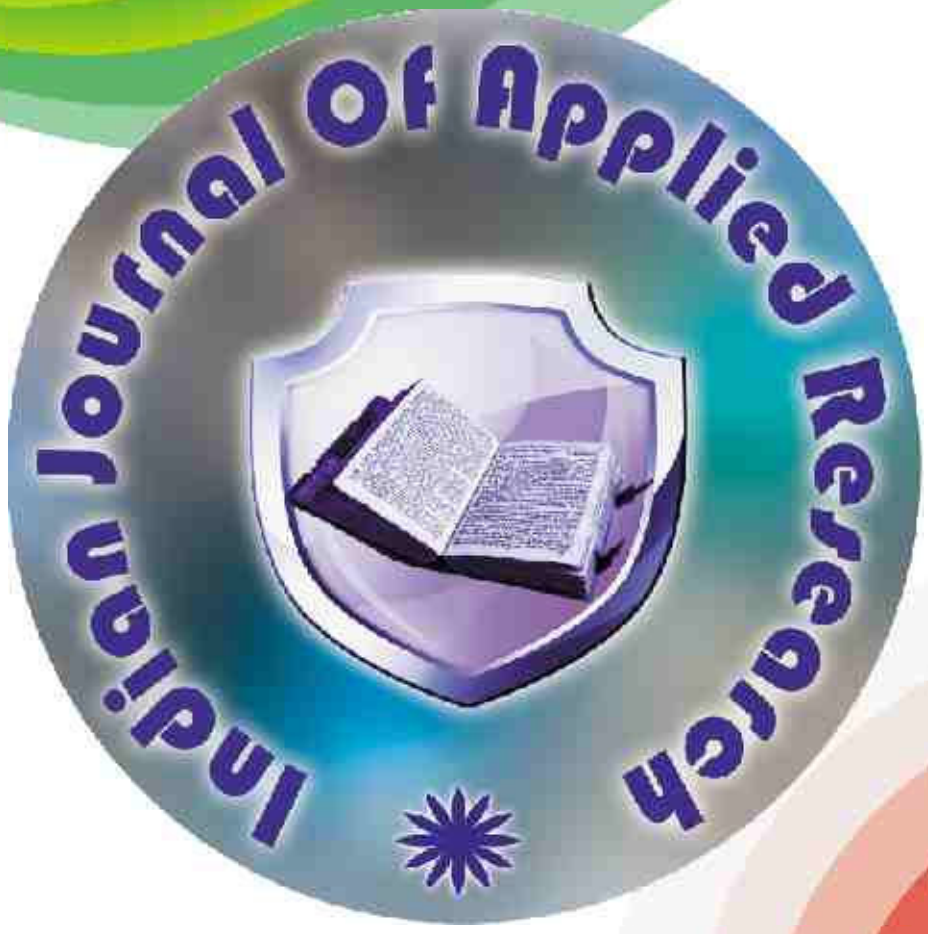
₹ 100 ISSN - 2249-555X

Volume : 1 Issue : 4 January 2012



Journal for All Subjects

www.ijar.in

Listed in International ISSN Directory, Paris.

ISSN - 2249-555X

Indian Journal of Applied Research

Journal for All Subjects

Editor,
Indian Journal Of Applied Research
8-A, Banans, Opp. SLU Girls College, New Congres Bhavan, Paldi,
Ahmedabad-380006**,** Gujarat, INDIA
Contact.: +91-9824097643 E-mail : editor@ijar.in

INDEX

Volume : 1 | Issue : 4 | January 2012 ISSN - 2249-555X

Research Paper Engineering

Wireless Speed Measurement And Control Of Universal Motor

* G. Prasad ** G. Ramya Swathi
*** Dr. P. V. N. Prasad **** A. Muneiah

* Asst.Prof, Dept of EEE, GIT, GITAM University, Visakhapatnam

** Institute of Aeronutical Engineering and Technology, Hyderabad.

*** Professor, Dept of EE, University College of Engineering, Osmania University, Hyderabad

**** Lecturer, Eritrea institute of Technology, Eritrea

ABSTRACT

This paper illustrates the speed measurement and control of Universal Motor by using Microcontroller. The setup consists of two units Motor & Power Control Unit and Remote Control Unit. Motor & Power control unit consists of Universal Motor, Speed sensor, Microcontroller and the other components. Similarly Remote control Unit consists of LCD display, Microcontroller, Keypad etc. The system continuously monitors the speed variation of Universal Motor by a Microcontroller and corrects it according to the set speed using a PID algorithm, written in 8051 assembly language. The usage of Microcontroller provides greater flexibility on the operation of the system.

