IJETST- Vol.||03||Issue||03||Pages 3647-3657||March||ISSN 2348-9480 2016

Open access Journal International Journal of Emerging Trends in Science and Technology

Impact Factor: 2.838 DOI: http://dx.doi.org/10.18535/ijetst/v3i03.05

Agricultural Water Saving Irrigation Controller

Authors

Asst. Prof. Pranita Bhosale[1], Dr. D B Salunke[2]

Email – *pranita.bhosale29@gmail.com, dbsalunke@gmail.com*

ABSTRACT

Agricultural irrigation uses considerable volumes of water, and is one of the largest groups of consumptive water uses in the state. The water efficiency practices listed in this fact sheet describe how to reduce excess water use through implementation of efficient irrigation technology, effective irrigation scheduling, and soil moisture determination and retention. These practices are designed to minimize water losses from evaporation, deep percolation and runoff. Current research proposed an Embedded System for the Automatic Control of Agricultural Controller. This project has wired sensor network for the real time sensing and controlling of irrigation system. There is a need to develop new indigenous irrigation controller to improve farm productivity and input use efficiency of water and other nutrients. This paper has real time sensing and control of an irrigation system. When the condition of watering the agricultural farm is abnormal then the system automatically switches ON the motor. When the water level reaches normal level the motor automatically switch OFF. In this project we are interfacing microcontroller through temperature sensor, humidity sensor and also interfacing to GSM through MAX 232. This paper presents the design and development of Irrigation controller System built around a microcontroller. The system consists of microcontroller, peripherals including RTC, LCD and driver circuit relay to switch on/off a motor. Different parameters i.e. soil moisture, water contents, intensity, humidity, wind speed, temperature etc. The key objective of this paper is to report on a developed indigenous low cost time based microcontroller based irrigation scheduler which performs user defined functions and outputs commands to derive appropriate actuators (solenoid valves, motor).

Keywords - *Water Saver, Irrigation Scheduling, Weather monitoring sensor.*

INTRODUCTION

A weather station is a facility with instruments for data collection on atmospheric phenomena. Many of these stations are linked to other facilities, satellites and field equipment to improve accuracy. Instruments that are used to collect data on the weather include anemometers, barometers, hygrometers, thermometers, rain gauges, Doppler radars and weather satellites. A weather station acts as the neural centre for the data collected by supporting equipment. This data is compiled and processed and interpreted by meteorologists. Meteorologists then distribute the information as forecasts. Weather stations are important for their detailed daily and weekly forecasts. Weather stations are also responsible for predicting and tracking dangerous phenomena like hurricanes and tornadoes. Storm chasers for the purpose of meteorological research can include volunteers, authorities and scientists. These men and women collect data for current use or for future study.

