Design and Implementation of Weather Monitoring and Controlling System

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ABSTRACT
Weather monitoring plays an important role in human life, so the collection of information about the temporal dynamics of weather changes is very important. In any industry during certain hazards it is very important to monitor weather. The fundamental aim of this paper is to develop an embedded system to design a weather monitoring system which enables the monitoring of weather parameters in an industry. Such a system contains pair of sensors like temperature, Gas and humidity will be monitored and LPC1768 microcontroller (ARM9). The data from the sensors are collected by the microcontroller and also microcontroller sends the sensors data in to the LABVIEW by using the Serial Communication and this module will keep the data in excel page & also we can get the SMS in the mobile with the help of GSM module. The system uses a compact circuitry built around LPC1768 (ARM9) microcontroller Programs are developed in Embedded C using the IDE Keiluvision4. JTAG is used for loading programs into Microcontroller.

Keywords
LPC1768 (ARM9), Humidity sensor, Temperature Sensor, LABVIEW, GSM Module

1. INTRODUCTION
An automated weather station is an instrument that measures and records meteorological parameters using sensors without intervention of humans. The measured parameters can be stored in a built-in data logger or can be transmitted to a remote location via a communication link. If the data is stored in a data logger, recorded data must be physically downloaded to a computer at a later time for further processing. Therefore, the communication system is an essential element in an automated weather station. Today, automated weather stations are available as commercial products with variety of facilities and options [1-3]. Although automated weather stations can be built and implemented in remote parts of Sri Lanka to bring down the cost of maintaining weather stations, until recently, not much emphasis has been given for building and using such instruments locally. Automated weather stations have been developed in universities by interfacing meteorological parameter monitoring sensors to microcomputer/commercially available data loggers with communication devices or through serial and parallel ports to obtain hard copies of weather data [4-6]. Recently, the University of Colombo developed an automated weather station with USB communication facility and a built-in data logging facility. The system used wired communication to transfer data to the monitoring station through the computer's built-in USB interface [7]. The present work is a further extension of the earlier developments. The main objective of this work is to develop a standalone modular weather station with a remote communication facility to capture and transmit meteorological parameters.

Remotely monitoring of environmental parameters is important in various applications and industrial processes. In earlier period weather monitoring systems are generally based on mechanical, electromechanical instruments which suffer from the drawbacks like poor rigidity, need of human intervention, associated parallax errors and durability. Kang and Park have developed monitoring systems, using sensors for indoor climate and environment based on the parameters mentioned [1] in 2000. Combination of these sensors with data acquisition system has proved to be a better approach for temperature and relative humidity monitoring in 2005 [2]. Vlassov in 1993 introduces the usage of surface acoustic wave's devices as temperature sensor [3]. This demand the development of a microcontroller based embedded system for weather monitoring. Such a system should monitor and provide data for remote examine. The collected data by weather monitoring system can easily be exported to a PC via a serial port to make subsequent data analysis or graphic and digital storage thus automatic data collection is possible without giving up PC resources.

2. EXISTING & PROPOSED SYSTEM
In the previous research, a single master-multi slave microcontroller communication method has been developed. The microcontroller is able to communicate using unicast communication, i.e. the master gave orders to one slave address via the master-slave network that has star topology. Then the slave who has the same address which is requested will respond or take action in accordance with the master command. Modbus Protocol is the rules of data communication with the master-slave technique. In these communications there is only one master and one or several slave which form a network. Master only do one communication at a time. Slave will only communicate if there is a command (query) from the Master and cannot communicate with another slave. Addressing modes used by the Modbus there are 2, i.e., unicast and broadcast [8].

The design and implementation of weather monitoring & controlling system is the model with the ability to perform data acquisition on temperature, gas, humidity and accelerometer sensors attached. And it can give these sensors data to ADC Port of LPC1768. It can also upload the data continuously to excel sheet in LABVIEW with the help of RS232 Cable and also receives SMS with the help of GSM.

