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Review of Water Management System Using PIC Microcontroller

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ABSTRACT: In this paper we proposed efficient method for water management using PIC microcontroller. It provides detail analysis of how system works For weather monitoring system and irrigation controller, we need to measure different parameters i.e. Atmospheric temperature, Humidity, Wind speed, Wind direction, Radiation, Soil temperature, Sunshine and Rain fall etc. The key objective of this project is to report on a developed indigenous low cost time based microcontroller based irrigation scheduler who performs user defined functions and outputs commands to derive the water management of system. A soil moisture sensor was modeled, simulated and tested for achieving, with low-cost, accurate and reliable measurements. A low-cost high-performance and small temperature sensor is used, with the same PCB circuit it can measure humidity also. The tipping bucket rain gauge is used to measure rain fall. After a pre-set amount of precipitation falls, the lever tips, dumping the collected water and sending an electrical signal. In this paper we propose transmitter and receiver of system with prototype of water management system.

KEYWORDS: PIC Microcontroller, LCD, RTC, Agriculture Techniques, Soil moisture sensor etc.

I.INTRODUCTION

THE weather station is a facility, either on land or sea, with instruments and equipment for observing atmospheric conditions to provide information for weather forecasts and to study the weather and climate. The measurements taken include temperature, barometric pressure, humidity, wind speed, wind direction, and precipitation amounts. Wind measurements are taken as free of other obstructions as possible, while temperature and humidity measurements are kept free from direct solar radiation. Manual observations are taken at least once daily, while automated observations are taken at least once an hour. Weather conditions out at sea are taken by ships and buoys, which measure slightly different meteorological quantities such as sea surface temperature, wave height, and wave period. Drifting weather buoys outnumber their moored versions by a significant amount. Water is a basic component of all known life on Earth. Water can both sustain life in correct quantities and threaten life when it is not available. Water as a result is a very precious natural resource that must not be wasted. If too much water is applied the problems arise consisting of runoff, erosion, waste of water and deceased plant life. If too little water is applied different problems arise such as turf burnout. The key in irrigation is striking to correct balance for optimal plant life with optimal use of water. An irrigation controller is a device to operate automatic irrigation systems such as lawn sprinklers and drip irrigation systems. Most controllers have a means of setting the frequency of irrigation, the start time, and the duration of watering. Some controllers have additional features such as multiple programs to allow different watering frequencies for different types of plants, rain delay settings, input terminals for sensors such as rain and freeze sensors, soil moisture sensors, weather data, remote operation, etc. Soil moisture sensor is a sensor connected to an irrigation system controller that measure soil moisture content in the active root zone. 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.

The anemometer measures wind direction and speed. The anemometer arm comes partially assembled with the wind vane attached. The wind vane rotates 360° to display current and dominant wind directions on the compass rose of the console display. The rain collector tipping bucket mechanism contains a standard measurement weight magnet that takes measurements in 0.01" (US versions) or 0.2 mm (UK and EU versions). 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

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collected an amount of water equal to the increment in which the collector measures 0.01" or 0.2mm. 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 Solar Radiation Sensor, or solar pyranometer, measures global radiation, the sum at the point of measurement of both the direct and diffuse components of solar irradiance. The sensor's transducer, which converts incident radiation to electrical current, is a silicon photodiode with wide spectral response. From the sensor's output voltage, the console calculates and displays solar irradiance. Sensirion's family of surface mountable relative humidity and temperature sensors. The sensors integrate sensor elements plus signal processing on a tiny foot print and provide a fully calibrated digital output. A unique capacitive sensor element is used for measuring relative humidity while temperature is measured by a band-gap sensor.

II. NEED FOR WEATHER MONITORING SYSTEM

Weather monitoring is the monitoring and analyzing of data that are received at a distance from their source. Monitoring the weather conditions manually is difficult. This is the implementation of an automated system which monitors the weather conditions like temperature, humidity, rainfall, wind speed, radiation and sends the details through the SMS to a central station. Benefits of weather monitoring system

-Reliable & efficient data offload storage & display
- High quality equipment built to specification
- Flexible service & installation options Portability