2. BLOCK DIAGRAM OF SYSTEM

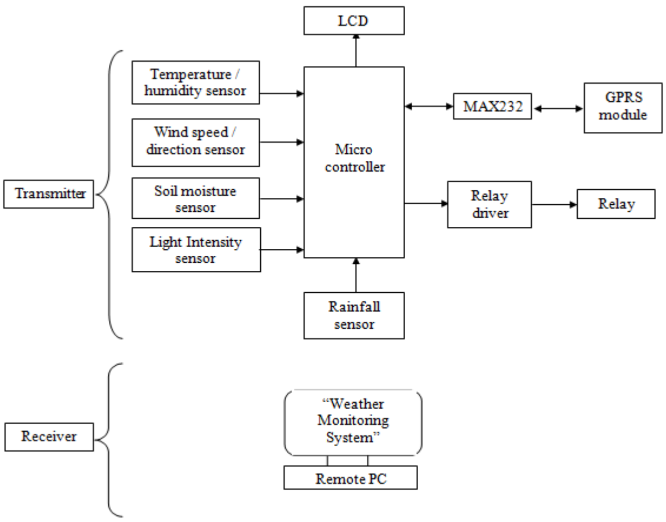

Fig. 2.1 System Block Diagram

2.1 Power supply

In our circuit we require 5V power supply for PIC and 12V for relay. We have designed +5 V using IC 7805. From chargeable battery 12 volt input is given to rectifier circuit which consists of four diodes connected in bridge. The output of bridge rectifier circuit is a pulsating dc voltage, to remove the ripples we need to use the filtering capacitors. The output of this filtering circuit further given to three terminal regulators IC's 7805 gives 5V output. The decoupling capacitors are used for filtering the noise. The 5V and ground terminal are connected to the motherboard as a supply. Decoupling capacitor is connected for noise filtering. Special titanium capacitors are used to remove noise of ARM processor.

2.2 ARM Microcontroller

Microcontroller is heart of the system. Program is loaded in microcontroller ARM7TDMI. LPC 214x microcontrollers are based on 32/16 bit ARM7TDMI with real time emulation and embedded trace support that combines microcontroller with high speed flash memory ranging from 32 kB to 512 kB. Due to their tiny size and low power consumption they are ideal for applications where miniaturization is a key requirement. A blend of serial communications interfaces ranging from USB 2 full speed device, multiple UARTs, SPI, SSP, to I2C and on chip SRAM of 8 kB to 40 kB. Various 32-it timers, single or dual 10-bit ADC/DAC, 45 fast GPIO lines makes suitable for industrial controls and medical systems.

The microcontroller accepts data from sensors and compares data with the set points, corresponding signal is generated. According to this, the relay can switch on and off. Simultaneously it sends all sensor data from SIM300 to mobile user at control station. When we want to read data of all the sensors monthly/yearly we can access that data from external memory card storage.

Some of the benefits for the customer include:

- Quick time to market
- Allows code changes to product, during production run
- No Non-Recurring Engineering (NRE) charges for Mask Revisions
- Ability to easily serialize the product
- Ability to store calibration data, without additional hardware
- Less risk, since the same device is used for development as well as for production.

2.3 Sensors

2.3.1 Humidity Sensor

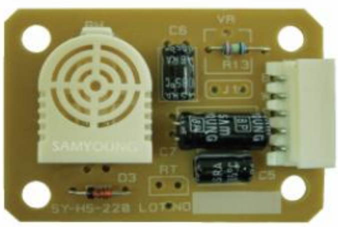

Figure 2.3.1 Humidity sensor IC

SY-HS-220 series modules consist of SYH-2 sensor and an integrated circuit to provide a linear DC voltage output for 20-95%RH. These are specifically designed for use in appliances and controllers.

Humidity is a term for the amount of water vapor in the air. Formally, humid air is not "moist air" but a mixture of water vapor and other constituents of air, and humidity is defined in terms of the water content of this mixture, called the Absolute humidity.

Specifications

- Input Voltage: - 5V DC
- Operational Humidity:- 95%RH or less
- Humidity Output:- 1.98V

2.3.2 Temperature Sensor

Figure 2.3 2 Temperature sensor IC

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.

Features

- Calibrated directly in º Celsius (Centigrade)
- Linear + 10.0mV/ºC scale factor
- 0.5ºC accuracy guarantee able (at +25ºC)
- Rated for full -55º to 150ºC range
- Suitable for remote applications
- Low cost
- Operates from 4 to 30 Volts

2.3.3 Soil Moisture Sensor

Figure 2.3.3 Soil Moisture sensor

The health of a plant is influenced by many factors, one of the most important being the ready availability of moisture in the soil. Soil moisture is an important component in the atmospheric water cycle, both on a small agricultural scale and in large-scale modeling of land/ atmosphere interaction. Vegetation and crops always depend more on the moisture available at root level than on precipitation occurrence. The two electrode thread is used to measure soil moisture. The electrical resistance between electrodes is proportional to its water content, which is related to the soil water metric potential of the surrounding soil. Thus, the wetter an electrode thread is, the lower the resistance measured across two embedded electrodes. Its size is up to 4-5 inches measurement cylinder radius. No maintenance needed for gypsum block. It is simple and inexpensive. In the control stage desires soil moisture is compared with the measured soil moisture following the comparison, a dynamic decision is made regarding the amount of water to be added to the soil of irrigation action, requires local soil moisture information. The control stage interfaces the desired soil moisture and the measured soil moisture (from the “soil” stage). This stage is intended to keep the actual soil moisture as close as possible to the desired moisture. Its output is the valve control value, which represents the amount of water that should be added to the soil continuously in order to maintain a minimal deviation.