3. BLOCK DIAGRAM

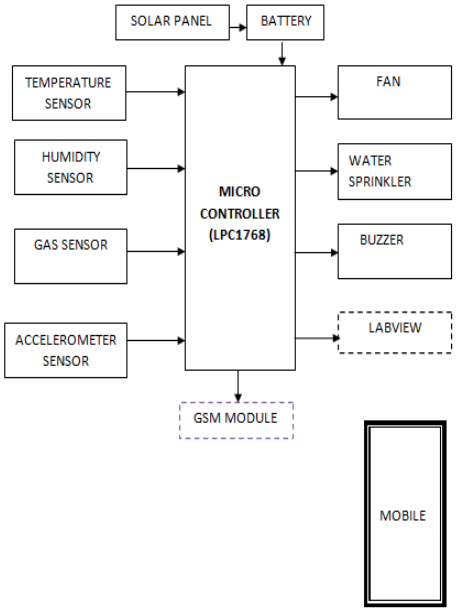


Fig 1: Block Diagram

3.1 Humidity Sensor

Humidity sensor works on the principle of relative humidity and gives the output in the form of voltage. This analog voltage provides the information about the percentage relative humidity present in the environment. A miniature sensor consisting of a RH sensitive material deposited on a ceramic substrate. The AC resistance (impedance) of the sensor decreases as relative humidity increases. The Humidity Sensor is shown in below Fig2.

Fig.2. Humidity Sensor

3.2 Temperature Sensor

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in ^{o}C). If the temperature is high then the fan will on and vice versa.., The Temperature Sensor is shown in Fig3.

The scale factor is .01V/^{o}C. The LM35 does not require any external calibration or trimming and maintains an accuracy of +/- 0.4^{o}C at room temperature and +/- 0.8^{o}C over a range of 0^{o}C to +100^{o}C.

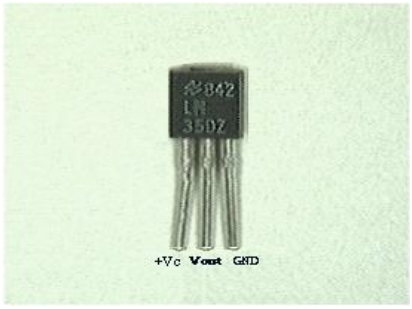


Fig 3: Temperature Sensor

3.3 Gas Sensor

Sensitive material of MQ-6 gas sensor is SnO which with lower conductivity in clean air. MQ-6 gas sensor has high sensitivity to Propane, Butane and LPG, also response to Natural gas. The Sensor could be used to detect different combustible gas, especially Methane; it is with low cost and suitable for different application. The Gas Sensor is shown in below Fig4.

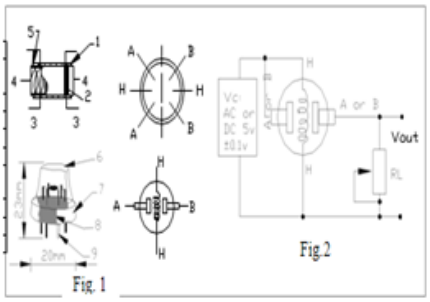


Fig.4. Structure and configuration, basic measuring circuit

3.4 LPC1768

The LPC1768 is an ARM Cortex-M3 based microcontroller for embedded applications requiring a high level of integration and low power dissipation. The ARM Cortex-M3 CPU incorporates a 3-stage pipeline and uses Harvard architecture with separate local instruction and data buses as well as a third bus for peripherals.

The peripheral complement of the LPC17xx includes up to 512kB of flash memory, up to 64kB of data memory, Ethernet MAC, a USB interface that can be configured as either Host, Device, or OTG, 8 channel general purpose DMA controller, 4 UARTs, 2 CAN channels, 2 SSP controllers, SPI interface, 3 I2C interfaces, 2-input plus 2-output I2S interface, 8 channel 12-bit ADC, 10-bit DAC, motor control PWM, Quadrature Encoder interface, 4 general purpose timers, 6-output general purpose PWM, ultra-low power RTC with separate battery supply, and up to 70 general purpose I/O pins.

4. SYSTEM SOFTWARE

In this project two types of software's are used. They are

- KEIL software for c programming
- LABVIEW

µVision4 is an IDE (Integrated Development Environment) to help you write, compile, and debug embedded programs.

