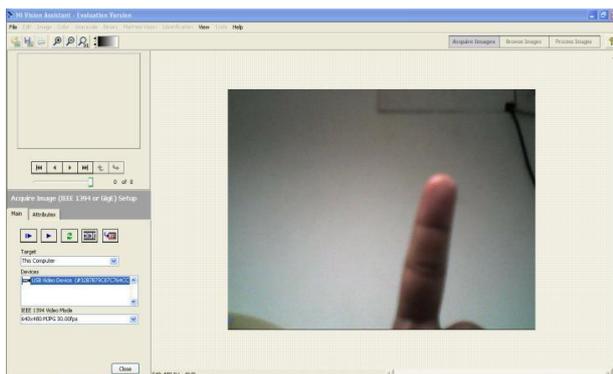


Figure4: Image Acquisition

d) Browse Image:

The next step is browse image. To view the images that are taken is seen by clicking the browse image icon. In that we can delete the unwanted images by selecting the unwanted image and clicking the **close image** icon. **Open image** icon is used to replace the selected image or insert the new image from the save images in the computer.

e) Process Image:

The final step is to process the acquired images. There are many processing functions to get clear image detection. We are using the **edge detector** from the **machine vision**. In the edge detector setup edge detector and the look for boxes are changed in to simple edge tool and all edges respectively. After getting the clear edges it is saved as a script. This script is acquired in the LabVIEW.

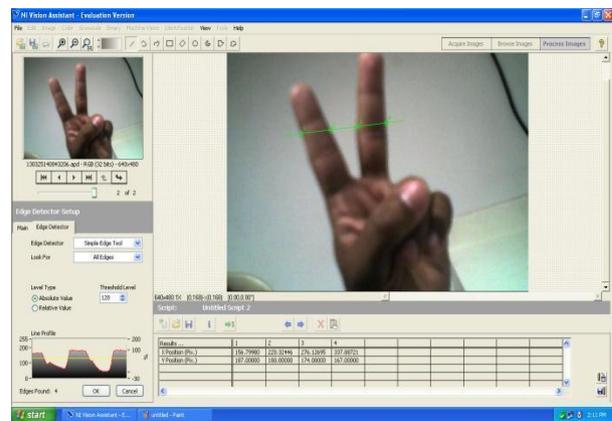


Figure5: Process image

f) LabVIEW programming

The vision acquisition is placed in the block diagram by click and drag from vision express. This opens the dialog box of **NI vision acquisition express**. Work to be done in vision acquisition is explained in previous topic. The vision assistant also placed in the block diagram. It opens the ni vision assistant dialog box. In this the script we saved is opened and clicks the select controls. The output to be taken out is selected and clicks the finish button.

For the movement of the robot case structure is used. The output from the vision assistant is in the form of numeric it is given to the case structure for changing the cases. In each case two DAQ is placed for controlling two robots. In the daq the voltage for the motor is generated by **generate signals**. In the generate signals voltage and the output port is selected. For each motor separate port is used. After selecting the port **generation mode** is selected as 1sample (on demand). Give the voltage for the motor and click the **run** for testing the DAQ. Then click ok for creating the DAQ. By repeating these, create the cases for the different motion of the robot on giving varying voltage to the DAQ. The output image from the vision acquisition is given as the input for the vision assistant. The number of edges from the vision assistant is given to the case structure.

The stopping condition in the vision acquisition is changed in to the Boolean for the continuous acquiring of real time images.

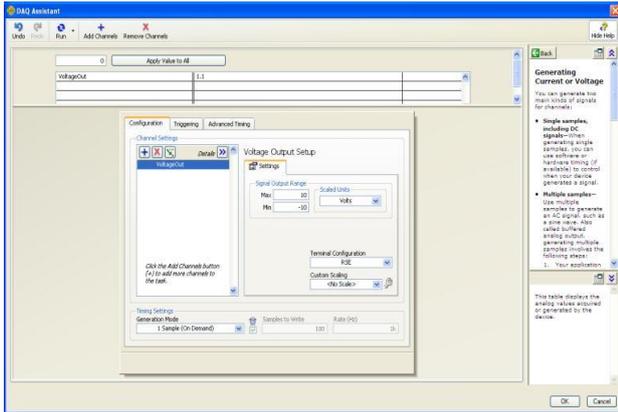


Figure6: DAQ Assistant

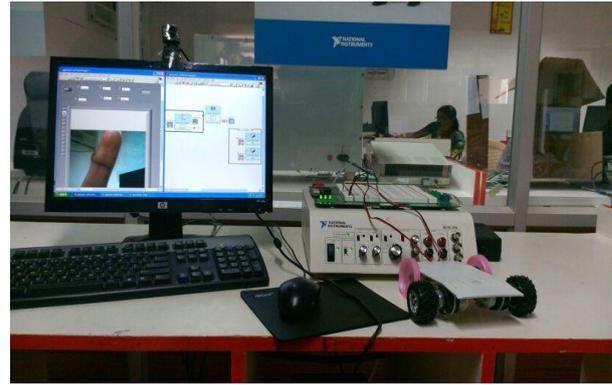


Figure9: Hardware Interface

g) Interfacing robot with Ni elvis:

The NI elvis has the two analog output port. The positive terminal of the robot is given to the different port and the negative terminal is connected to the ground. The maximum voltage given got from the ni elvis is 10v.



Figure7: Interfacing robot with NI-elvis

VII. RESULTS AND DISCUSSIONS

The simulation is tartan with the alteration in the wave form. When the gesture change the wave form also changes. The figure shows the different gestures and corresponding edge detected. On showing one finger it will detect the two edges of the finger.