2.3.4 Wind Speed and direction Sensor

Figure 2.3.4 Wind Direction and Wind Speed Sensor

Air Speed is the speed of an aircraft relative to the air. Among the common conventions for qualifying airspeed are: indicated airspeed ("IAS"), calibrated airspeed ("CAS"), true airspeed ("TAS"), equivalent airspeed ("EAS") and density airspeed [3].

The anemometer measures wind direction and speed. The anemometer arm comes partially assembled with the wind vane attached. The anemometer comes with a 40' (12 m) cable for flexibility in configuring the system to monitor wind conditions. For example, the anemometer could be mounted at the highest point of a roof. The wind vane rotates 360° to display current and dominant wind directions on the compass rose of the console display. To obtain accurate readings, the vane must be correctly oriented when mounting the anemometer outside. By default, the wind vane reports the correct wind direction if the anemometer arm points true north.

Features

- Fast power-on time
- Low Noise
- Stable Operation over full operating temperature range
- Reverse battery protection

2.3.5 Light Intensity

Figure 2.3.5 Light Intensity sensor

A photo resistor or light-dependent resistor (LDR) or photocell is a resistor whose resistance decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photo resistor is made of a high resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its hole partner) conduct electricity, thereby lowering resistance.

Features

- Cell Resistance: 400 to 9 KΩ
- Wide spectral response
- Wide ambient temperature range
- Low cost

2.3.6 Rain fall

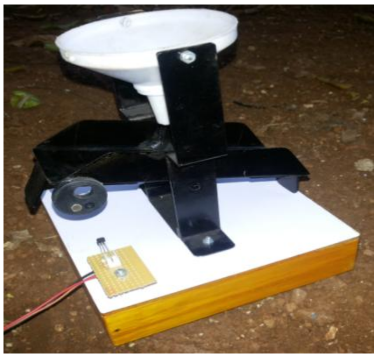

Figure 2.3.6 Rain gauge- Rain fall sensor

The rain collector tipping bucket mechanism contains a standard measurement weight magnet that takes measurements in 0.01" (US versions) or 1mm (UK and EU versions). The Rain Collector is designed to meet the guidelines of the World

Meteorological Organization. Rain enters the collector cone, passes through a debris-filtering screen, and collects in one chamber of the tipping bucket. The bucket tips when it has collected an amount of water equal to the increment in which the collector measures 0.01" or 1mm. As the bucket tips, it causes a switch closure and brings the second tipping bucket chamber into position. The rain water drains out through the screened drains in the base of the collector. The collector is designed for years of accurate, trouble-free service.

Rainfall intensity is classified according to the rate of precipitation

- Light rain: when the precipitation rate is < 2.5 mm per hour
- Moderate rain: when the precipitation rate is between 2.5 mm-7.6 mm
- Heavy rain: when the precipitation rate is > 7.6 mm per hour, or between 10mm and 50 mm per hour
- Violent rain: when the precipitation rate is > 50 mm per hour [3]

2.4 GSM/GPRS Module

Figure 2.4 GSM/GPRS Module SIM900A

In our project we are using SIM900 for transfer of data from weather station. Interfacing with ARM is done with RS-232 through D-TYPE 9 pin connector.

The SIM900 is a complete Quad-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications. This device delivers GSM/GPRS 850/900/1800 /1900MHz performance for voice, SMS, Data and Fax in small form factor, with low power consumption.

