



Web Based Multi DC Servo Motor Monitoring, Controlling and Management Using Embedded System

Colin I Christian ^[1], Dr. Yagnesh. B. Shukla ^[2]

M.E Student, Dept. of E.C., SVIT, Gujarat Technological University, Vasad, India

Associate Professor, Dept. of E.C., SVIT, Gujarat Technological University, Vasad, India

ABSTRACT: In this work an effort is made to monitor and control the Multi DC Servo Motor through web browser using embedded system. This system monitor the voltage, angle, temperature and current parameters of Multi DC Servo Motor and also control this motor anytime & anywhere through web browser. This system shows that user can set limit range of the above parameters & if these parameters goes beyond that value, it will control DC Servo Motor according to that parameters. Embedded web server technology is the combination of embedded device and web technology. Using embedded web server flexible remote device monitoring, controlling and management function based on web browser.

KEYWORDS: Raspberry pi; Pulse width modulation; DC servo motor; Embedded web server

I. INTRODUCTION

Design and implementation of this project using Embedded System for intelligent monitoring is an advance method to control and monitor Multi DC Servo Motor which is designed here for the real time implementation. It provides online-monitoring and controlling not only within Private Network (Local Area Network) but also in Public Network (Internet). Using this project user can monitor and control angle, temperature, current and voltage parameters of DC Servo Motor. It is possible to interface various types of sensors with these modules and make different application. Using Embedded System it reduce cost as well as reduce the complexibility of Motor and also can do work as high efficiently. Real time data monitoring and controlling of device from distance location that is possible using Embedded System and web server.

Pulse width modulation method in raspberry pi for controlling the angle of DC servo motor is discussed. This method has better performance compared to other referred methods. The advantages and disadvantages of the various methods for DC servo motor control are mentioned in this paper. This whole system is control by the Raspberry pi unit, which is low cost on board minicomputer [6].

II. REVIEWED METHODS FOR MULTI DC SERVO MOTOR CONTROL

A. Controlling Servo Motor Angle by Exploiting Kinect SDK:

In this method servo motor angle controlled by using Kinect SDK, remotelyas shown in figure 1. User can control servo motor angle by using right hand via Kinect and system is based on ATmega8 microcontroller. For operate the servo motor were used Kinect. Kinect is used for receive information from user and provide communication between user and computer then send information of angle of servo motor to microcontroller. For suitable interaction for controlling servo motor by user, was created Graphic User Interface in visual C# [1].

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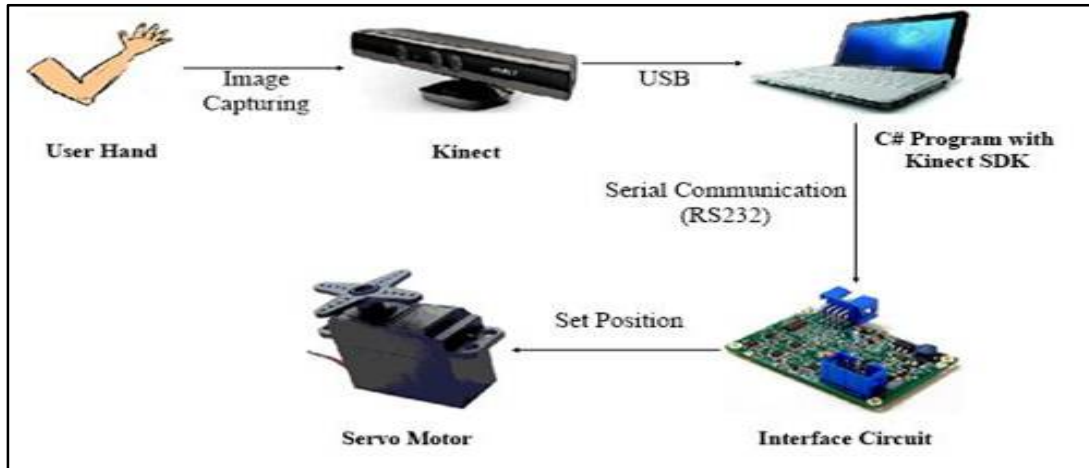


Fig.1. Scheme of whole process [1]

The major advantages of this method is servo motor controlled by users without any background, no training is needed to user for controlling servo motor like traditional controller. Disadvantage of this method is it cannot handle accurately.

