" A man of true science uses but few hard words, and those only when none other will answer his purpose; whereas the smattered in science thinks that by mouthing hard words he understands hard things. "

– Herman Melville.

MICROPROCESSOR BASED WIND SPEED INSTRUMENTATION SYSTEM

MIHIR VORA

ABSTRACT:

This system is basically related with wind measurement parameters like wind speed, wind direction, humidity, pressure, temperature and process the sensed data to get result in an appropriate form for some useful purpose. Our dissertation is capable to measure wind speed only.

⊗ INTRODUCTION :

Measurement of wind speed is very important to people such as pilots, sailors, and farmers. Accurate information about wind speed is important in determining the best sites for wind turbines. Wind speeds must also be measured by those concerned about dispersion of airborne pollutants. Winds speeds are measured in a wide variety of ways, ranging from simple go-no go tests to the most sophisticated electronic systems. The variability of the wind makes accurate measurements difficult, so rather expensive equipment is often required. We have tried to develop a system using general type of components making it a low cost system. But we must have good data on wind direction before such a choice can be made. We shall examine some of the methods of measuring wind speed in our dissertation. *Anemometers*, instruments that measure wind speed, have been designed in great variety. In our system we have used propeller and cup type anemometers. Each anemometer contains appropriate sensor with an appropriate signal conditioning transducers based circuits, and gives voltage output which is proportional to physical quantity being measured. Anemometer have output which is ac and dc, or string pulse. In our proposed system, the output is string pulse. The outputs of different parameters are given to the input of data acquisition system. The data acquisition system is having a facility to select appropriate signals by selecting appropriate channels which are used for different transducers. The data acquisition system will convert input signals into its equivalent binary codes by using successive approximation method. This binary output is used by microprocessor for processing the data. The results of processed data are displayed on the display unit of the microprocessor. The measured physical quantity is displayed one by one either by using time slot method or by interrupt method. The software for data acquisition system is written in assembly language. In time slot method the physical quantity is measured after certain period of time for a particular time interval one by one. The measured physical parameters are displayed one by one interrupt method. In this method microprocessor waits for a key to be pressed. This system contains interrupt method for display of wind parameters

⊗ WIND SPEED MEASUREMENT TECHNIQUES :

Wind speed can be measured by following two methods:

[1] Motor Generator Method, and

[2] Optical Method.

[1] MOTOR GENERATOR METHOD: In this method, propeller type anemometer has been used. One can make it by either aluminum or fiber glass. For our system anemometer is made by aluminum. Wind shaft used for rotation of wind cups is connected with a motor shaft which generates the electromotive force (emf) when motor shaft is rotates and produces the electromotive force; which is directly proportional to the anemometer speed. The major disadvantage of this method is that, the generator is to be brushed regularly. As such the motor will restrict the smooth motion, hence producing less emf which is insufficient for getting accurate results.

[2] OPTICAL METHOD: The problem of motor generator method is eliminated in optical method. In this method, one optoelectronic device is used for emitting the radiation of particular frequency. Other device is used for detecting the emitted radiation. For our circuit purpose we have used infrared detector and emitter because infrared detectors and emitter do not influenced by visible light, hence this will eliminate the false triggering of detector. For wind speed detection cup type anemometer is connected with circular disc, infrared transistor optoelectronic device, and transducer based circuit. In the circular disc there are 18 holes at every 22.5º location. So the disc will generate a series of pulses. The number of pulses generated per given period of time can be translated into equivalent speed. The arrangement of infrared detector and LED is such that so as to face each other through disc holes whenever the disc rotates. Here the arrangement of infrared detector and LED is such that they can see to each other through disc holes when disc holes rotate. When infrared detector faces the LED and the disc, the collector voltage of infrared transistor falls

- **CALIBRATION**: The distance between disc and center of cone for one revolution is circular type which is 2pR where R is radius of revolution i.e. distance between centre of disc and centre of cone. Here in our design R = 22.5cm ∴ 2 p R = 141.3 cm Here speed = Distance / Time so if speed is one mile per second for one resolution per second, it is equivalent to wind speed of 3 miles per hour. Since there are 18 hole in circular disc, increase of 5 to 6Hz frequency corresponds to an increase in wind speed of one mile per hour. By considering above concept circuit can be calibrated by applying different frequencies at test frequency injection point and by measuring proportional output voltage. The calibration result obtained by inputting known frequency is shown in calibration Table.1.

⊗ MICROPROCESSOR SOFTWARE :

This chapter describes the microprocessor software developed for the proposed wind measurement system. This includes software for data collection from anemometer, to convert analog data into digital word through ADC, to process it through microprocessor 8085 and to display result at seven segment LED display. For the solution of any problem through microcomputer or computer, the schematic presentation of solution is desired in the form of flow chart. The system software has been divided into different parts which are as follows:

[1] Main program.

[2] Processing routine for each anemometer.

[3] Subroutines used for main program and processing routines.

[4] Utility subroutines provided in the system.

- **MAIN PROGRAM:** The main program is used to select channel of ADC to display desired wind parameters like wind speed and wind direction. Interrupt Service Routine is used in this program. One can observe desired parameter by pressing predefined key from the following:

➢ **WIND SPPED** The program can be stopped by pressing RST key.

- **UTILITY SUBROUTINES** :

The different utility programs used from system ROM is OUT, DELAY and MODIDT.

OUT ⇨ This subroutine is used to display character data in address/data field of seven segment microprocessor display.

DELAY ⇨ This subroutine used is to get required time delay in Different program during program execution at required location.

MODIDT ⇨ This subroutine is used to display numerical result of Processing routine in data field of seven segment display of microprocessor.