2.5 Relay

A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. A simple electromagnetic relay consists of a coil of wire surrounding a soft iron core, an iron yoke, which provides a low reluctance path for magnetic flux, a moveable iron armature, and a set, or sets, of contacts.

When an electric current is passed through the coil, the resulting magnetic field attracts the armature and the consequent movement of the movable contact or contacts either makes or breaks a connection with a fixed contact. If the set of contacts was closed when the relay was de-energized, then the movement opens the contacts and breaks the connection, and vice versa if the contacts were open. Port A is used for relay switching.

2.6 MAX232

The MAX220–MAX249 family of line drivers/receivers is intended for all EIA/TIA-232E and V.28/V.24 communications interfaces, particularly applications where ±12V is not available. These parts are especially useful in battery-powered systems, since their low power shutdown mode reduces power dissipation to less than 5µW.

The MAX220–MAX249 has two internal charge-pumps that convert +5V to ±10V (unloaded) for RS-232 driver operation. The first converter uses capacitor C1 to double the +5V input to +10V on C3 at the V+ output. The second converter uses capacitor C2 to invert +10V to -10V on C4 at the V- output. A small amount of power may be drawn from the +10V (V+) and -10V (V-) outputs to power external circuitry.

2.7 LCD

LCD display is connected to ARM microcontroller as a output device. 20x4 LCD display is used to display preset set point and the changing value sensed by all sensors. We are using 2 lines 16 segments each for the display purpose. It is connected to the D port of the microcontroller. The LCDs are available in 4 bit and 8 bit mode.

3 INTEGRATED SENOR SUITE (ISS)

Automatic weather station is such kind of station that can observe weather and collect data automatically, controlled by electronic devices or computer, which generally made up of sensors, converters, data processing devices, data transmitter, power supply etc. Converter can transmit meteorological parameters that the sensor senses into electrical signals (such as voltage, current, frequency, etc.); Data processing unit will process these signals and then change to corresponding meteorological elements. The processed meteorological elements will be arranged according to required format, and transmit to users by Data Transmitter wired or wireless, or store on the media, and recovered by the user on a regular basis. The basic composition of automatic weather station is shown in Figure 3.9 [1].

Figure 3 Integrated sensor suite at field

The Integrated Sensor Suite (ISS) collects outside weather data and sends the data to a Weather control station. The standard version of the ISS contains a rain collector, temperature sensor, humidity sensor and anemometer. In addition to the standard weather features, the ISS Plus adds a pre-installed solar radiation sensor and an ultra-violet (UV) radiation sensor. Temperature and humidity sensors are mounted in a passive radiation shield to minimize the impact of solar radiation on sensor readings. The anemometer measures wind speed and direction and can be installed adjacent to the ISS or apart from it. On an ISS Plus, the additional solar and UV sensors are mounted next to the rain collector cone. Separate solar and UV sensors are available to upgrade a standard ISS.

4 TESTING

Testing is an integral part of any project work. This is important to check whether the paper design is practically realizable or not. It also realizes the feasibility of the hardware with the design software. The various test cases were designed for the program modules so as to find the errors in the program and an attempt was made to make it error free.

4.1 Steps done during testing phase

Following are the test cases that were performed during the testing phase of the project.

1. Verification of PCB layout
   a. Continuity between all the tracks has been checked.
2. Circuit testing
   a. Availability of supply at various points on PCB checked
   b. All used ICs tested on bread board.
   c. Software testing for LCD, keyboard, relays using micro controller

3. After completion of PCB testing, the power supply board testing is done.
4. Then power supply from 12V battery is connected to main board and specific pin of IC are checked for supply and ground.
5. When ICs mounted on PCB, rechecked for supplies.
6. For microcontroller we have checked the reset pin, voltage on crystal and output pin ports. The crystal voltages are found OK i.e. 1.5 and 0.5 which indicates that microcontroller is working properly.
7. LCD is also checked so that its screen is also getting ON. Before downloading the software all pins are connected and are checked with multi-meter from starting point to end point.