Keywords : Wireless, Motor, Microcontroller, LCD Display, Keypad.

Introduction

The industries need to control the process parameters like Temperature, Speed, Flow etc [1]. accurately. The PID controllers are capable of controlling the process more accurately and also take very less time to correct the process deviations. Modern electronics play a vital role in modeling the instrumentation systems. Wireless [2] speed measurement and control of Universal Motor [3] is one such illustration. The remote wireless setup enables the user to avoid long wires from the probe to the control station and the possibility of short circuit due to cables. Remaining cables between sensor and control are not required which ultimately reduce the error due to unwanted noise signals. Using Microcontroller [4] provides greater flexibility on the operation of the system.

The Wireless Speed Measurement and Control of Universal Motor utilizes 315 MHz VHF carrier, which is approved by government body for a short range wireless communication [2], [5]. This system does not interfere with the other industrial gadgets. It is also immune to celestial noise developed in the harsh environment. The system continuously monitors the speed variation by a Microcontroller and corrects it according to the set speed using a PID algorithm, written in 8051 assembly language.

The present work deals with the hardware setup of motor & power control unit and remote control unit. Which find its key applications in military, agricultural and industrial sectors. The advantages of this unit can be drawn in terms of cost, accuracy in speed and reduction in the error due to unwanted noise signals.

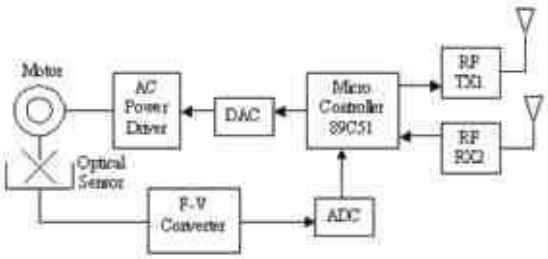
Wireless Speed Measurement And Control

The work aims at controlling and measuring the speed of Universal Motor by implementing PID logic control algorithm with wireless RF (Radio Frequency) interface. The work comprises of Motor & Power Control Unit and Remote Control Unit. The Motor & Power Control unit consists the following components Motor setup, Optical Sensor, AC Power Driver [6], DAC [7] (Digital to Analog converter), Microcontroller [4], ADC [7] (Analog to Digital converter), F-V (Frequency to voltage) Converter [8] & RF (Transmitter 1 & Receiver 2 Module) [8] while the Remote Control Unit consists of Microcontroller [4], LCD Display [9], keypad & another RF (Transmitter 2 & Receiver 1 Module) [8].

A. Motor & Power Control unit

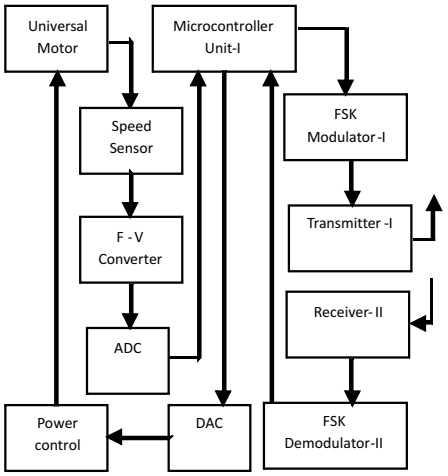
Fig. 1 shows the basic block diagram of Motor & Power Control Unit and fig. 2 shows detailed block diagram of Motor & Power Control Unit.

Figure 1 Basic Block diagram of Motor & Power Control Unit



A Universal Motor is a relatively small series motor specially designed to operate at approximately the same speed and output power on either DC or single phase AC at a frequency of 60 Hz / 50 Hz, and an rms voltage i.e. approximately equal to the DC voltage.

