

DESIGN AND DEVELOPMENT OF MULTI-CHANNEL USB DATA ACQUISITION SYSTEM FOR PARAMETERS MEASUREMENT

¹SWATI J. MODI, ²KUNAL B. BHOYANIA

¹Research Scholar, Department of Instrumentation and Control Engineering, LD College of Engineering, Ahmadabad, Gujarat, India

²Head and Prof., Department of Biomedical Engineering, LD College of Engineering, Ahmadabad, Gujarat, India

¹swati_modi12@yahoo.com, ²kbbld@yahoo.com

ABSTRACT: This paper describes the design and development of ZigBee based Data Acquisition System (DAS) for the measurement of physical parameters. Physical parameters such as temperature, humidity, light intensity etc., which are generally slowly varying signals are sensed by respective sensors or integrated sensors and converted into electrical signal. The DAS is designed using PIC18F458 microcontroller, communicating with Personal Computer (PC) through ZigBee. The designed DAS has been tested with the application program developed in MATLAB, which allows controlling and monitoring measuring parameters.

Keywords: Automation, ZigBee, Data Acquisition System (DAS), temperature, humidity, monitoring, MATLAB GUI

1. INTRODUCTION

The design and development of the PC based DAS using microcontrollers for use in various fields has been a challenging task. Research is going on in various fields for the design and development of ZigBee based real time DAS. Physical parameters such as temperature, pressure, humidity, light intensity etc., are generally slowly varying signals [1]. They can be sensed by respective sensor or transducer giving changes in electrical parameters. In the laboratories or industrial environment, it is very much essential to monitor and/or control such physical parameters. Manual observation and recording of such parameters for continuously for a long time is almost impossible and it cannot fulfill the current requirements in terms of the accuracy and time duration [2]. The efficient solution of this problem is to develop data logger or DAS .the data at receiver are stored in excel file for future reference. The present work is to explore the design and development of the DAS using PIC18F458 microcontroller for continuous monitoring and storing of the physical parameters such as temperature, light humidity etc [3]. The unique feature of this designed DAS is that, it is designed and developed with commonly available components in the market at low cost; firmware and application program are also developed and are user friendly.

2. DATA ACQUISITION SYSTEM

A data acquisition system (DAS) has been developed using PIC18F458, which is a 40-Pin, High-Performance, Enhanced Flash, and USB Microcontrollers with nano Watt Technology.

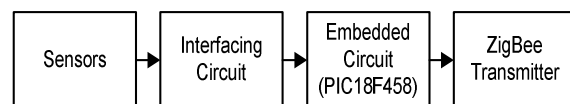


Fig. 1(a): Data Acquisition System Transmitter

Figure 1(a) shows the block diagram of the transmitter system. It uses 8 (eight) analog input channels (AN0 through AN07) having 10 bit resolution ADC, in which the entire operation is controlled by the firmware. RS-232 or USB Cable is used to communicate with the embedded circuit and ZigBee. All sensors are connected to analog input channels of 18F458 PIC microcontroller these analog inputs are converted first and then send it to transmission pin of microcontroller.

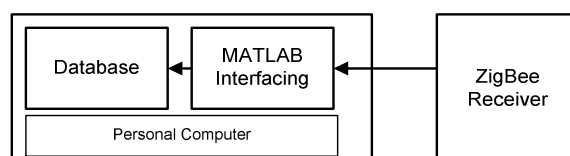


Fig. 1(b): Data Acquisition System Receiver

Figure 1(b) shows that the receiver section of DAS. The received data from ZigBee is sending to MATLAB-GUI using serial USB communication or RS232 Cable .MATLAB-GUI handles all the data Display it, and Stores it into the Database file.

3. PROTEUS SIMULATIONS OF DAS

Circuit diagram of transmitter circuit is shown in figure there are two sensors used in this circuit, one is LM35 which is temperature sensor and another is LDR or Photo transistor which is light sensor are connected to pin3 and 4 of port RA and LCD data port is connected to port RD [4], [5], [6], [7].

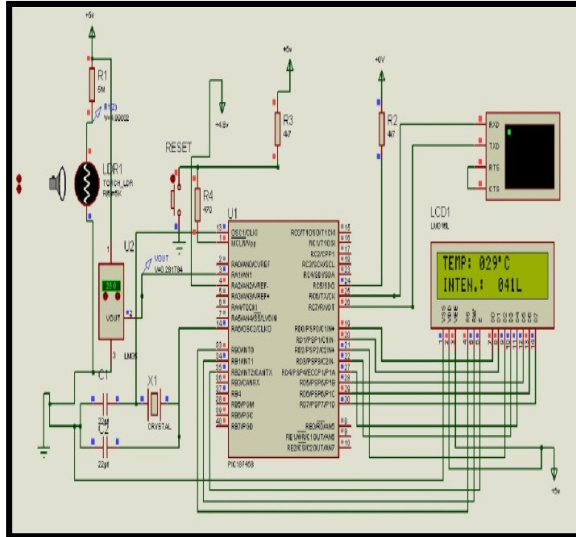


Fig. 2: Circuit diagram of Data Acquisition System

The PCB layout of the circuit is designed using DIP Trace software, DIP Trace is EDA software for creating schematic diagrams and printed circuit boards.