Figure10: Gesture Images

The figure 11 shows how the wave from is changed according to the image.

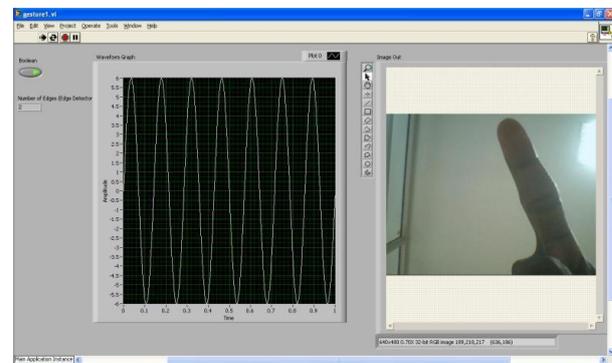


Figure11: Wave form Generation

VI. ROBOT DESIGN

The hard ware is made of simple card board with two dc gear motors. The motor is fixed with the card board by tag. The front wheel is taken from a plastic bottle and the rear wheel is taken from the toy.

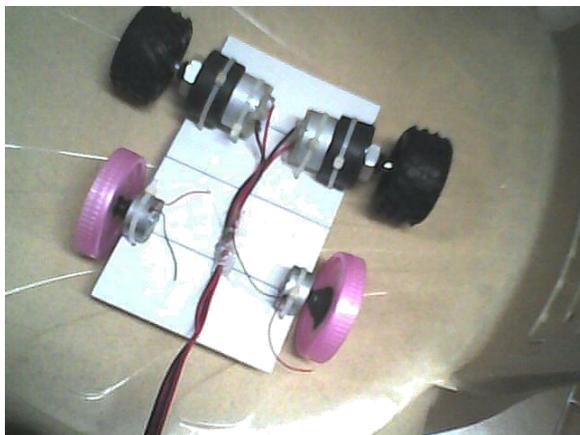


Figure8: Hardware

Controlling the motor direction inturn it will change the direction of the robot. The figure 2.28 shows the hard ware interfaced with the LabVIEW through the daq.

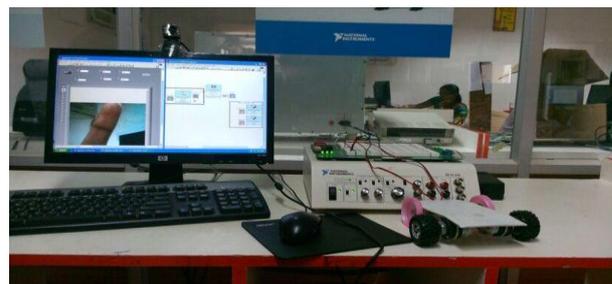


Figure12: Hardware Interface

The figure 12 shows the hard ware interfaced with the LabVIEW through the DAQ.

VIII. CONCLUSION

The autonomous robot vehicle has been lucratively interfaced with the LabVIEW through DAQ. The gesture input was rehabilitated into digital pulse signals. These digital pulse signals are given to the dc gear motor. Primarily the robot was tested for forward and reverse movement according to the hand gesture. And it was also effectively tested for movement in all directions. This mission is functional in the places where minimum requirement for substantial exertion is required. It is used as a vehicle which carries load in industries, laboratories and factories. It can also be used physically by disabled populace, where they will be proficient to control the movement of the vehicle with just their hand gestures without others assistance.

REFERENCES

- [1] Raghuraman Gopalan and Behzad Dariush, Toward a vision based hand gesture interface for robotic grasping, The 2009 IEEE/RSJ International Conference on Intelligent Robots and Systems October 11-15, 2009 St. Louis, USA
- [2] Rubén Posada-Gómez, Oscar Osvaldo Sandoval-González, Albino Martínez Sibaja, Otniel Portillo-Rodríguez and GinerAlor-Hernández Instituto Tecnológico de Orizaba, Digital Image Processing Using LabView, Departamento de Postgrado e Investigación, México.
- [3] Wu.Y.Huang.T.Vision-basedgesturerecognition;A review In: The 3rdGestureWorkshop.1999: 103-115.
- [4] Y. Sakagami, R. Watanabe, C. Aoyama, S. Matsunaga, N. Higaki, and K.Fujimura, “The intelligent ASIMO: System overview and integration,” in IEEE Int. Conf. Intell. Robots Syst., 2002, pp. 2478–2483.
- [5] Ganesan A, Nishanth R, Kamban.S, Gopalakrishnan.R, design and control of 3-dof articulated robotic arm using labview and nmyrio,IJREEICE, Vol.3, Issue3, Mar 2015. DOI: 10.17148/IJREEICE.2015.3342
- [6] Gopalakrishnan.R, P.Kavitha, Umamaehswari.B, Rotor Position Estimation of Switched Reluctance Motor and Its Validation, National journal of Technology, psg Coimbatore, Vol. 8, Issue. 3, Sep 2012.
- [7] Po-Lei Lee, Hsiang-Chih Chang, Tsung-Yu Hsieh, Hua-Ting Deng, and Chia-Wei Sun, A Brain-Wave-Actuated Small Robot Car Using Ensemble Empirical Mode Decomposition-Based Approach, IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS, OL. 42, NO. 5, SEPTEMBER 2012
- [8] Jonathan Kofman, Xianghai Wu, Timothy J. Luu, and Siddharth Verma, Teleoperation of a Robot Manipulator Using a Vision-Based Human–Robot Interface, IEEE TRANSACTIONS ON INDUSTRIAL ELECTRONICS, VOL. 52, NO. 5, OCTOBER 2005