B. Client-Server based Remote Motor Control System Using LabVIEW:

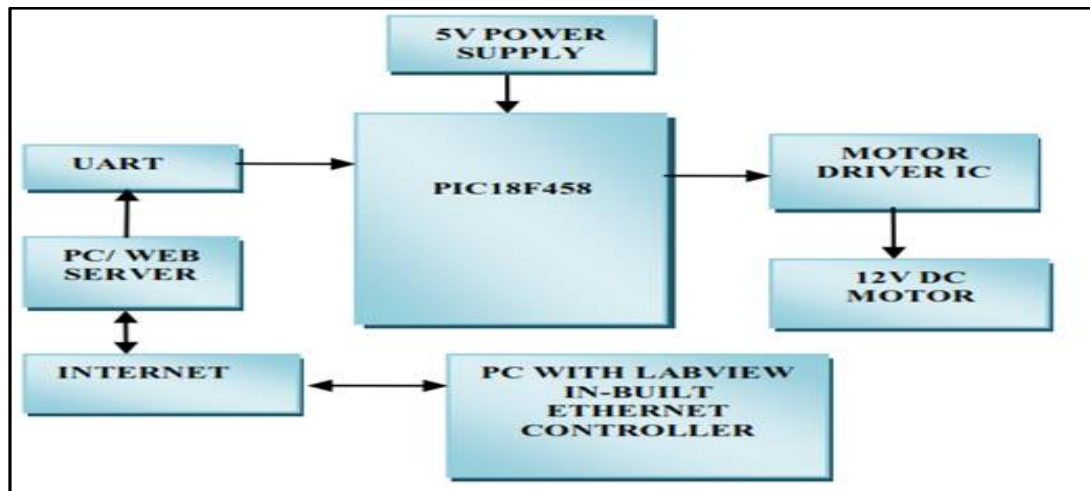


Fig.2. Scheme of whole process [2]

In this method, the server system which contains PIC Microcontroller module which is connected to the internet so that motor can be monitored and controlled from remote places, the client system runs on LabVIEW platform is also connected to the same internet as shown in figure 2. By typing the IP address of server system on the client side the user gets connected to the remote system and proceeds the monitoring and controlling process. Here the command is entered in PC with LabVIEW which is used as interface software for communicate with microcontroller by accessing the IP address of server system.

The major advantages of this method is -with the help of LabVIEW software the system provides high accuracy and flexibility. Disadvantage of this system is not portable [2].

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C. Pulse Width Modulation for DC servo motor control using Raspberry Pi:

1. Pulse width modulation:

Servos are controlled by sending them a pulse of variable width. The control wire is used to send this pulse. The parameters for this pulse are that it has a minimum pulse, a maximum pulse, and a repetition rate. Given the rotation constraints of the servo, neutral is defined to be the position where the servo has exactly the same amount of potential rotation in the clockwise direction as it does in the counter clockwise direction. It is important to note that different servos will have different constraints on their rotation but they all have a neutral position, and that position is always around 1.5 milliseconds (ms).

The angle is determined by the duration of a pulse that is applied to the control wire. This is called Pulse width Modulation. The servo expects to see a pulse every 20 ms. The length of the pulse will determine how far the motor turns. For example, a 1.5 ms pulse will make the motor turn to the 90 degree position (neutral position) shown in figure 3.

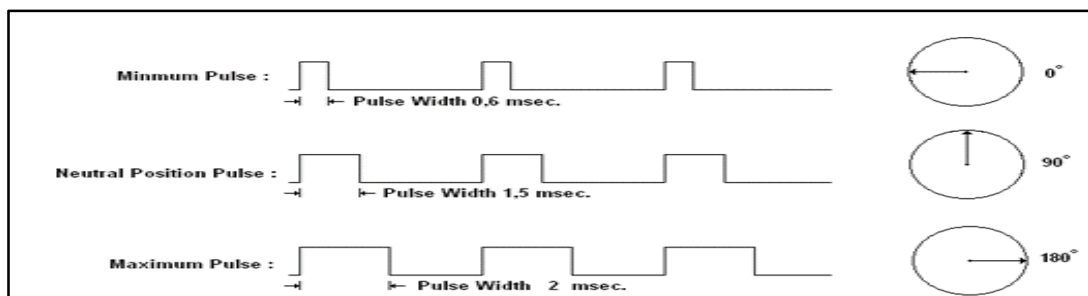


Fig. 3. Pulse Width Modulation [13]