Figure 2 Detailed Block Diagram of Motor & Power Control Unit



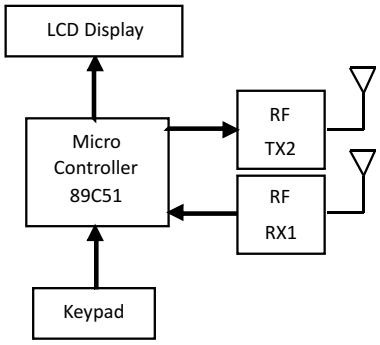
The speed of the Universal Motor is sensed using an optical pick-up sensor. One fan leaf is fixed in the shaft, which cuts the infra-red lights passed to the phototransistor so that it gives a square wave output. The F-V converter block converts the frequency into dc voltage signal. The ADC converts the analog input voltage into digital value. The Microcontroller reads the digital value from ADC and converts into serial format. This serial data is sent to FSK modulator [10] from where the output is transmitted with 315 MHz carrier frequency through RF (Radio Frequency) Transmitter 1 (RF TX 1) module.

The RF Receiver 2 (RF RX 2) module, which demodulates the signal, receives the signal and the data is fed to the Microcontroller. The Microcontroller sends the data to the DAC for Digital to Analog conversion and the output is given to the AC power control Driver. This section controls the AC output given to the motor depend upon the speed settings.

B. Remote Control Unit

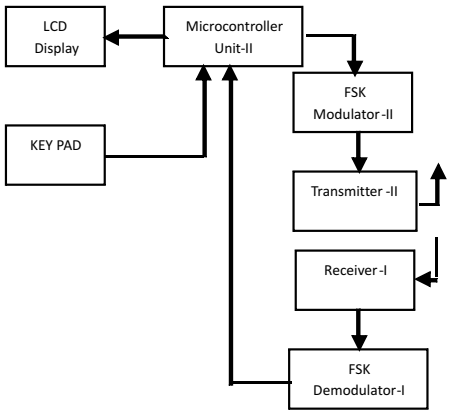
Fig. 3 shows the basic block diagram of Remote Control Unit and fig. 4 shows detailed block diagram of Remote Control Unit.

Fig. 3 Basic Block diagram of Remote Control Unit



The transmitted RF signal is received in the receiver end by RF Receiver (RF RX 1) module. This RF module demodulates [10] the carrier and reproduces the original signal. Another Microcontroller in the receiver end reads this signal and the value is displayed in the LCD display [9]. The user can also change the set point (i.e. speed of the motor can be incremented / decremented) using keypad. The same Microcontroller again reads the value changed by the user and it is transmitted through another RF Transmitter2 module. This module has 433 MHz carrier frequency.

Fig. 4 Detailed Block Diagram of Remote Control Unit



Hardware Implementation

The hardware setup of Motor & Power Control Unit is shown in fig. 5. This hardware setup consists of following components Universal Motor, Optical sensor, F-V converter, ADC [7], Microcontroller [4], FSK modulator [10], FSK demodulator [10], Transmitter, Receiver, DAC [7], AC Power Driver [6].

Fig. 5 Motor & Power Control Unit

The hardware setup of Remote Control Unit is shown in fig. 6. This hardware setup consists of following components Microcontroller [4], LCD display [9], keypad, FSK modulator [10], FSK demodulator [10], Transmitter, Receiver

Fig. 6 Remote Control Unit

Programming Flowcharts

A. Flowchart of Motor & Power Control Unit

The Flowchart of Motor & Power Control Unit enables to visualize the initialization and configuration of Serial Port Baud, 32-byte data array with the aid of 2 pointers, and transmitting the default values to Remote control Unit. It also emphasis on the reset values of the speed transmitted in turn from the Remote control unit to Motor & Power Control unit and thus function according to the new set values. This procedure is reproduced in a schematic diagrammatic representation of the flowchart as shown in fig. 7.

B. Flowchart of Remote Control Unit

The Flowchart of Remote Control Unit enables to visualize the initialization and configuration of Serial Port Baud, LCD, 32-byte data array with the aid of 2 pointers, and display of LCD. The following is the diagrammatic representation of the flow cart as shown in fig. 8.