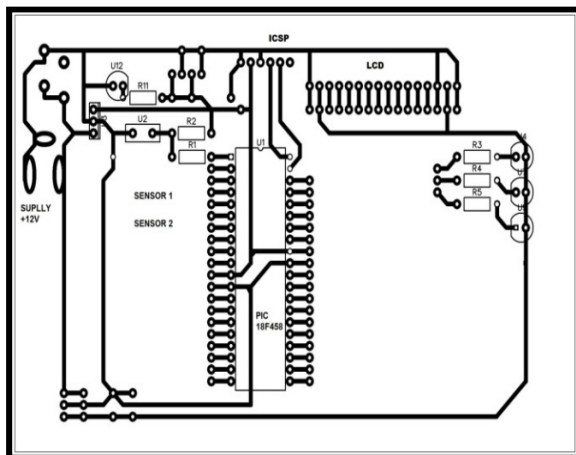


Fig. 3: PCB layout of the circuit

4. SENSORS

There are two type of sensors interfaced with the circuit, for measuring the temperature and light intensity.

LM35

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.

The LM35 thus has an advantage over linear temperature sensors calibrated in° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of $\pm 1/4^{\circ}\text{C}$ at room temperature and $\pm 3/4^{\circ}\text{C}$ over a full -55 to $+150^{\circ}\text{C}$ temperature range. Low cost is assured by trimming and calibration at the wafer level. As it draws only $60\ \mu\text{A}$ from its supply, it has very low self-heating, less than 0.1°C in still air.

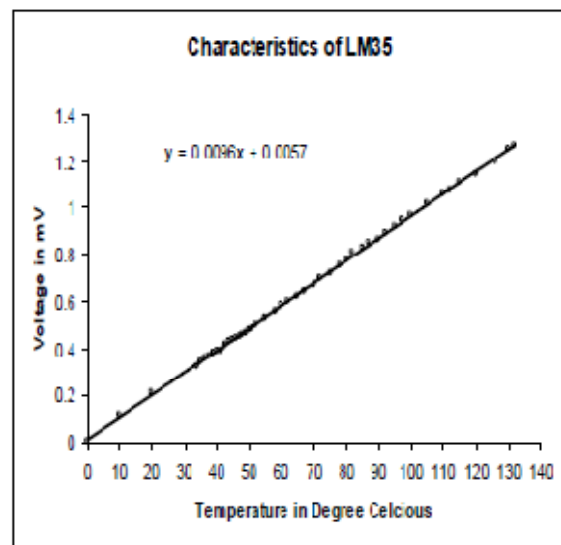


Fig. 4: Characteristic graph of the LM35

LDR

A photo resistor or light dependent resistor (LDR) is a resistor whose resistance decreases with increasing incident light intensity; in other words, it exhibits photoconductivity.

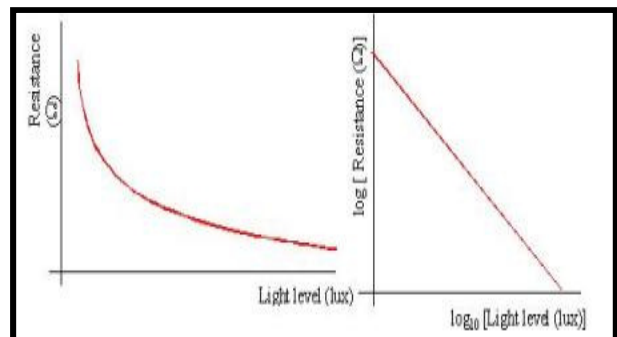


Fig. 5: Characteristic graph of the LDR

5. MATLAB GUI

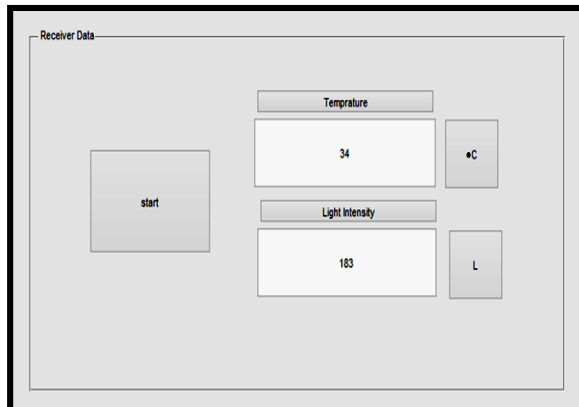


Fig. 6: Snapshot of GUI

GUI (graphical user interface) allows users to perform tasks interactively through controls such as buttons and sliders. Within MATLAB, GUI tools enable you to perform tasks such as creating and customizing plots of various sensors data. There is a provision of creating custom GUIs for others to use – either by running them in MATLAB or as standalone applications.

This GUI display real time Temperature and Light in different textboxes and it will starts to display by using start button.

6. RESULTS AND CONCLUSION

The use of MATLAB GUI contains data of sensors and it stored for future analysis and also the wave form can be reconstructed. For temperature representative curve for 12 hour continuous observation is presented. The obtained real time data for temperature is presented. Presently in the designed system, we have used only two channels for giving the inputs for DAS. Since the system is workable for 8 – channels, as tested, some other physical parameters such as light intensity, pressure, displacement, level etc. will also be able to monitor simultaneously using various sensing devices. This system will be useful in research and practical laboratories where acquisition for the measurement, monitoring, analysis and storage of temperature and relative humidity are necessary. In addition, the system can also be used in test and calibration laboratory. The designed system is a low cost with 10 bit resolution having accuracy of 4.88mV (0.0977%) and compatible to PC and laptops. Further, with slight modification, the DAS can also be used for controlling physical parameter.

7. REFERENCES

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