When these servos are commanded to move they will move to the position and hold that position. If an external force pushes against the servo while the servo is holding a position, the servo will resist from moving out of that position.

The maximum amount of force the servo can exert is the torque rating of the servo. Servos will not hold their position forever though; the position pulse must be repeated to instruct the servo to stay in position.

When a pulse is sent to a servo motor that is less than about 0.6 ms the servo motor does not rotate to any position and holds its output shaft at zero degree. If the pulse is wider than 0.6 ms the servo motor rotates. For example, if pulse width is equal to 1.5 ms Servo motor will rotate 90 degrees and for pulse width is equal or greater than 2 ms, servo motor will make rotation of 180 degrees [13].

2. Pulse width modulation in raspberry pi

In Raspberry Pi we do not specify a pulse width, but we specify a Duty Cycle. So, we can use the following relationship:

$$\text{Duty Cycle} = \text{Pulse Width} / \text{Period}$$

Remember that Period = 1/frequency, so: Duty Cycle = Pulse Width / (1/frequency) = Pulse Width * frequency

The Pulse Width that will give us a full left position is 1 millisecond. We now calculate the applied Duty Cycle to give us the desired position:

$$\text{Duty Cycle} = \text{Pulse Width} * \text{frequency} = .001 * 50 = .05 = 5\%$$

So, for a 50 Hz signal, if we set the Duty Cycle to 5, then we should see the servo move to the full left position.

Similarly, if we set Duty Cycle to 7.5, we should get the middle position, and if we set it to 10 we should be in the full right position. You can get all the intermediate positions by linearly scaling between 5 and 10.

If we want the servo in the full left position, we should set the Duty Cycle to 5%, if we want to go to the middle position, we want a Duty Cycle of 7.5, if we want the full right position, we want a duty cycle of 10.

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Remember, it is not Duty Cycle that actually controls servo position, it is Pulse Width. We are creating Duty Cycles to give us the desired Pulse Width.

The advantage of this method is - accuracy is high compare to above methods, user can make portable system and user can control multi dc servo motor using raspberry pi [9][11].