III. ARCHITECTURE DESIGN

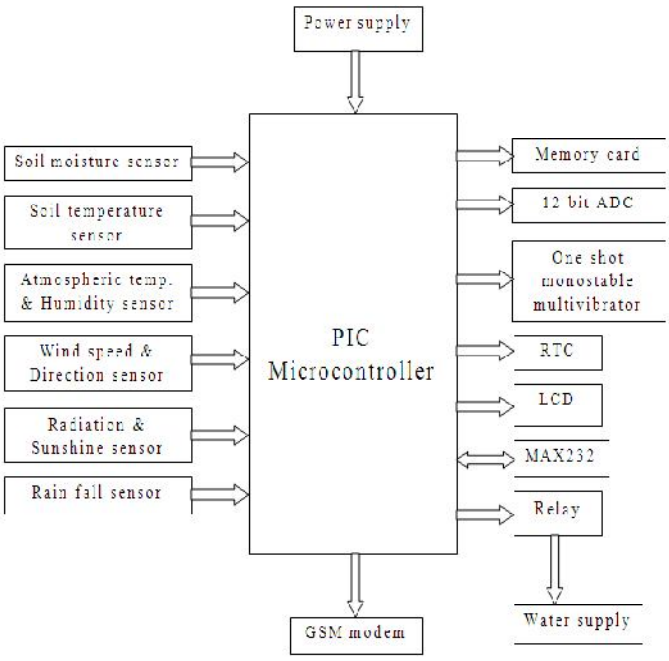

Figure1: Block Diagram

IV. INPUT PARAMETER

A. ATMOSPHERIC TEMPERATURE AND HUMIDITY

SHT1x (including SHT10, SHT11 and SHT15) is Sensirion's family of surface mountable relative humidity and temperature sensors. The sensors integrate sensor elements plus signal processing on a tiny foot print and provide a fully calibrated digital output. A unique capacitive sensor element is used for measuring relative humidity while temperature is measured by a band-gap sensor. The applied technology guarantees excellent reliability and long term stability. Both sensors are seamlessly coupled to a 14bit analog to digital converter and a serial interface circuit. This

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results in superior signal quality, a fast response time and insensitivity to external disturbances (EMC). Humidity is a term for the amount of water vapour in the air, and can refer to any one of several. Formally, humid air is not "moist air" but a mixture of water vapour and other constituents of air, and humidity is defined in terms of the water content of this mixture, called the Absolute humidity .Specific humidity is a ratio of the water vapor content of the mixture to the total air content (on a mass basis).

B. SOIL TEMPERATURE

It is a measure of temperature at different levels of the Earth's atmosphere. It is governed by many factors, including incoming solar radiation, humidity and altitude. This variable should be defined as a continuous signal (normally as a sine wave which simulated the day and night temperature changes) [2]. An analog temperature sensor that is LM35 is a chip that tells us what the ambient temperature is. These sensors use a solid-state technique to determine the temperature. That is to say, they don't use mercury (like old thermometers), bimetallic strips (like in some home thermometers or stoves), nor do they use thermistors (temperature sensitive resistors). Instead, they use the fact as temperature increases, the voltage across a diode increases at a known rate. Technically, this is actually the voltage drop between the base and emitter of atransistor. By precisely amplifying the voltage change, it is easy to generate an analog signal that is directly proportional to temperature. These sensors have no moving parts, they are precise, never wear out, don't need calibration, work under many environmental conditions, and are consistent between sensors and readings.

Moreover they are very inexpensive and quite easy to use. 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 ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range.

C. SOIL MOISTURE

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 modelling of land/ atmosphere interaction. Vegetation and crops always depend more on the moisture available at root level than on precipitation occurrence. Water budgeting for irrigation planning, as well as the actual scheduling. The gypsum block is used to measure soil moisture. The electrical resistance between electrodes embedded in a porous medium (block) is proportional to its water content, which is related to the soil water metric potential of the surrounding soil. Thus, the wetter a block is, the lower the resistance measured across two embedded electrodes. A gypsum block sensor constitutes an electrochemical cell with a saturated solution of calcium sulfate as electrolyte. The resistance between the block- embedded electrodes is determined by applying a small AC voltage (to prevent block polarization) using a Wheatstone bridge. Since changes to the soil electrical conductivity would affect readings, gypsum is used as a buffer against soil salinity changes (up to a certain level).

The inherent problem is that the block dissolves and degrades over time (especially in saline soils) losing its calibration properties. It is recommended that the block pore size distribution match the soil texture being used. The readings are temperature dependent (up to 3% change/°C) and field measured resistance should be corrected for differences between calibration and field temperatures. Some reading devices contain manual or self-compensating features for temperature or the manufacture provides correction charts or equations. Its size is up to 4 inch 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: 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.

