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# WEATHER DATA LOGGER BASED ON PIC MICROCONTROLLERS FOR ASTRONOMICAL SITE SURVEY

**VISHNU S.N.K.N., JEEVAN B., RATHAN K.G.A. AND HEGDE R.***
Department of Telecommunication Eng., BMS College of Engineering Bangalore-560 019, Karnataka, India.
*Corresponding Author: Email- rajeshwari.hegde@gmail.com

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**Abstract-** This paper is aimed at measuring and acquiring the weather data parameters like temperature, pressure, humidity, wind direction, wind speed and solar radiation at a given site for setting up an astronomical observatory. These weather parameters with other data help to determine the potentially good site for astronomical seeing. The proposed weather data acquisition system should be working as an autonomous instrument generating its own power from solar panels and location information, time tags from the GPS system. Though general data acquisition systems are available in the market, they may be expensive or very general in acquiring the data. The data will be logged onto thumb drive which is a plug and play device.

**Keywords-** Astronomy, data logger, VDRIVE, wind vane.

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## Introduction

A data logger is an electronic device, generally based on a digital processor, records data over time or in relation to location either with a built in instrument or sensor or via external instruments and sensors. Generally, a data logger is a small, battery powered, portable device. These data loggers are equipped with a microprocessor which is interfaced with memory for data storage, and sensors. The ability to automatically collect data on a timely basis is one of the primary benefits of using data loggers. Upon activation, data loggers are typically deployed and left unattended to measure and record information for the duration of the period being monitored. This gives a comprehensive and accurate picture of the environmental conditions such as air temperature, relative humidity, wind speed, wind direction etc. which are being monitored for a particular duration. Data loggers presently available use EEPROM built in microcontroller for data logging whose memory is a constraint for recording large amount of data and reading data from EEPROM is tedious. Moghavvemi M. et, al. [1] proposed a system which combined analogue and digital circuit theory together with programming techniques to design a remote temperature and relative humidity sensing system. The sensors analogue signal was applied to a micro-controller based data logger for storage purposes. The data was then transferred to the computer through standard RS232 serial port using the user interface program. Chris Jordan G. Aliac [2] proposed a weather monitoring system which monitors weather conditions of different locations with the use of SMS technology which uses a series of sensors, connected to a microcontroller. The microcontroller, interfaced with a mobile phone, sends data from the sensors to a data center via SMS. The data center is mainly composed of a mobile phone interfaced to a computer. Software collects data coming from different weather condition sensing modules and presents them in a user interface map. The data is also saved for future analysis or for possible weather forecast. This paper presents the implementation of the data logger that comes up with a Vdrive2 interface through which data can be logged on to a Thumb drive which is a plug and play device and data can be acquired easily [3]. The pen drives have a large storage space making it possible to log the data for several months. The paper is organized as follows. Section II deals with the system design. Section III deals with results and discussions. The paper is concluded in section IV.

## System Design

Weather data logger Station is designed to monitor various parameters such as air temperature, relative humidity, wind speed and wind direction. [Fig-1] shows the block diagram of the system.

PIC microcontroller [4] forms the heart of the module which is embedded on a LV18FV6 development board and is powered up by USB which is connected to the computer. Data from various sensors like wind vane, rain gauge and anemometer is acquired through I/O ports which in turn is connected to ADC and timers through PORT (A0, C0 and A4) respectively. All the acquired data is logged onto thumb drive through VDRIVE 2 module using Serial

Peripheral Interface (SPI) and the vdive2 module is powered up using external power supply. The GPS module is interfaced using UART interface used to display location co-ordinates on LCD.

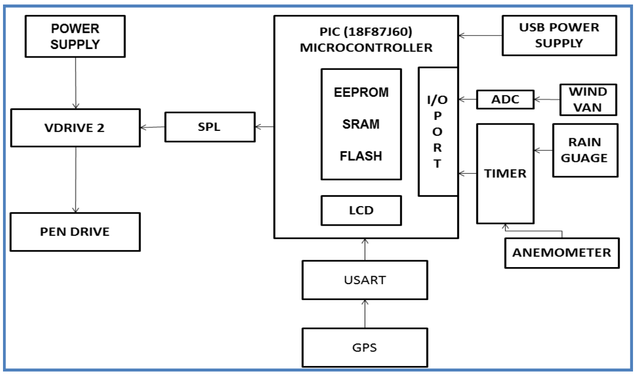


**Fig.1-** System Block diagram

### GPS Algorithm

Initialization in the [Fig-2] refers to defining connection from TX of (PIC18F87J60) to RX of (GPS) and vice versa. GPS module sends a stream of data that begins with $ and ends with $ after searching for dollar sign that marks the beginning of string and required string is obtained [5]. In this case it is GPGGA and required data like latitude, longitude and time is obtained and displayed on LCD.