III. PROPOSED SYSTEM

A. Block diagram For Web based Multi DC Servo Motor Control:

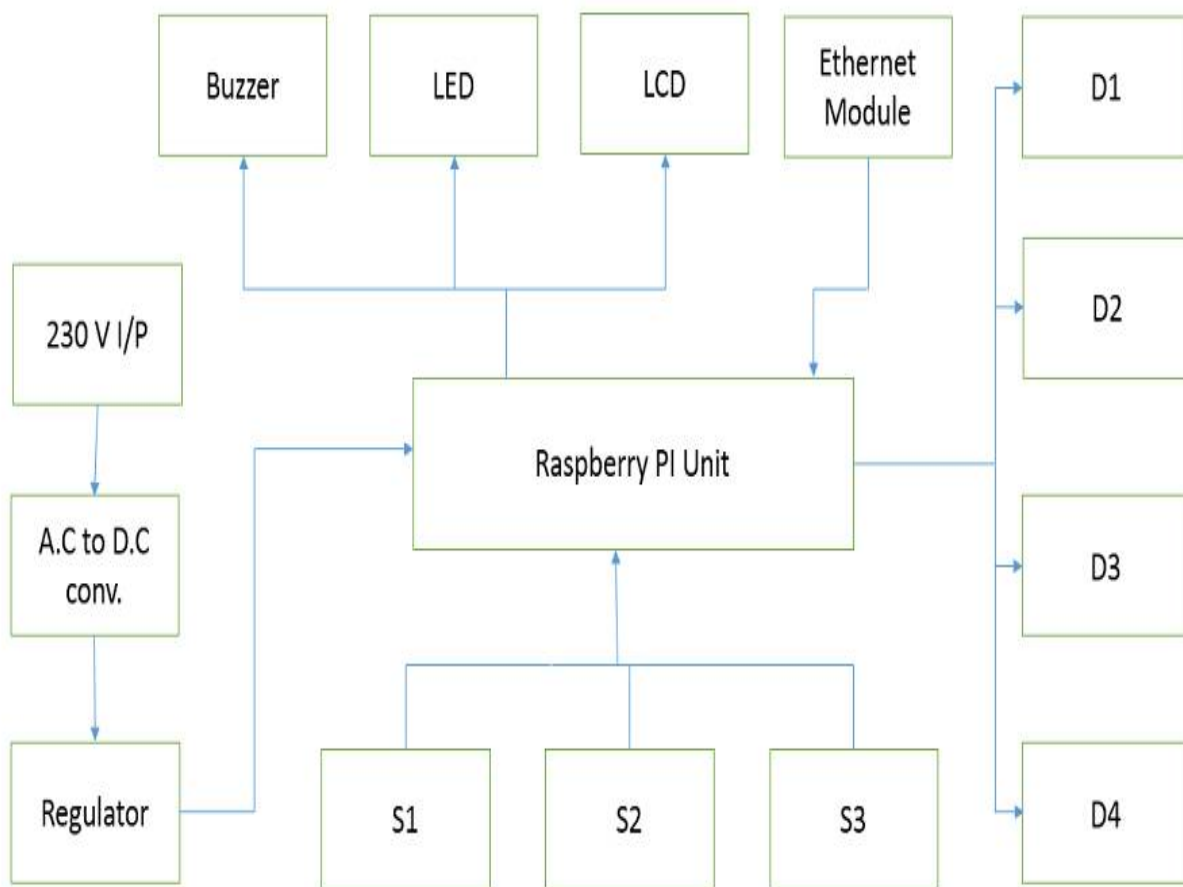


Fig.4. Block diagram of Multi DC Servo Motor control through internet

D1, D2, D3 and D4 are the DC Servo Motors. S1, S2, S3 are angle, temperature, current and voltage sensor parameters of DC Servo Motor. Hardware consists Raspberry Pi 2 model, Temperature sensor, voltage divider circuit & calculating current using ohm's law, and software includes Raspbian OS, PHP and Python language.

Using LM35 temperature sensor, Voltage divider circuit and using ohm's law user can monitor and control the temperature, current and voltage parameter of DC servo motor.

B. Raspberry pi2 model B:

The Raspberry Pi is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation. The Raspberry Foundation provides Debian and Arch Linux ARM distributions for download. Tools are available for Python as the main programming language, with support for BBC BASIC(via the RISC OS image or the Brandy Basic clone for Linux), C, C++, Java, Perl and Ruby. The video controller is capable of standard modern TV

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resolutions, such as HD and Full HD, and higher or lower monitor resolutions and older standard CRT TV resolutions [6].

Raspberry Pi2 runs Linux based operating systems and there is a specialized version of Linux based kernel known as Raspian which can run almost all programs which are Linux compatible. Hence in this project we have used python. As shown in figure 5 Raspberry pi2 model has 1 GB RAM and 900MHz quad-core ARM Cortex-A7 CPU and locking microSD card slot. Raspberry Pi2 model B has four USB ports.



Fig. 5. Raspberry pi2 model B [6]

These USB ports are used for interfacing of camera, keyboard and Wi-Fi dongle. It provide one LAN port for communication. It has 40 GPIO pins for input and outputs, so user can control multi DC servo motor. It has one HDMI port. It can play 1080p resolution videos without lagging. It has a low price relatively as compared to machines in the market. Using embedded web server user can control the DC servo motor through internet [9][10].