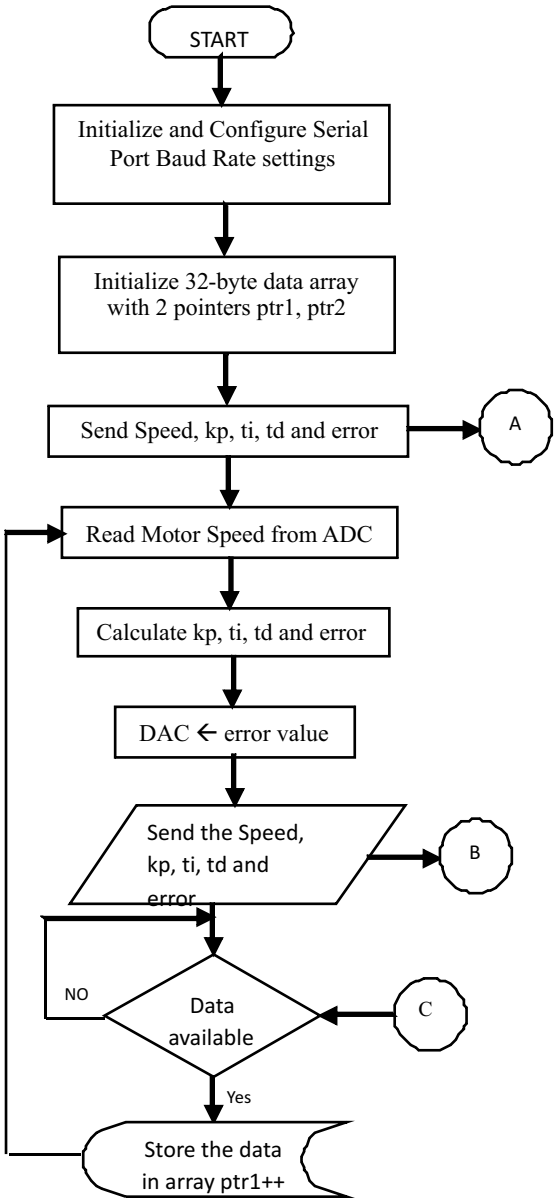


Fig. 7 Flowchart of Motor & Power Control Unit

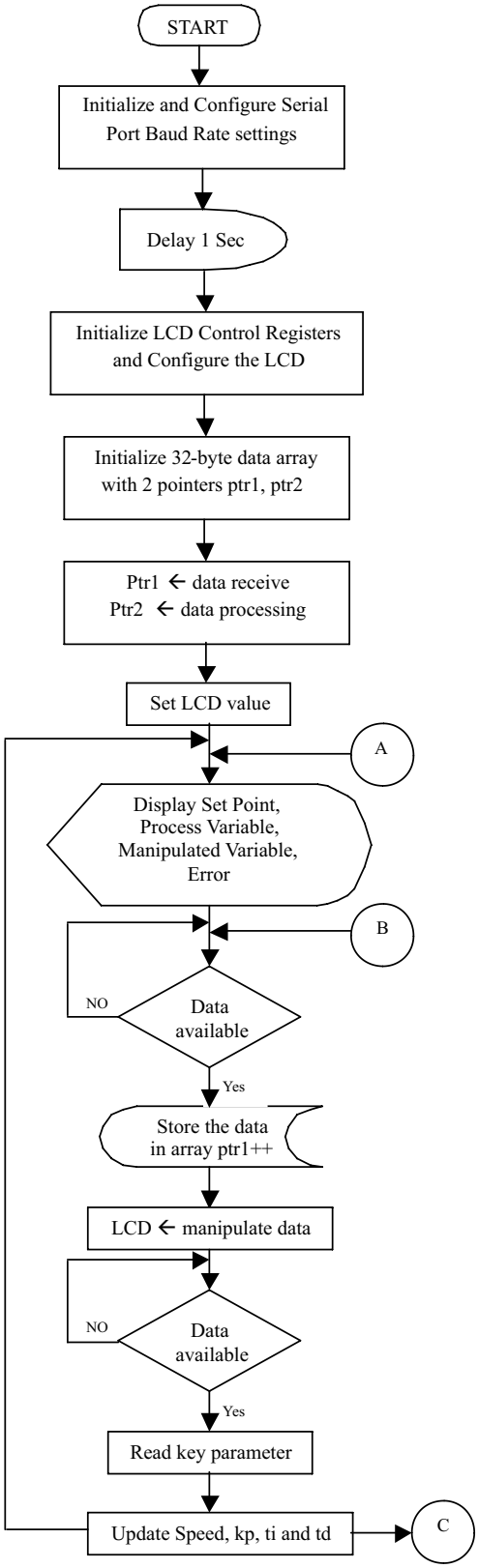


Fig. 8 Flowchart of Remote Control Unit

Result

The following are the experimental results observed when the Motor & Power Control unit and Remote Control unit are setup and the results of the various speeds, current and voltage values are tabulated in Table I. and the corresponding characteristics of the results are graphically represented in Fig. 9.