4.1 FLOWCHART

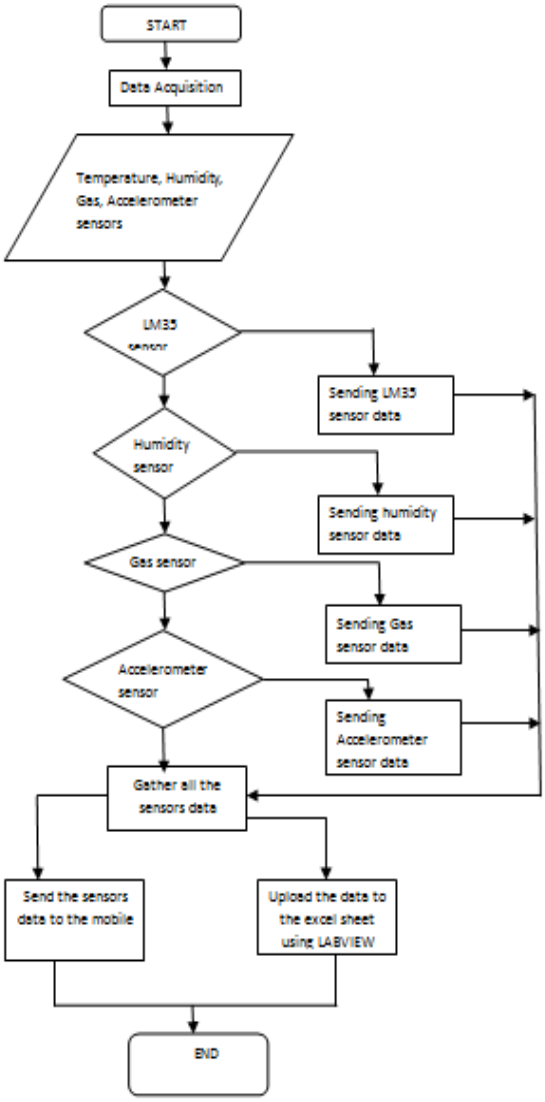


Fig.5. Flowchart

4.2 Experimental Results

The environmental monitoring data sensors automatically monitor the temperature, humidity, Accelerometer and other gas concentrations. It can realize the remote access of sensor monitoring data and download of the environmental monitoring data to the client according to requests. The simulation result is shown below.

4.2.1 Schematic

In this proteus, we take one lpc1768 microcontroller and the inputs to the microcontroller are the sensors and give those Sensors to the each ADC Pins from ADC0…6 except ADC4. The Controller converts Analog data of sensors to Digital Using ADC pins and we can see the Sensors data in Virtual terminal using Serial Communication. The schematic is as shown below fig 6.

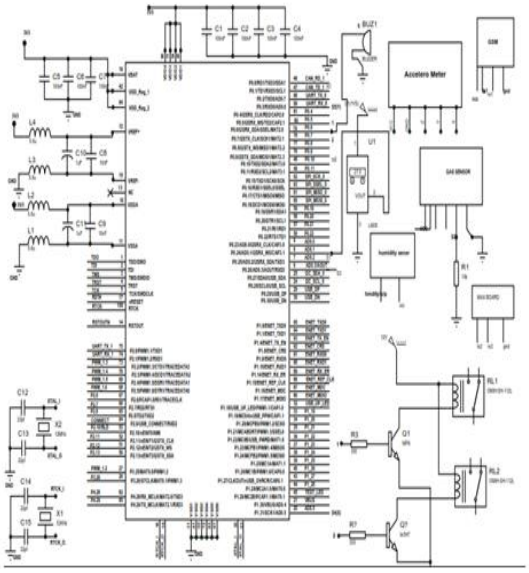


Fig.6. proteus output

4.2.2 Hardware

In this project, we have to acquire all the environmental parameters like temperature, humidity, gas and accelerometer sensors and the measure these sensor values using ADC pins in LPC1768. Here in the above figure we use Multi sensor Board for placing the sensors, and accelerometer sensor for checking the earthquake condition. And for the power supply I'm using the 12v battery. Max Board is used for transmitting the data using serial communication. And also these sensor values will be displayed wirelessly on a Mobile using GSM Module.