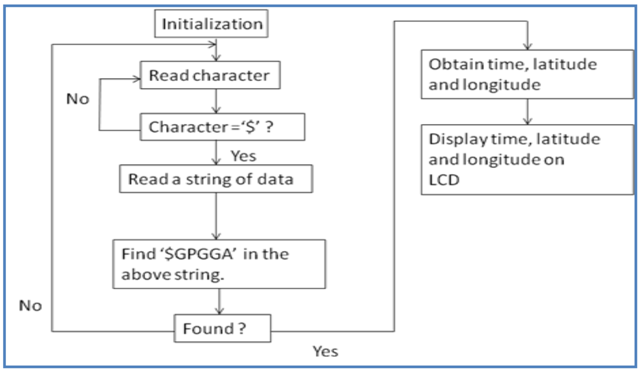


**Fig. 2-** GPS algorithm

### Wind Vane Algorithm

Initialization in [Fig-3] refers to defining connection from wind vane output and PORTA0 through which analog voltage is read from ADC and compared against voltages that are defined for different directions to determine the direction and the wind vane is powered up through PORTA.

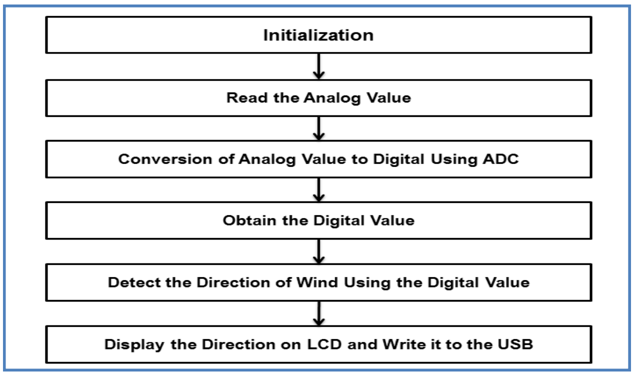


**Fig. 3-** Wind vane algorithm

### Anemometer Algorithm

Initialization in [Fig-4] refers to defining connection from anemometer output and PORTA4 through which the number of pulses that determine the wind speed is counted (within one second) using timer0 as counter and the anemometer is powered up through PORTA (+Vcc).

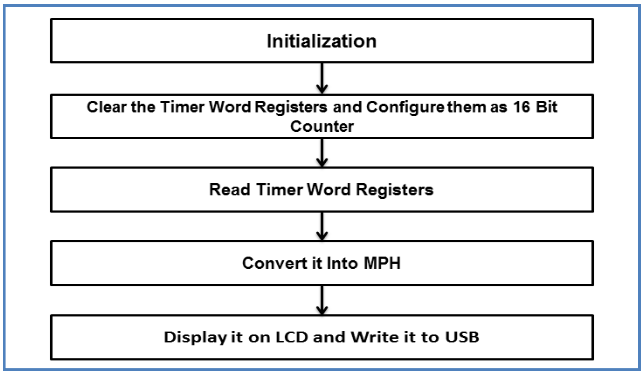


**Fig. 4-** Anemometer algorithm

### Rain Gauge Algorithm

Initialization in [Fig-5] refers to defining connection from rain gauge output and PORTc0 through which the number of pulses that determine the amount of rainfall is counted (within log time) using timer1 as counter and the rain gauge is powered up through PORTC (+Vcc).

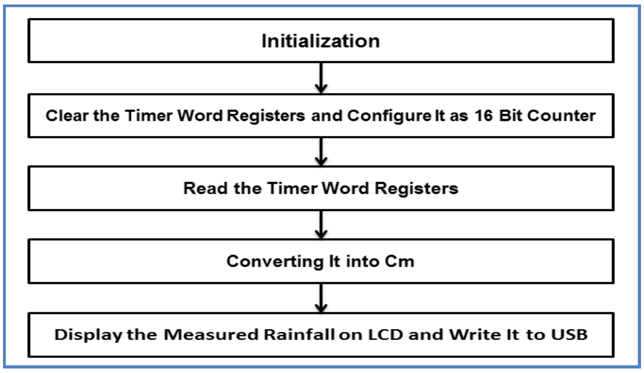


**Fig. 5**- Rain gauge algorithm

### USB Algorithm

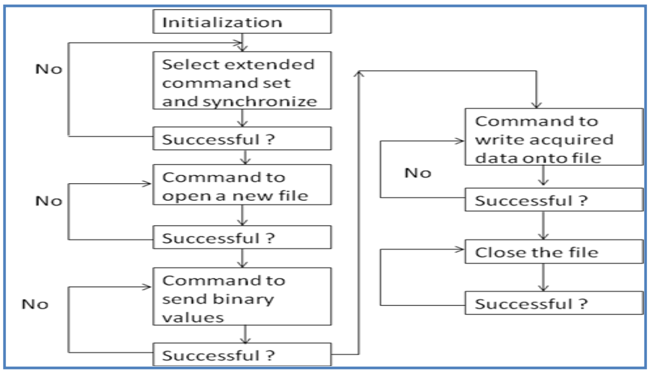


**Fig. 6-** USB algorithm

Initialization in [Fig-6] refers to connections like Data in (SDI), Data out (SDO), Clock (SCK) and CS (chip select) between VDRIVE2 and PIC18F87J60. Extended command set is selected for passing commands followed by synchronization commands to setup communication between vdrive2 and PIC18F87J60 [6] and successful execution of command is indicated by return of command Prompt (D:\>) and then command is passed to create new file and log acquired data onto pen drive and file is closed to prevent over writing of data.