⊗ **CONCLUSIONS:** This system is a basic system to measure the wind parameters like wind speed for wind speed, a visual indication of wind speed is obtained by dc generator to dc voltmeter with appropriate calibrated scale. The scale needs to be arranged such that the pointer indicates a speed of 1milepersecond when the generator stalled and voltage is zero. Then any speeds above 1 mile / second will be correctly displayed if the scale is calibrated according to given graph of frequency verses output voltages. Our circuit design works with a accuracy of 1 mile / second and best suited for examining heights between 30 and 100 m Both wind parameters are measured using microprocessor based instrumentation system. By pressing a respective key respective parameters can be measured for which interrupt service routine is used.

⊗ **FUTURE SCOPE:** The proposed instrumentation system is a basic circuit design for wind measurements system. The system can be expanded to measure some other weather parameters like temperature, pressure, humidity, rain etc. By changing the input parameters one can develop new software for weather conditions. Further, the circuit design of the system can be utilized in Balloon tracking system.

➢ **REFERENCES**

[1] B. S. Rai, C. B. Tripathi, B. P. Singh,
Microprocessor Based System for Monitoring of Underground Mine Environments,
IETE Student's Journal, Vol. 27, No.3 (1986), pp.102 – 105.

[2] S. G. Kar, A. K. Mukhopadhyay,
Microprocessor Based Temperature Monitoring Control and Protections,
IETE Student's Journal, Vol. 28, No.3 (1987), pp.102 – 106.

[3] Mukesh M. Jotani,
Microprocessor Based Instrumentation System [Weather Data Collection System],
M. Phil Dissertation, Sardar Patel University (1991).

[4] *Temperature Transducer: AD 590*
Analog Devices: Linear Product Data Book (1988),
pp.10.7 – 10.15.

[5] Josheph J. Carr,
Elements of Microcomputer Interfacing Temperature Transducer: SEC LIB.681.3 C 3112, pp 306, 310.

[7] S. P. Awta,

8085 Assembly Language Programming and Applications Interfacing, pp. 73 – 78.

[8] *Microprocessor and Microcomputer: 8080, 8085, and Z80 programming, interfacing and Trouble Shooting*,
[a] Sec.7.2, pp.292 – 311, PPI: 8255A,
[b] Sec.11.4, interfacing an analog to digital converter, pp. 555-559.

[9] Ashok Raj, Harisah C. Rai, Atam P. Dhavan,
Electronics and Communications engineering [6th addition]
Mushy Publications, New Delhi (1990), pp.426 - 442.

[10] B. Ram,
Microprocessor and Microcomputer,
Dhanpat Rai Publications, New Delhi (1998), pp. 240 – 243,
388 – 394.

[11] B. C. Nakara, K. K. Chaudhry,
Instrumentation Measurement and Analysis,
Tata McGraw-Hill Publishing Com. Ltd., New Delhi (1996),
pp. 311 – 313.

[12] *Wind Energy Systems*,
by Dr. Gary L. Johnson, November 12, 2001.

[13] E. Golding,
The Generation of Electricity by Wind Power,
Halsted Press, New York (1976).

[14] E. W. Hewson, J.W. Wade
Biological Wind Prospecting – Third Wind Energy Workshop Proceedings, Washington, D.C., September (1977),
CONF 770921, pp. 335 – 348.

[15] G. L. Johnson,
Measuring Wind Speed Profiles with Balloons,
Wind Energy Technology *Conference*, Kansas City, Missouri, March 16, 17, 1981.

[16] P. B. MacCready Jr., H. R. Jex
Response Characteristics and Meteorological Utilization Of Propeller and Vane Wind Sensors,
Journal of Applied Meteorology 3 (1964) 182.

17] R. W. Marrs, J. Marwitz
Locating Areas of High Wind Energy Potential by Remote Observation of Eolian Geomorphology and Topography – Third Wind Energy Workshop Proceedings, Washington, D.C., September (1977), CONF 770921, pp. 307 – 320.

[18] Middleton, W., E. Knowles, A. F. Spilhaus,
Meteorological Instruments, 3rd Ed.,
University of Toronto Press, Toronto (1953).

[19] K. E. Noll, T. L. Miller,
Air Monitoring Survey Design,
Ann Arbor Science Publishers, Ann Arbor (1977), pp. 215 – 237.

[20] P. C. Putnam,
Power from the Wind,
Van Nostrand, New York (1948).

[21] Roger S. Pressman,
Software Engineering: A Practitioner's Approach, 5th Ed.,
McGraw Hill Pub. Comp., New York (2001).

[22] Robert W. Botcher, Steven J. Hoff.
Eds. Livestock Environment V. St. Joseph,
American Society of Agricultural Engineers, Michigan (1997).

[23] Wathes, Charles,
Eds. Livestock Housing,
University Press, Cambridge, UK (1994).

[24] *Road Weather Information Systems* (RWIS),
Data Integration Guidelines January 2002,

Submitted by**:** Castle Rock Consultants, Inc. 6222 SW Virginia,
Avenue Suite 2 Portland, OR 97201.

[25] *Database on Wind Characteristics*,
Contents of Database Bank, Gunner C. Larsen Risø National Laboratory, Kurt S. Hansen, MEK, DTU, November 2002.

[26] K. S. Hansen, M. S. Courtney,
Database on wind Characteristics,
ET-AFM-9901, Department of Energy Engineering, DTU, Denmark (1999).

[27] G. C. Larsen, K. S. Hansen,
Database on Wind Characteristics – Philosophy and Structure. Riso-R-1299 (2001).

[28] G. C. Larsen, K. S. Hansen,
Database on Wind Characteristics – Users Manual,
Riso-R-1300 (2001).

Tables & figs are given in other file :

Bio data: Mihir Vora physics teacher in kkps Bhuj kachchh Gujarat