C. Circuit diagram for controlling of Temperature, Voltage, Current using LM324 IC

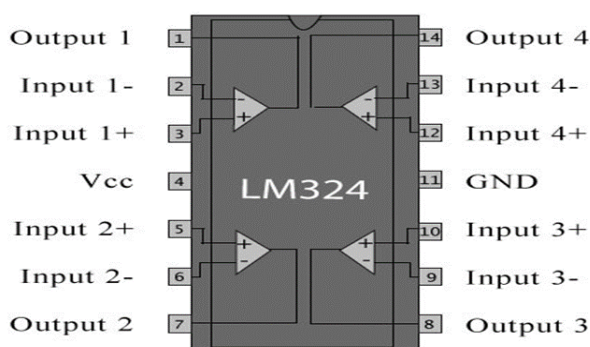


Fig. 6.LM324 IC [14]

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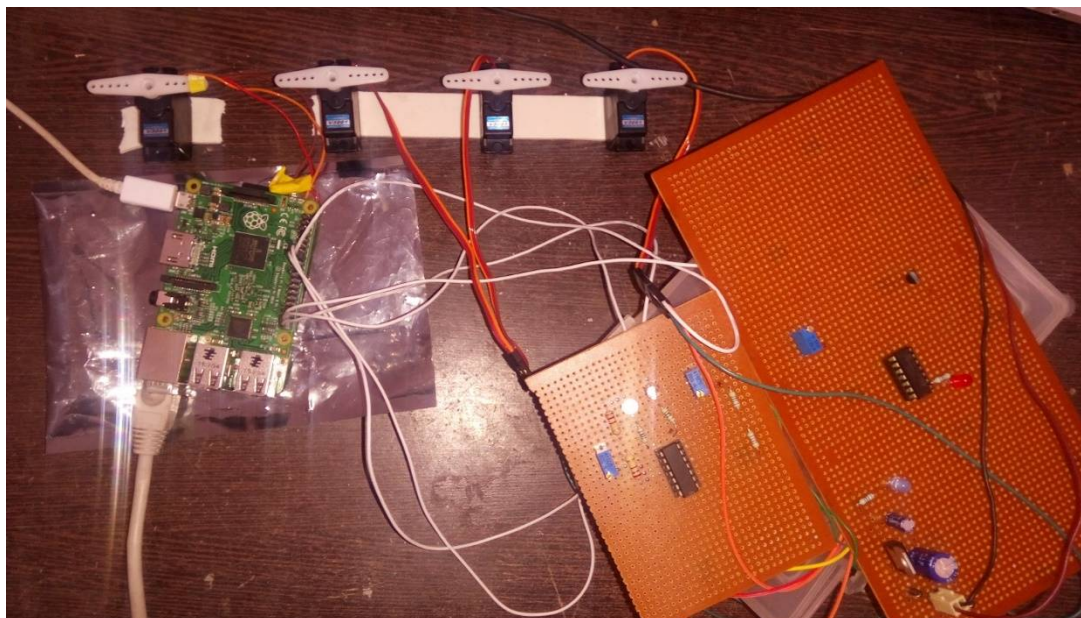


Fig.10. Circuit Implementation

If the voltage, current, temperature of DC servo motor goes above the set value then the DC servo motor will turn off. Here four DC servo motor's control wire is connected with Raspberry Pi 2 model at 11,13,15,16 GPIO pin.

D. Controlling of DC Servo Motor through Internet

By typing the IP address of raspberry pi we can see the login web page as shown in below figure 11. In this login web page we can see the two boxes, first is for username and second is for password.