5 HARDWARE AND SOFTWARE DESIGN

5.1 Hardware design

The hardware of Automatic weather station includes: sensors, data acquisition module, processor, and data transfer module. It primarily realizes data acquisition and transmission of the system. Design of data processing module Automatic weather station is required to automatically collect meteorological parameters in specific place, which includes temperature, humidity, wind speed, wind direction, rainfall, light intensity, and soil moisture etc. These meteorological parameters first need to convert to electrical signals by sensors (current or voltage), and they become digital signal through the converter, then they are sent to CPU for processing. The numbers of the meteorological parameters are large, so they should be measured by different sensors. Temperature Sensor is used to measure temperature; Humidity Capacitive Humidity Sensor is used to measure humidity etc [1].

Figure 5 Hardware of modified system at field

5.2 Software design

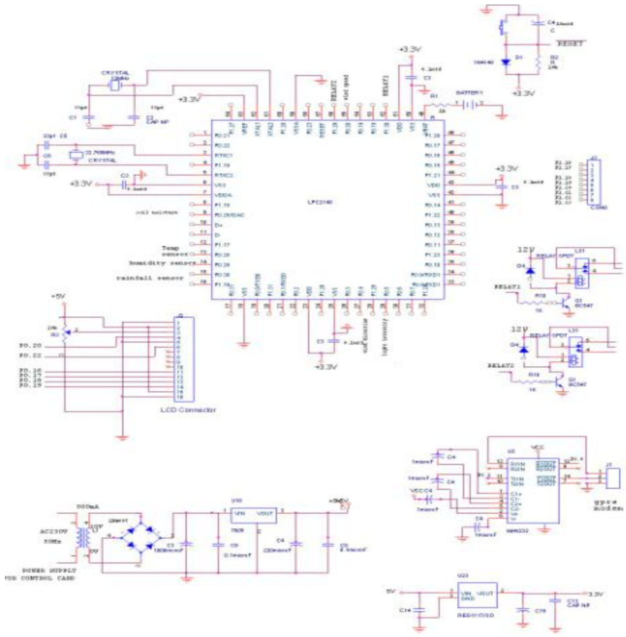

Figure 5.2 Circuit Diagram

Software of Automatic weather station is mainly composed of meteorological parameters from the collection, the subroutine read by clock, messaging as well as the serial communication interrupt and the main loop. Programming is achieved by embedded C.

AT commands are used to communicate between microcontroller and SIM900 modules. AT command format can refer to relevant information, and microcontroller establishes communication links by issuing AT commands, while supporting 8-bit data, no parity bit, 1 stop bit, transfer rate can adapt between 48 and 115kbits.

There are three ways to control the message: Block mode, PDU mode, Text mode. Block model requires driver support of cell phone manufacturers. At present, PDU mode is most widely used because all of the bureaus are to provide support Short Message Service of PDU mode. Text mode does not support Chinese, so the system uses the PDU mode to receive and send text messages.

Data communication between Automatic weather stations and host computer, as needed, can be general data communication. General data communication refers that the automatic weather station uploads the data to the host computer at regular intervals [1].

There are various compilers for writing the program code such as keil uVision, CCSC, HIGHTECH, IAR, etc. We have used in our project, the Keil uVision software for writing the program. After compiling the program code in flash magic software, .hex file is generated which can be burned into the ARM Micro-controller.