### Software

For the software implementation of the prototype, we make use of a compiler called mikroC designed especially for PIC microcontrollers [6].

*Step 1:* After launching the compiler, one should create a new project.

While creating a new project, one should specify the project name, device used and the device clock details. Once the project is created successfully, the editor window opens, where the code needs to e written.

*Step 2:* Once the C code is written, it needs to be saved.

*Step 3:* next, we need to build the code to check for the presence of any errors.

*Step 4:* Once the code is being built successfully, one needs to program the code to the development board or the controller.

### Results and Discussions

The details of the sensor data is logged on to the pen drive in an excel(.xls) file is shown in [Fig-7].

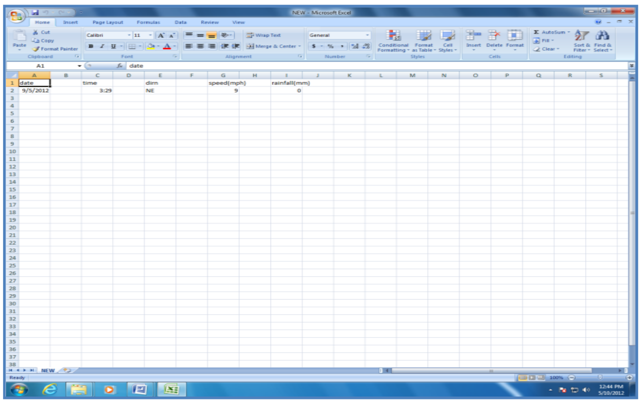

**Fig. 7-** Sensors data in .xls file


**Fig. 8-** Latitude

The location co-ordinates, latitude and longitude of module where it is being placed and the time are displayed on LCD as shown in [Fig-8], [Fig-9] and [Fig-10]. The experimental setup of the weather data logger system is shown in [Fig-11].


**Fig. 9-** Longitude

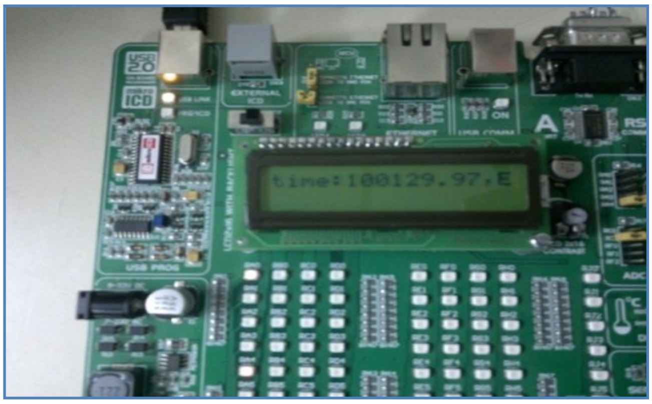


**Fig. 10-** Time

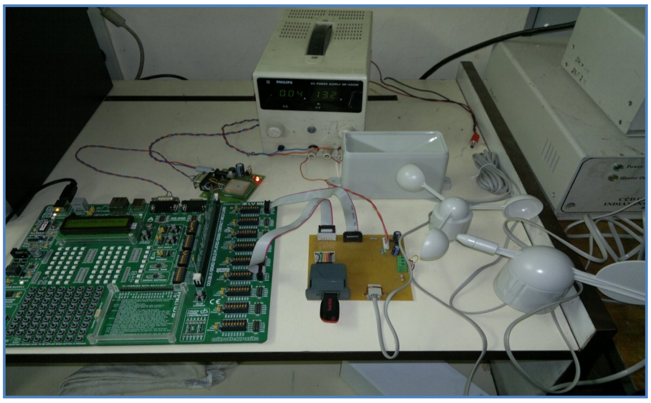

**Fig. 11-** Experimental Setup of the system

### Conclusion

Our objective was to work on weather data acquisition system using master slave configuration of PIC 18 and PIC 16 controllers respectively connected using RS 485 for astronomical site survey and log the data on to a thumb drive along with location co ordinates of the place obtained using GPS. Master part of the prototype performed almost flawlessly and we were able to log all the sensor data on to thumb drive by connecting sensors directly to the master i.e. PIC18F87J60 and we were able to obtain location co ordinates and display on LCD, this entire prototype works almost flawlessly in real time. This work will be continued by interfacing the sensors to different low power microcontrollers which act as slaves to the pic 18F87J60. The master and the slave will be connected by RS485 communication standard. The master would initiate the communication with slaves at various logging intervals. Power supply to all the slaves will be provided through RS 485 cable by tapping and diverting supply to only that sensor whose data has to be logged at that instant. This data acquisition system can be made available at a cheaper price as PIC controller is cheap compared to other microcontrollers with more communication interfaces. It is possible to power this acquisition system through solar panel and voltage regulator as it will be placed in remote places where battery powering is not an efficient option as it is not possible to monitor battery status and cannot be replaced. This forms the future scope of our prototype.

**Acknowledgement**

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