Graphical representation of the results was done by plotting Speed versus Voltage (y-axis depicting Speed and x-axis depicting Voltage); and Current versus Voltage (y-axis depicting Current and x-axis depicting Voltage).

In the Speed versus voltage curve the speed represented on the y-axis is one-tenth (1/10th) of the actual speed in 'rpm'. Similarly, x-axis is the actual values of the Voltage in 'volts'.

In the Current versus voltage curve the current represented on the y-axis is the actual current in mA. Similarly, x-axis represents the actual values of the Voltage in 'volts'.

It can be observed that the variation of speed with voltage is linear while the variation of current is non-linear.

Fig. 9 Characteristics of Universal Motor

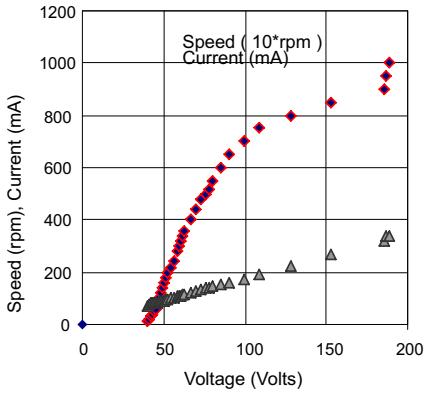


Table I

Speed (rpm)	Voltage (Volts)	Current (mA)
0	0	0
100	40	71
200	41	75
300	42	80
400	43	83
500	44	84
600	45	85
800	46	86
1000	47	88
1200	48	89
1400	49	90
1600	50	92
1800	51	93
2000	52	97
2200	54	100
2400	56	105
2800	58	106
3000	59	109
3200	60	110
3400	62	113
3600	63	116
4000	67	123
4400	70	128
4800	73	134
5000	76	138
5200	78	140
5500	80	145
6000	85	152
6500	90	162
7000	99	175
7500	109	190
8000	128	222
8500	153	268
9000	186	318
9500	187	338
10000	189	340

Conclusion

This work involves the speed measurement and control of Universal Motor by using Microcontroller. The project illustrates basically two units 'Motor & Power Control Unit' and 'Remote Control Unit'. The system continuously monitors the speed variation of Universal Motor by a Microcontroller and corrects it according to the set speed using a PID algorithm, written in 8051 assembly language, which provides satisfactory results for the prescribed job assigned. The key principle of this project is increasing the efficiency, accuracy by reduction of wires and the usage of Remote sensing technology. This remote wireless setup enables the user to avoid long wires from the probe to the control station and the possibility of short circuit due to cables. Remaining cables between sensor and control are not required which ultimately reduces the error due to unwanted noise signals. The usage of Microcontroller in Motor & Power Control Unit and Remote Control Unit provides a greater flexibility on the operation of the system.

REFERENCES

A.K.Sahney, "Electrical & Electronics Measurements", Khanna Publishers, 2002. | [2] Theodore S. Rappaport, "Wireless communication", Pearson Education, 2000. | [3] Charles I Hubert, "Electric Machines Theory, Operation, Applications, Adjustment and control", Second edition Pearson Education, 2003. | [4] Charles I Hubert, "Electric Machines Theory, Operation, Applications, Ad justment and control", Second edition Pearson Education, 2003. | [5] Taub and Schilling, "Principles of communication systems", second edition, Tata Mcgrawhill, 2000. | [6] Harish C.Rai, "Industrial and Power Electronics", Umesh Publication, Millinium Edition, 2004 | [7] P.Chakrabarti, "Principles of digital communication" Dhanpat Rai & Co Publishers, 2003 | [8] Data Sheets of National Semiconductor, www.national.com, May 1998. | [9] D a t a s h e e t , http://www.crystalfontz.com | [10] "Engineering basic Electronics", Version 1.0, Edurite Technologies Private limited, www. edurite.com.

Sara Publishing Academy
Indian Journal Of Applied Research
Journal for All Subjects

Editor,
Indian Journal Of Applied Research
8-A, Banans, Opp. SLU Girls College,
New Congres Bhavan, Paldi, Ahmedabad-380006.
Contact.: +91-9824097643 E-mail : editor@ijar.in

Printed at Unique Offset, Novatsing Rupam Estate, Opp. Abhay Estate, Tavdipura, Shahibaug, Ahmedabad