6 ALGORITHM & FLOW CHART

Algorithm steps**:**

1. Initialization of Microcontroller
2. Initialization of LCD & Keypad
3. Get IP address from remote PC, Enter it with the help of Keypad, so that microcontroller will get connection to the Remote PC
4. All Initial Internet testing will be done step by step.
    a. Modem connection
    b. SIM Internet availability
    c. SIM Network connection
    d. SIM TCP connection
5. Initially Display All parameter's sub names on LCD with their respected measurement unit
6. Get data from each and every Sensor and send it to the microcontroller
7. After arrival of all the sensor's data, data logger table will get updated through internet, similarly we can see current sensor data on a single window through the use of Visual Basic

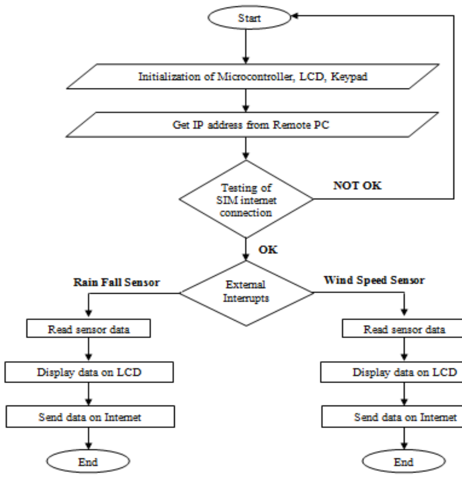

Figure 6.1 Flow chart for Rain Fall Sensor & Wind Speed Sensor

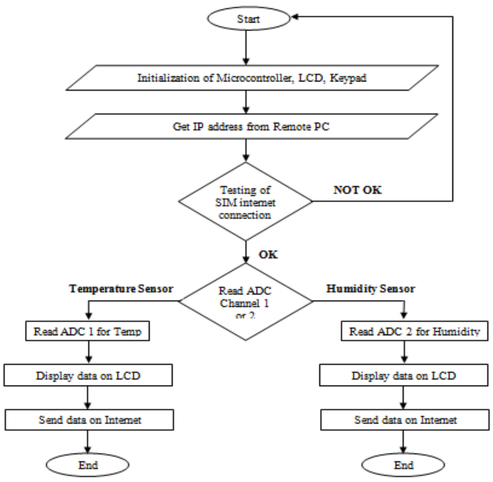

Figure 6.2 Flow chart for Temperature and Humidity Sensor

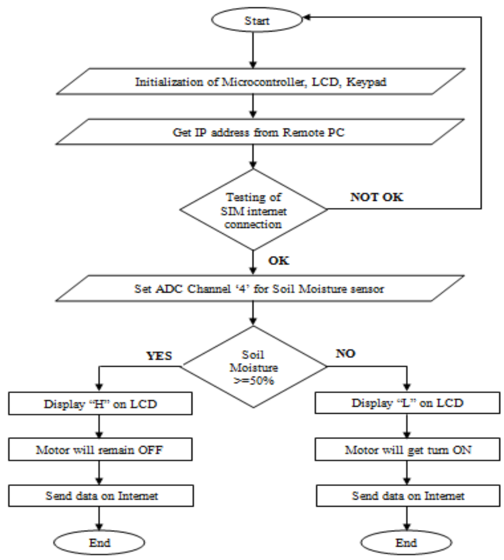

Figure 6.3 Flow chart for Soil Moisture Sensor

7 RESULTS

All Sensors will determine the moisture level and Radiation, Humidity, Temperature, Wind speed and Rain fall at the root zone. Micro controller should get sensor data per minute. Micro controller should analyze the data, take correct action and record the data.

Soil moisture sensor is a sensor connected to an irrigation system controller that measure soil moisture content in the active root zone before each scheduled irrigation event and bypasses the cycle if soil moisture is above user defined set point. Soil moisture sensors, like rain sensors, are considered rain shut off devices, but while rain sensors measure evapotranspiration rates, soil moisture sensor measures real time moisture. When connected to conventional system irrigation time clocks, soil moisture sensors can override scheduled watering events by interrupting the irrigation controller circuit when adequate moisture is detected in the soil. The sensors have user-adjustable moisture content set-points that allow unique watering regimes based on plant species, soil type, and/or seasonal rainfall. Micro controller should upload the data once every 24 hours at 8.30am with central server using GSM modem SIM300 to send SMS from weather station to control station.