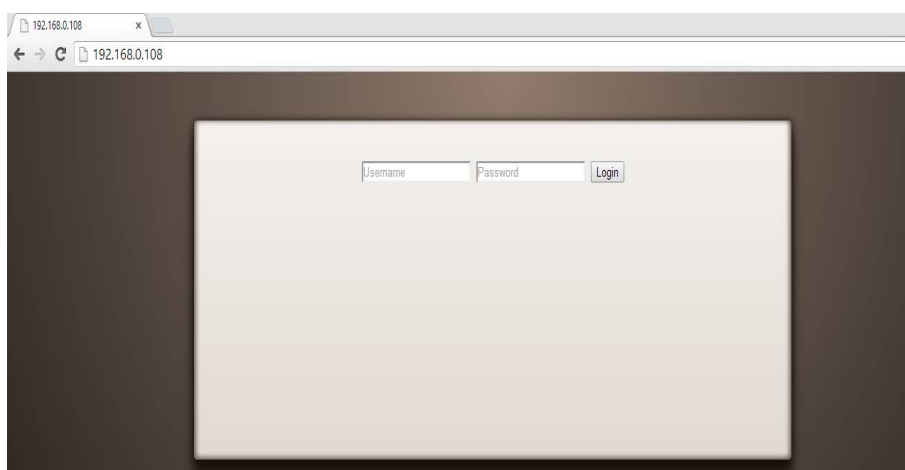


Fig.11. Login web page

After typing the username and password, click on the login button then you are connected with this system as shown in below figures 12 and 13.

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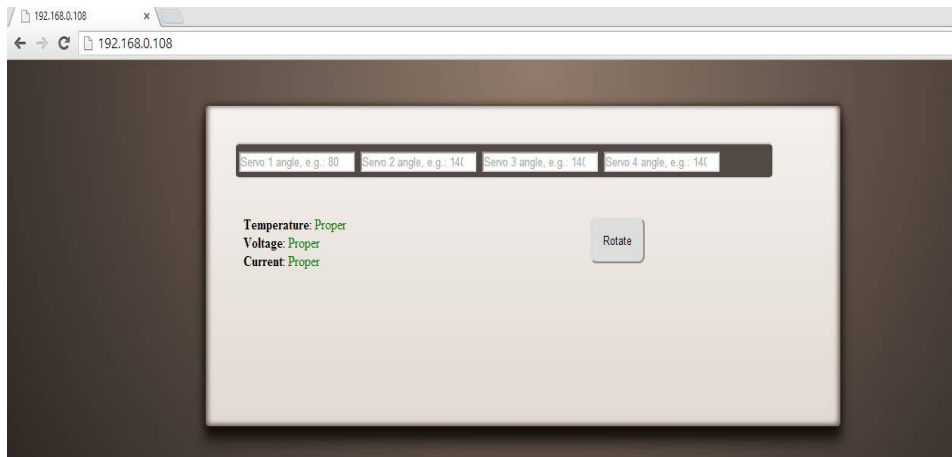


