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SIMULATION AND IMPLEMTATION OF DC SERVOMOTOR POSITION CONTROL : A TECHNOLOGICAL REVIEW

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Abstract *— this paper is intended to Review the implementation of dc servomotor position control using AVR controller, for increasing the energy capture of wind turbine. AVR controller is implemented with Graphical User Interface (GUI) in MATLAB to track the rotational angle of DC servo motor. The input angle entered in GUI will act as an input signal into the Microcontroller. A simulation of the system is done in Proteus software, which is interfaced with MATLAB via virtual serial port. And the controller programing is done in BASCOM compiler. The system is tested on real-time. Simulation and hardware results are compared and verified.*

Keywords-MATLAB GUI; DC servo motor; AVR Microcontroller; Proteus software, virtual serial port

I. INTRODUCTION

Industrial applications like automation, robotics, and other mechanism where the starting and stopping functions are quickly and accurately required. These applications also require high dynamics on position control, better accuracy and good dynamic response. Servo motor is an important for the application at the industries which require quick response and precise positioning. Also it works on close loop control system [1, 4].

There are basically two types of servomotor: AC and DC servomotor. DC Servo Motors are widely used in Industrial Automation & Drive Technologies compare to AC servomotor because of their low cost, higher reliability, high power output, and higher efficiency.

Normally the problems occur in controlling the servo motor with specific speed and position is the tuning of the parameters. Various techniques are used to cope with the tuning problems [1]. Fuzzy Logic is one of the best methods that have been used to sort out with these problems [5]. Another difficulty in controlling the servo motor is nonlinearity. Because of load pressure variation over a wide range under internal parameter variations and external disturbances, higher degree of nonlinearity occurs [6].

Different methods for controlling servo motor are proportional integral derivative, which is conventional method. Other suggested methods are artificial intelligence and fuzzy logic control which are mentioned in Ref [7]. Out of these methods, fuzzy logic control (FLC) method is better compare to other methods because FLC has better stability, small overshoot, fast response, better control performance and robustness. Also FLC can effectively eliminate dangerous oscillations and provides smooth operation in transient period, while PID controller provides severe oscillations with high overshoot which can damage the system [2, 3].

Servo motors are controlled by a variable pulse width. The sent signal of input pulse is characterized by a minimum pulse, maximum pulse, and a repetition rate as seen in Figure 1.As the frequency of the supply is 50Hz, the servo should detect a pulse every 20 milliseconds. The amount of servomotor shaft rotation depends on duration of pulse width. The position pulse must be repeated for servo to hold the position [1].

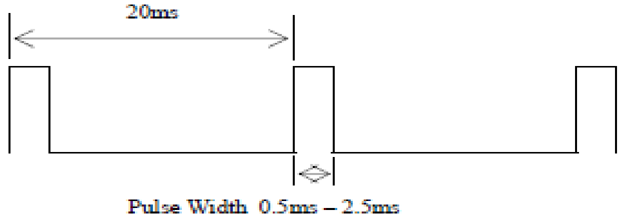

Figure 1. Input pulse of servomotor

Reasons for using AVR microcontroller in comparison with 8051 and PIC microcontroller are: Higher processing speed, low power consumption, large memory, RISC architecture, inbuilt ADC, PWM channels and timers.

II. BLOCK DIAGRAM AND WORKING OF SYSTEM

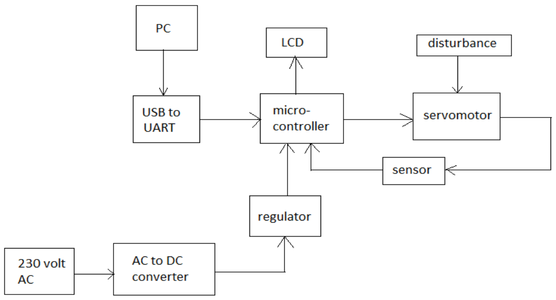

Figure 2.block diagram of the system

Referring to the whole controlling system, the servo controller receives position commands through a serial connection which can be provided by a PCs serial port. First, the angle which we want to control is entered in the PC. The signal from PC is given to microcontroller via USB to USART serial communication port. Microcontroller gives control signal to servomotor according to the entered angle. And so the servomotor rotates. When disturbance is given to servomotor, it will send a signal to microcontroller, and compares it with reference input. It will adjust the position until the error becomes zero.