Once the irrigation starts, Micro controller will request data from corresponding sensor every 30 seconds. When threshold moisture level is reached, it will record the data and stop the irrigation. Stored data will be sent to central server using GSM modem. Similarly reference user defined data table needs to be synchronized after data is uploaded with the server. This will enable user to take out maximum/minimum parameter values from sensors and have them updated at control station.

7.1 EXPERIMENTAL SETUP

Figure 7.1 Experimental setup at field

7.1 Data recorded at field

Sr No	Temp	Humidity	soil moisture	light intensity	wind speed	Rain fall	wind direction	Time	Date
1	23	45	67	89	8	000	S	4:38:38 PM	11/19/2015
2	25	00	55	87	6	000	SW	5:03:37 PM	11/19/2015
3	25	32	62	87	6	000	N	5:03:38 PM	11/19/2015
4	24	44	64	87	6	000	N	5:03:55 PM	11/19/2015
5	25	58	65	87	6	000	NE	5:04:15 PM	11/19/2015
6	25	57	65	87	5	000	NW	5:04:35 PM	11/19/2015
7	25	55	65	87	7	000	E	5:04:56 PM	11/19/2015
8	25	34	87	68	6	001	E	5:14:04 PM	11/19/2015
9	25	68	87	69	6	001	S	5:14:20 PM	11/19/2015
10	25	98	87	67	7	001	SW	5:14:39 PM	11/19/2015
11	24	28	87	64	6	001	N	5:15:00 PM	11/19/2015
12	26	29	87	67	5	005	N	5:15:21 PM	11/19/2015
13	25	01	87	64	5	005	NE	5:15:42 PM	11/19/2015
14	25	57	87	57	8	005	NW	5:16:03 PM	11/19/2015
15	25	65	87	58	8	005	E	5:16:28 PM	11/19/2015
16	25	72	87	57	6	005	E	5:16:44 PM	11/19/2015
17	24	32	87	57	6	006	S	5:17:09 PM	11/19/2015
18	25	50	87	59	6	010	SW	5:17:27 PM	11/19/2015
19	26	93	87	67	5	010	N	5:17:49 PM	11/19/2015

Table 7.1: Readings taken at field

7.2 Data recorded at Remote PC

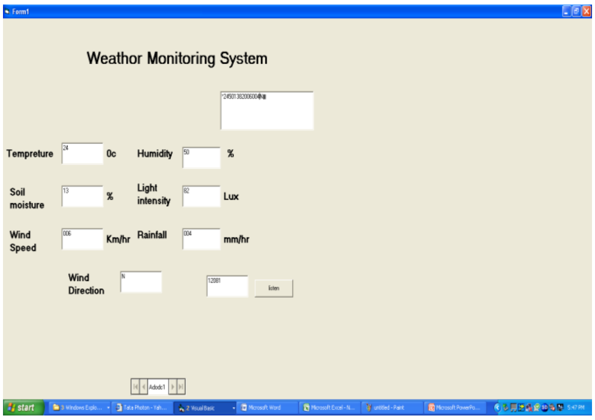

Figure 7.2 Window showing sensor data at Remote PC

8 CONCLUSION

The key benefits of automated measurements include:

- All current weather readings can be seen from indoors, at any time.
- With the help of this research saving of water With great amount is possible.

- Our Weather station automatically records values for a range of weather parameters through each day and keep track, for example, of total monthly and yearly rainfall
- Readings can be easily taken direct from the LCD display
- Our Automated systems has run for weeks and months without attention whilst continuously recording all details of the weather
- Soil Moisture measurement gave information about water table at the ground that is the present availability of underground water and how much is the requirement of water for various crops.
- Wind speed and direction measurements: Depending upon information about wind direction we decided direction of rain as well as movement of cloud.
- Atmospheric temperature measurement updated us for change in temperature through the day.
- Humidity: It is important parameter as from the humidity readings evaporation of water is calculated, detection of various diseases of crops. Hence continuous measurement is needed to control disease of crops due to constant humidity.
- Radiation and sunshine measurements: It is necessary to have information of sun intensity, evaporation rate and hence mostly the information about the water table. It is needed for the crop photosynthesis. And from light intensity reading we conclude that at what time the day was sunny or cloudy.