Fig. 12. Servo Motor Control through Internet

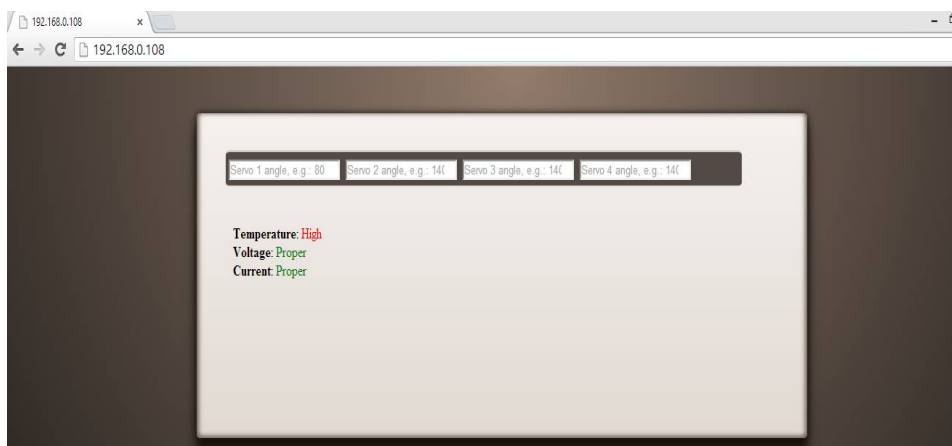


Fig. 13. Servo Motor does not rotates

E. Results for DC Servo Motor Control through LAN and Internet

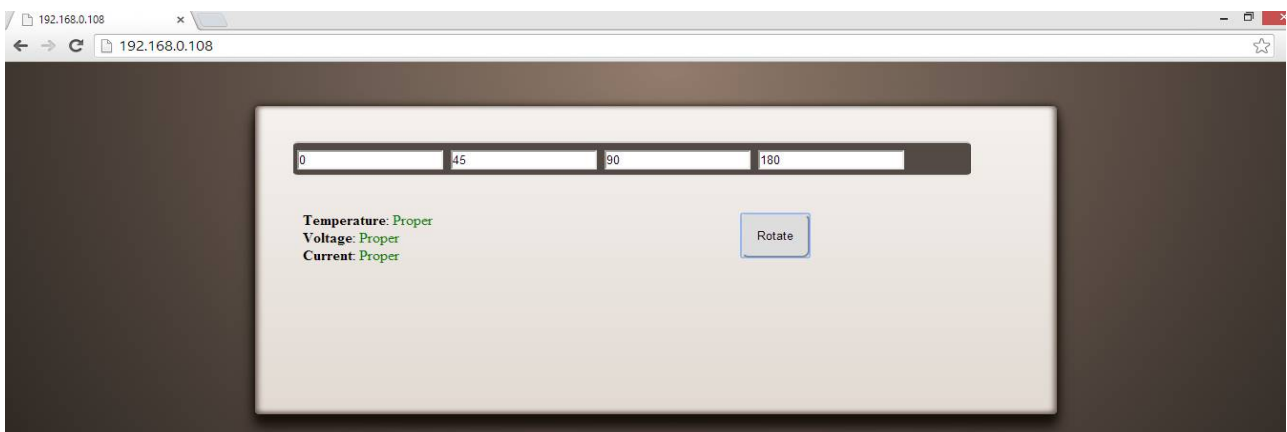


Fig. 14. Input given to the Raspberry Pi through Internet

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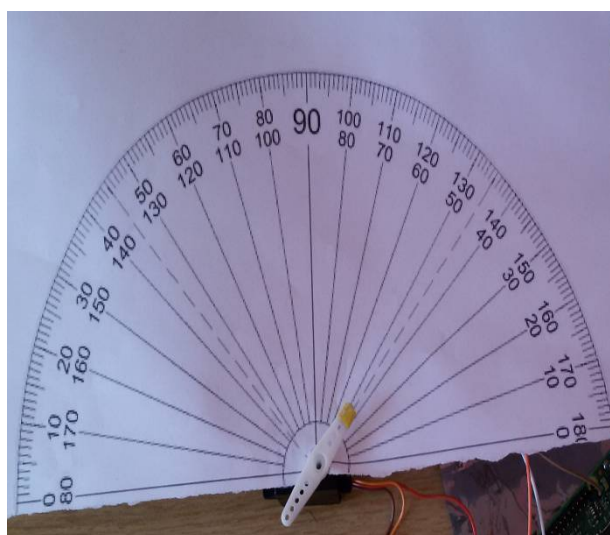
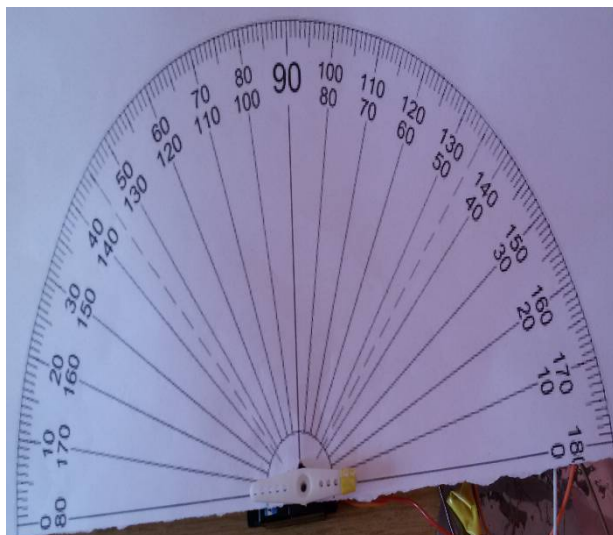


Fig. 15. First servo motor does not rotates Fig. 16. Second servo motor will make rotation of 45 degree