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D. WIND SPEED AND DIRECTION

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

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E. RAIN FALL

The rain collector tipping bucket mechanism contains a standard measurement weight magnet that takes measurements in 0.01" (US versions) or 0.2 mm (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 0.2mm . 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. The body and base of the collector are constructed of tough, UV resistant plastic; the tipping bucket pivots on bearings that minimize friction and wear. Stainless steel adjustment screws under each chamber of the tipping bucket allow you to fine-tune the calibration of the Rain Collector. Rain Collector is wind tunnel tested to be stable in winds up to 140 MPH. 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 [4]

F. SOLAR PANEL

Newly added feature for my project is ―Solar Panel‖. As we were facing problem for regularly discharge of 12v battery used at filed. We finally decided to go for solar panel renewable energy source. It converts light energy from the sun into 12 Volt DC electricity. Slowly charges our 12V battery. It also helps to maintain a charge and extend battery's life. It protects battery through long storage periods. This solar panel charger has no moving parts that could wear out over time. Pre wired for immediate operation. Ensures quick starts. Environmentally friendly - no noise, pollution Weather/Rust/UV resistant frame. Maintenance free - only general cleaning needed. Estimated life - more than 35 years

V. PIC MICROCONTROLLER

This stage converts the water flow rate, temperature, air humidity, wind speed and light intensity to the actual well balanced readings. 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.

VI. OUTPUT PARAMETER

Short Message Service is GSM techniques to transfer data from distinct places such as from one area to the area of the same city or from another city .In our project we are using SMS technique to instant or quick transfer of data or notice to the required destination. It is a convenient facility of the GSM network. A message consisting of a maximum of 160 alphanumeric characters can be send to or from a mobile station. If the subscriber's mobile unit is powered of f or has left the coverage area, the message is stored and offered back to the subscriber when the mobile is powered on or has reentered the coverage area of the network. This function ensures that the message will be received. In our project we are using SIM300 for transfer of data from weather station. Interfacing with PIC is done with RS-232 through D-TYPE 9 pin connector. SIS is the leading manufacturers of GSM modems for lower price in India.

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A. GSM MODEM

A GSM Modem is a specialized type modem which accepts a SIM card, operates over a subscription to a mobile operator, just like mobile phone.

B. RELAY MODULE

A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

C. LCD MODULE

A liquid-crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images, such as preset words, digits, and 7-segment displays as in a digital clock.

VII. WORKING & ADVANTAGES

A.WORKING:TRANSMITTER SECTION:

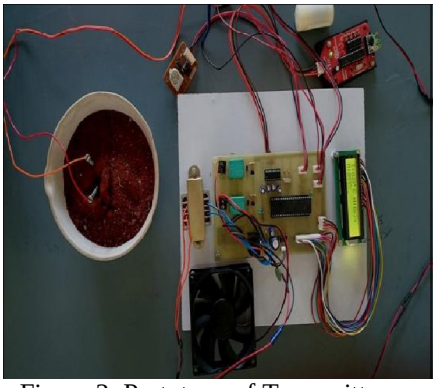

Figure 2: Prototype of Transmitter

Initially when power is on, signals are read by different sensors like temperature, humidity, soil moisture and its output is given to microcontroller. Output of microcontroller from sensors is taken through ADC pins and then it is given to zigbee module through Rx & Tx pins. Then it will transmit these data wirelessly to the receiver side.

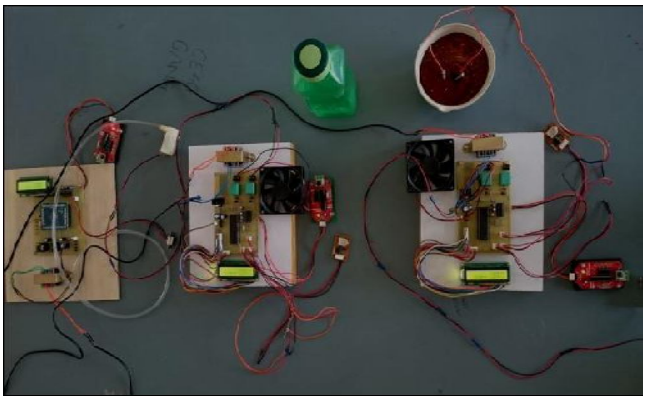

Figure 3: Final Hardware setup

ADVANTAGES

By this project we can control the moisture content of the soil in the cultivating field. Based on soil moisture, pumping motor will be automatically switch on or off through relay. This saves the water at the same time and on the other hand

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the plant can get optimum level of water, so increasing productivity of crop. Provides ultimate technique for water saving and management.

VIII. CONCLUSION

The implemented water deployment system supports water management for agricultural, horticultural lands, parks, gardens irrigation. It was found to be feasible & cost effective for optimizing water resources for agricultural production. This system has an advantage of using both GSM & zigbee technology which eliminates the cost of network usage to a great extent. By using Zigbee technology it is possible to send as well as receive all the information easily. The pic microcontroller based this irrigation system using wireless techniques monitor the activities of irrigation system efficiently. The water deployment system developed proves that the use of water can be diminished & it has some advantages such as it saves time of farmer, can be adjusted to variety of specific crop needs. The configuration of the irrigation system allows it to be scaled up for larger greenhouses or open fields. Thus, this system is reliable & efficient when compared to other type of irrigation system.

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