III. FLOWCHAT OF PROGRAMMING

3.1. MATLAB programming Flowchart

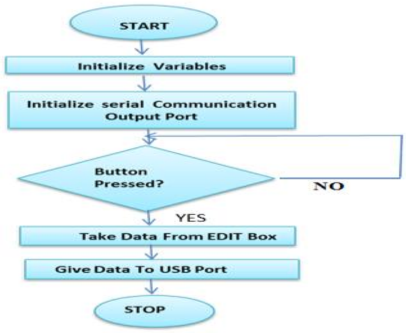

Figure 3.flowchart of MATLAB programing

3.2. BASCOM programming Flowchart

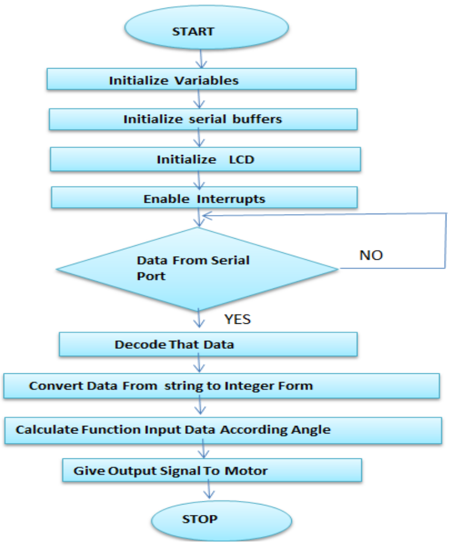

Figure 4.flowchart of BASCOM programing

IV. HARDWARE COMPONENTS

1.Servomotor ratings

operating voltage: 4.8-6.0 V dc
PWM input range: pulse cycle 20±2ms, positive pulse 1~2ms
Std direction : counter clockwise / pulse traveling 800 to 2200µsec
Stall torque : 3 kgf.cm(41.3 oz/in) at 4.8V, 3.2 kgf.cm(44 oz/in) at 6V
Operating speed : 0.2 sec/ 60° at 4.8V, 0.18 sec/ 60° at 6V at no load
Stall current : 0.8 A at 4.6 V, 1A at 6 V
Weight : 38g
Size : 1.6*0.79*1.53 inch
Special feature : heavy duty plastic gears, economy servo

2.USB to UART: for serial communication between PC and microcontroller
3. LCD: To display angle that we entered in MATLAB GUI
4. Microcontroller: Atmel AVR series 8 bit- ATMEGA16
5. Power circuit: 230 volt ac to 5 volt dc

V. SIMULATION CIRCUIT AND RESULT

5.1. MATLAB GUI EDIT box

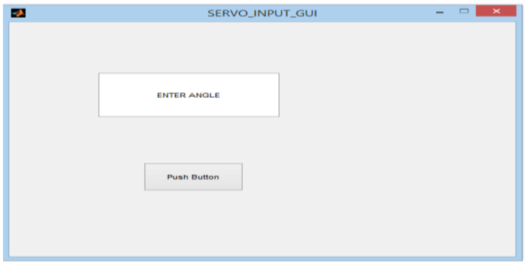

Figure 5.Matlab GUI EDIT box

5.2. Simulation circuit in proteus

Proteus has an ability to simulate the interaction between software running on a microcontroller and any analog or digital electronics connected to it. Proteus can work with popular compiler and assembler to simulate the execution of the machine code, just like a real chip.

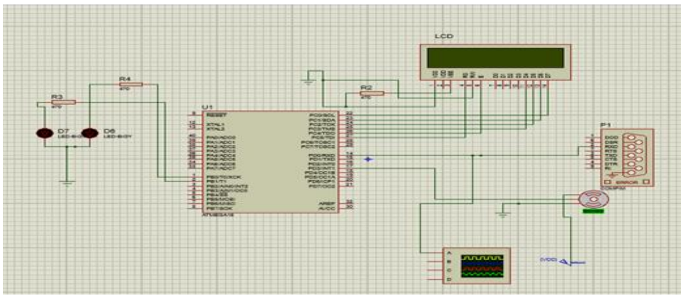

Figure 6.Proteus simulation circuit

5.3. Simulation result in proteus

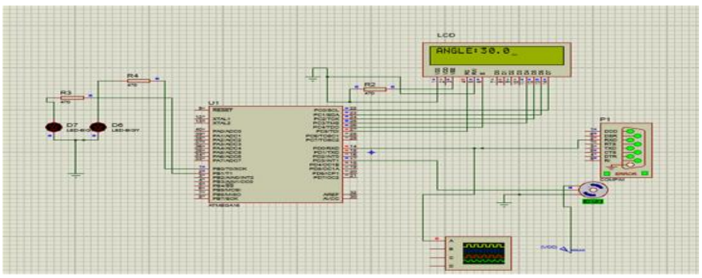

Figure 7.Proteus simulation result

5.4. Output of oscilloscope

Figure 8.waveform of oscilloscope

VI. HARDWARE RESULT

For controlling the position of servomotor, enter the value in MATLAB GUI EDIT box that we want to control. Suppose entered value is 30 degree. So that value will be display on LCD. And the servomotor turns its shaft to 30 degree