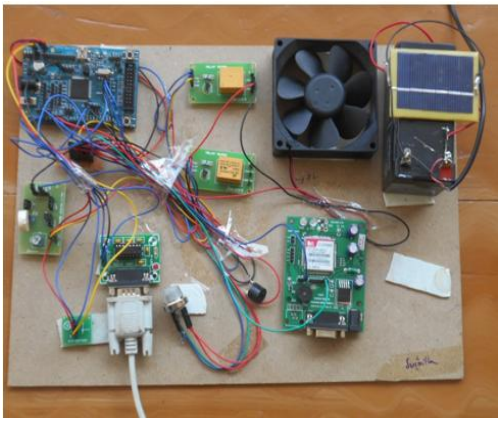
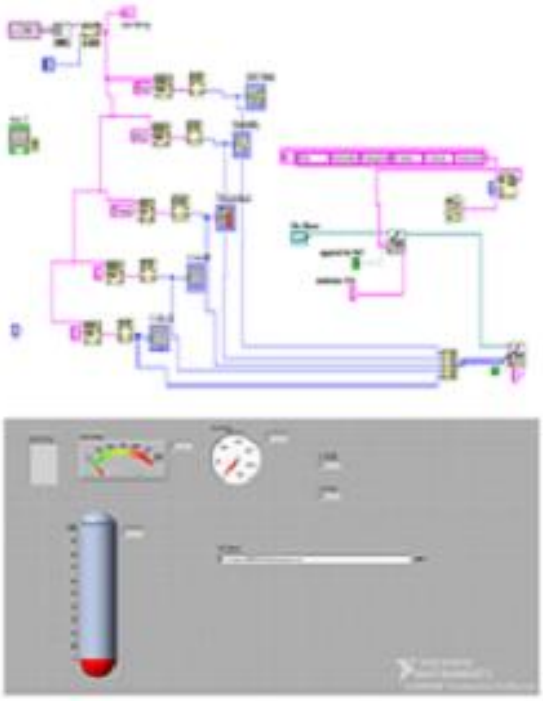


Fig.7. Hardware Screen Shot

4.2.3 Lab VIEW Results

LABVIEW (short for **Lab**oratory **V**irtual **I**nstrumentation **E**ngineering **W**orkbench) is a platform and development environment for a visual programming language from National Instruments. The graphical language is named "G".



The data transmitting from the hardware can be received in Lab view using the serial communication. The read string displays the transmitted data. And here Different sensors & those corresponding values are displayed with the indications like Metering etc., And in the Lab view itself we create a Excel File And Place the excel file in that folder because the updating or value changes can also seen in the excel file like shown below.

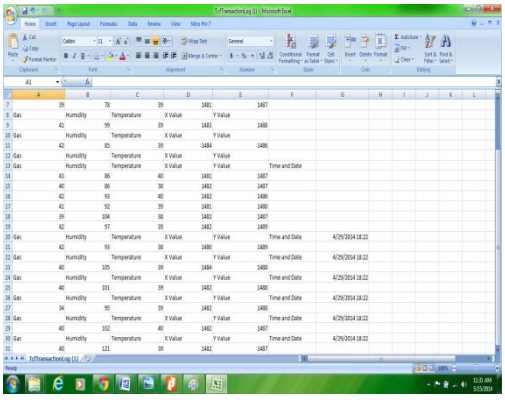


Fig.8. Lab VIEW Result

5. APPLICATIONS & ADVANTAGES

5.1 Applications

1. Used in coal mine, bio gas manufacturing centers.
2. Used in power plant generation.
3. Agriculture field monitoring.
4. Home automation.
5. Industrial purpose

5.2 Advantages

1. This project can be used to save power.
2. Security purpose.
3. Enhanced for monitoring & controlling of atmosphere conditions.

6. CONCLUSION

This paper demonstrates Design and Implementation of Weather Monitoring & Controlling System used for controlling the devices as well as monitoring the environmental parameters. Embedded controlled sensor networks have proven themselves to be a reliable solution in providing remote control and sensing for environmental monitoring systems. The sensors have been integrated with the system to monitor and compute the level of existence of Accelerometer, gas, temperature and humidity in atmosphere using information and communication technologies. The sensors can upload the data in Lab view using serial Communication.

7. FUTURE SCOPE

Adding of more sensors to monitor other environmental parameters such as Soil PH Sensor, CO2 and oxygen Sensor while allowing the replacing of current sensors if a wider range of measurements is desired. And also Integration of additional monitoring devices such as a Wi-Fi camera to monitor growth of agricultural product. And also the data can be uploaded to web server continuously.

8. REFERENCES

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