As the data is recorded for nearly about one month at the end of July, as it was rainy season, we can say that though all over the readings 34ºC was maximum and 21ºC was minimum atmospheric temperature, 32ºC and 24ºC was maximum and minimum soil temperature, 97% and 48% was maximum and minimum humidity, 33Km/hr was maximum wind speed, 1665 W/m2 was maximum radiation, 640 min was maximum sunshine and 9.0mm was maximum rain.

REFERENCES

1. Xingang Guo, Yu Song, "Design of Automatic Weather Station Based on GSM Module", International Conference on Computer, Mechatronics, Control and Electronic Engineering (CMCE).pp-80-82,2010
2. Hao sipeng Zhang Yangfei Li Xianyun Yuan Yue, "The equivalent wind seepd model in wind farm dynamic analysis", Forth international conference on Electric Utility Deregulation and Power Technogolies (DRPT), 2011
3. Sulaiman, S. Manut, A. Nur Firdaus, A.R, "Design, Fabrication and Testing of Fringing Electric Field Soil Moisture Sensor for Wireless Precision Agriculture Applications", International Conference on Information and Multimedia Technology, 2009. ICIMT '09.
4. P. Javadi Kia, A. Tabatabaee Far, M. Omid, R. Alimardani and L. Naderloo," Intelligent Control Based Fuzzy Logic for Automation of Greenhouse Irrigation System and Evaluation in Relation to Conventional Systems"in World Applied Sciences Journal 6 (1): 16-23, 2009.
5. Valente, A. Boaventura Cunha, J. Couto, C., "Soil moisture sensor with built-in fault-detection capabilities", Proceedings of the 24th Annual Conference of the IEEE Industrial Electronics Society, 1998. IECON '98.
6. Zhen fang, Zhan Zhao, Lidong Du, Jiangang Zhang, Cheng Pang, Daoqu Geng, "A New Portable Micro Weather Station", Proceedings of the 2010 5th IEEE International Conference on Nano/Micro

Eingineered and Molecular systems January 20-23, Xiamen, Chaina
7. Integrated sensor suite installation manual
8. Singh,N.Mohan,A. Dept. of Phys., Nehru Coll., Chhibramau "Determination of size and number density of water droplets by the measurement of intensity of scattered light" International Conference on Mathematical Methods in Electromagnetic Theory, 1998. MMET 98. 1998
9. Jiachun Li Wentei Tu,"An Irrigation Control System Based on C8051F and ARM", International Conference on Digital Manufacturing and Automation (ICDMA), 2010
10. Qing-An Huang, Ming Qin, Zhongping Zhang, Minxin Zhou,Lei Gu, Hao Zhu, Desheng Hu, Zhikun Hu, Gaobin Xu, and Zutao Liu, "Weather Station on a Chip", Key Laboratory of MEMS of Ministry of Education, Southeast University, Nanjing 21 0096, CHINA,2003
11. Vesa Hasu, Heikki Koivo, "Automatic Rain and Wind Measurement Fault Identification in Mesoscale Weather Station Networks" IEEE International Insrtumentation & Measurement Technology Conference,Vicotria, Vancouver Island, Canada, May12-15,2008.

BIBLOGRAPHY

Miss. Pranita A. Bhosale was born on June 29th 1989. She received her BE degree in the field of E&TC Engineering in 2010 from Pune University. She has completed ME in VLSI and Embedded system at SCOE, affiliated to University of Pune in 2007. She is working as Assistant Professor in the Department of E &TC of PGM College of Engineering Pune since August 2015. Her research interests are in Embedded Processing Systems and related various applications. She has 6 months of teaching experience. She has published 3 paper in International Journal and one paper in International and National Conferences.