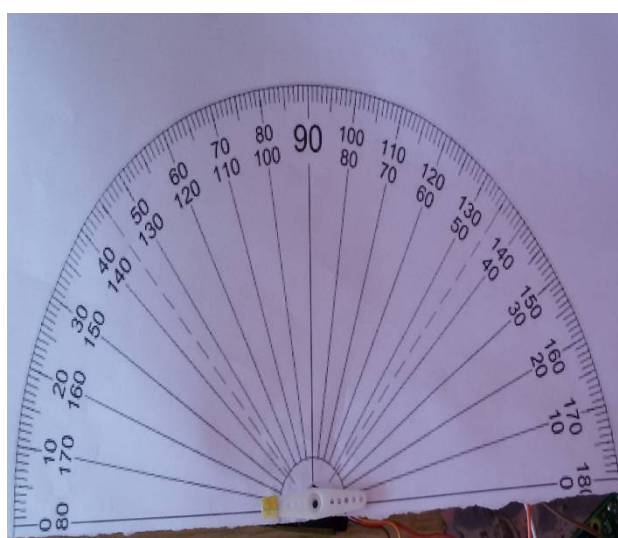
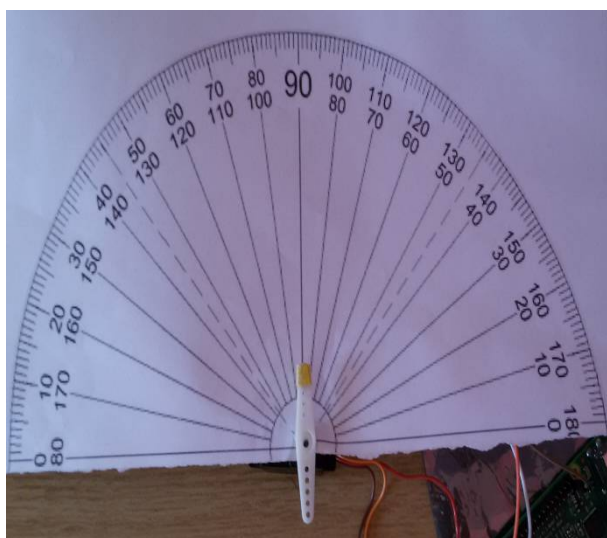


Fig. 17. Third servo motor will make rotation of 90 degree Fig. 18. Fourth servo motor will make rotation of 180 degree

Results shows that When input is given via web browser to a first servo motor is 0 degree, a second servo motor is 45 degree, a third servo motor is 90 degree and a fourth servo motor is 180 degree then the first servo motor does not rotates to any position and holds its output shaft at zero degree (shown in figure 15), second servo motor will make rotation of 45 degree (shown in figure 16), third servo motor will make rotation of 90 degrees (shown in figure 17), fourth servo motor will make rotation of 180 degrees (shown in figure 18). If the voltage, current, temperature of DC servo motor goes above the set value then the DC servo motor does not rotates it will turn off (shown in figure 13).

F. Application

- Automatic Railway Gate Control System
- Robotics
- Industrial Automation



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- Automated Manufacturing
- Machine Tool (Metal Cutting)
- Dam Gate Control System

IV. CONCLUSION

Here, the Multi DC Servo Motor control system through internet browser is implemented using pulse width modulation and Raspberry Pi, and the results gives better performance compared to the Kinect SDK. The results of the actual output of the DC servo motor as compared to the input send to Raspberry Pi via web browser is between 98% to 100%, system is portable and also the computational complexity of this method is less. This system also monitor and control the temperature, voltage, current parameter of the servo motor, if this parameter goes above the set value it will turn off the DC servo motor.

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BIOGRAPHY

Colin I Christian is a Research Student in the Electronics & Communication Department, College of Sardar Vallabhbhai Patel Institute of Technology, Gujarat Technological University. He received Bachelor of Engineering (B.E) degree in 2013 from KJIT, Savli, Gujarat, India. Now pursuing Master of Engineering (M.E) in Communication System. His research interests are Embedded System.

Dr. Yagnesh B. Shukla has received the B.E. degrees in Electronics engineering from N.M. University, Jalgon, India, in 1998. Also he has received M.E degree in Industrial Automation from M.S. University, Vadodara, Gujarat, India in 2004. He has received Ph.D. from M.S. University, Vadodara, 2013. Since 1999, he is working as an Professor(HOD) in SVIT, Vasad. His area of interests are Power Electronics, Digital VLSI Design, Digital Signal Processing, Microcontroller.