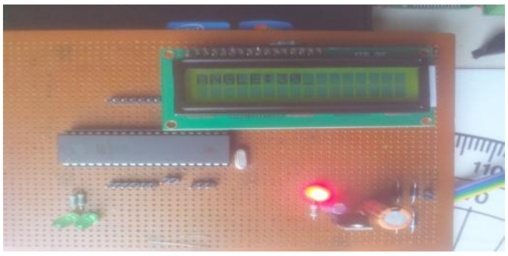

Figure 9. Result of LCD Display

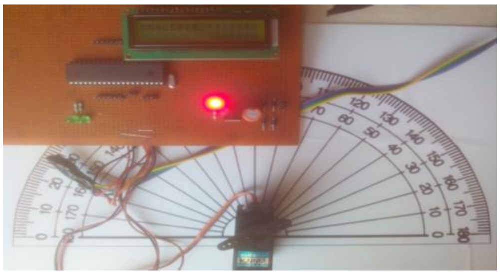

Figure10. Result of servomotor rotation

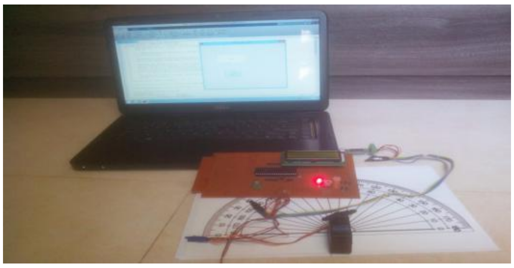

Figure11. The complete hardware result

VI. COMPARISON OF RESULTS

Table1 . comparision of hardware and software results

Entered angle (degree)	software result (degree)	hardware result (degree)
10	9.16	9
25	22.8	22

30	27.2	27
60	54.2	56
90	81.2	83
120	116.7	117
150	143.7	145
180	170.7	172

VII. CONCLUSION

Implementation of AVR Microcontroller with Graphical User Interface (GUI) in MATLAB is performed to track the rotational angle of DC servo motor. A simulation has been carried out using Proteus software interfaced with MATLAB and the controller was tested on real-time application. Hence by varying the rotor angle (position) of servomotor according to wind inflow angle for variable wind direction turbine, the energy can be increased, and so the output power.

APPENDIX

Table 2. List of components and values required for hardware implementation

SR.NO.	COMPONENTS	VALUE	TYPE	QUANTITY
1	Servomotor	-------	DC	1
2	LCD	-------	-------	1
2	LCD	-------	-------	1
4	Microcontroller	-------	Atmega16	1
5	Microcontroller Base	40 pins	-------	1
6	Resistor	470 ohm	-------	5
7	Capacitor	10µF	Electrolytic	1
8	Capacitor	1000µF	Electrolytic	1
9	Crystal	11.0592 MHz	-------	1
10	IC 7805	-------	-------	1
11	15 PIN connector	-------	MALE	1
12	15 PIN connector	-------	FEMALE	1
13	USB to UART cable	-------	-------	1
14	Adapter	------	------	1
15	General purpose PCB	------	-----	1

REFERENCES

[1] Ahmed M. A. Haidar, Chellali Benachaiba, Mohammad Zahir, " Software Interfacing of Servo Motor with Microcontroller, Journal of Electrical Systems," JES9-1(2013):84-99

[2] Munadi, M. Amirullah Akbar, "Simulation of Fuzzy Logic Control for DC Servo Motor using Arduino based on Matlab/Simulink," 2014 International Conference on Intelligent Autonomous Agents, Networks and Systems Bandung, Indonesia, August 19-21, 2014

[3] Paul I-Hai Lin, Santai Hwang and John Chou, "Comparison on fuzzy logic and PID controls for a dc motor position controller , " * Indiana-Purdue University Fort Wayne *National Taipei Institute of Technology Taipei, Taiwan 0-7803-1993-1994 IEEE

[4] [006]K. Seki, H. Yokoi & M. Iwasaki, "Experimental evaluations of friction behavior in micro-displacement region positioning for servo motor with air bearings," Proceeding of IEEE International Conference on Advanced Intelligent Mechatronics, 2012.

[5] [007]R. Wai, & R. Muthusamy, "Fuzzy-Neural-Network Inherited Sliding-Mode Control for Robot Manipulator Including Actuator Dynamics," IEEE Transactions on Neural Networks and Learning Systems,Vol. 24, NO. 2, 2013

[6] [008]A. Sadeghieh, H. Sazgar, K. Goodarzi & C. Lucas, "Identification and real-time position control of a servo-hydraulic rotary actuator by means of a neurobiologically motivated algorithm," ISA Transactions 51: 208–219,2012

[7] C. C. Lee, "Fuzzy logic in control systems: fuzzy logic controller-part1," IEEE Transaction System. Man. Cybernetics., vo1.20 (no.2), pp.404-418, 1990.

[8] Mehmet, & T. Ismail, "Motion controller design for the speed control of DC servo motor," International Journal of Applied Mathematics And Informatics, Volume 1.(4):131-137, 2007.

[9] Abdulrazig Alarabi, "Rotor angle wind turbine energy capture control," IEEE 28th Canadian Conference on Electrical and Computer Engineering Halifax, Canada, May 3-6, 2015

