

**Local Weather Interpolation Using Sparse WSN for Automated Irrigation for Indian Farming**

Automated irrigation System using sensor for indian farming

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**Abstract** — The main aim of this paper is to provide automatic irrigation to the plants which helps in saving money and water. The entire system is controlled using 8051 micro controller which is programmed as giving the interrupt signal to the sprinkler. Temperature sensor and humidity sensor are connected to internal ports of micro controller via comparator, Whenever there is a change in temperature and humidity of the surroundings these sensors senses the change in temperature and humidity and gives an interrupt signal to the micro-controller and thus the sprinkler is activated Automated irrigation system needs weather information for irrigation control. And these information Scattered automated weather stations (ASW) from government agencies or wireless sensor network (WSN) are used for weather monitoring purpose. This proposed technique is Increase the accuracy of climatic parameters for the area consideration with more precise irrigation, which in turn saves water, energy and installation cost to farmers.

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**Keywords**- Automatic weather station, Error Corrections; Spatial Interpolation; Soil Moisture Sensors; Precise Irrigation ; Wireless Sensor Network

**I. INTRODUCTION**

The major sector is that fresh water resources are used up to 80% for irrigation control. [1] Also, this content includes like to water pollution from excess nutrients, pesticides and other pollutants. Due to industrialization, urbanization, climate change and population Growth in countries like India, the competition for water level is increasing and the cost of water pollution can be also increase. Sustainable management of water in agriculture is a sharp to increase agricultural production, ensure water usage is minimal and so maintains the environmental and they give social benefits of water systems. In this way water resource is managed in ecological, equity and economic manner. Technology for sustainable use of water is the use of smart controllers for irrigation system control. This is one of the better solutions for saving irrigation water. This technology can be more save irrigation water up to 80-90%. Smart controllers are control that automatically updates the watering parameter schedule depending upon climatic condition. Smart controller is automatically reduced the watering duration as per the weather gets cooler and saves more amount of water.

*A Smart Controller's for Irrigation [2] System has following Different Ways:*

Historical weather and water usage data, for area under consideration to calculate irrigation requirements .Weather forecasting using satellite images, Back Propagation network, Artificial Neural Networks, Feed Forward Neural Network, Multi Regression MLR model this techniques used successfully for weather forecasting and evaluation.

To minimizing errors in weather prediction from historical data, in those additional sensors like temperature/soil moisture sensor /humidity sensor are used for error corrections. Historical data are used for to determine a stating calculation of water timing and further adjustment are also based on sensor data.

Using long data for water usage and weather details. These Remote providers are like Indian Meteorological Data can use for smart irrigation system control. If data comes from a nearby automatic weather station it can be very accurate. If data take from a central database of historical data that is analyzed and produced for real condition can be very correct for smart irrigation system.

Having your own automatic weather station with sensors like wind speed, evaporation, soil moisture, wind direction, rainfall, temperature relative humidity and solar radiation. From the paper [1] reference total cost of automatic weather station is around Rs. 226000/-. For small farming lands this system becomes very costly, but they are producing more accurate result for site-specific irrigation.

Using sparse sensors that measure the actual proportion of moisture in the soil and control the irrigation respectively. The judgment of irrigation control will be based on current values and previous values of the sensors. Rainfall occurs quickly after irrigation the controller has no future look to control over it. This supervised to waste of water resources.

## II. RELATED WORK

In this system we will see the more methods

### A. Evapotranspiration – Based Irrigation Sheduling[3] for Agriculture

For this system irrigation schedule, essential parameters are soil characteristics, plant characteristics weather data, irrigation system characteristics and local management practices. By Using these parameters net-irrigation requirement is calculated. In soil moisture sensor based irrigation, soil moisture sensors are measure the total moisture level in the soil and a controller uses this information to control the frequency of irrigation.

- WSN Based

In WSN various weather monitoring sensors [4] are placed inside the field, sensors include evaporation, wind direction, wind speed, soil moisture, solar radiation, rainfall, temperature and relative humidity. Using this information, irrigation requirement is calculated remotely at central computer and control irrigation controller module wirelessly [5].

- Automatic Weather Station (AWS)

Automatic Weather Station (AWS) are used for remote data acquisition, which are installed and maintained by Indian Meteorological Data (IMD), Government of India. AWS data is available for 24 hour with an interval of 1 hour and transmit sensor data automatically to IMD database center to manipulate these data and convert them into engineering units.

## III. AUTOMATED IRRIGATION SYSTEM

Which Architecture Used for Automated Irrigation System are as follows

### A. Architecture Used for Automated Irrigation system

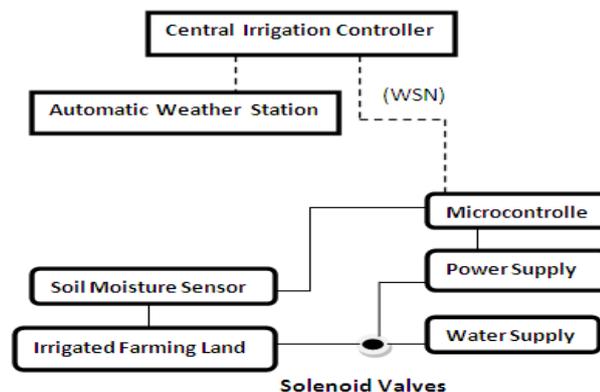
Central Irrigation Control (CIC) server is used for making decision for irrigation control. It also receives the real-time sparse sensor are used for soil moisture data indicating current soil moisture level. Irrigation control using soil moisture is done for land specific irrigation and also used as feedback report for error control.

### B. Components of Automated Irrigation system

Main components required for automated irrigation are irrigation control server, climatic sensors, solenoid valve, wireless communication, and microcontroller. [1] In our system design, climatic parameters are read from nearest automatic weather station and are interpolated to suit the local climate. For wireless communication ZigBee S2 from DigiKey is used for which have has cover space up to 100 meters with line-of-sight. 12V solenoid valves are used for control flow of water.

Following figure shows the flow of our proposed system. It shows interfacing between microcontroller and motherboard. This interface is attached to sensors. Sensors used in proposed system are of two types first sparse sensor and other one is AWS . Where sparse sensors are used for measuring moisture of soil and AWS sensor are used for displaying weather information.

- Automated Irrigation System Work flow



“Figure 1. Block Diagram of Automated Irrigation using ASW”

### *C. Sparse sensor network*

Wireless Sensor Unit (WSU) [6] its consists of a soil moisture sensors, Radio Frequency transceiver, power sources and a microcontroller. Several WSUs can be deployed in-field to configure as a distributed sensor network for accurate and correct result irrigation control. This setup can also be used for multi-crop systems, which has different type of water demand. Each unit is based on the microcontroller ATmega168 that controls the radio modem Zigbee S2 (DigiKey) and process information from the soil moisture sensor. is used in our system design. Series 2 has improved data protocol and power output and also, allows creating a complex mesh networks based upon the XBee ZB ZigBee mesh firmware. These modules allow a very simple communication and reliable between microcontrollers, systems, computers, really anything with a serial port and its Standard baud rate up to 9600 bps. Point to point and multipoint networks are also supported to these module.

### *D. Soil Moisture sensor Conduction*

The output of soil moisture sensor is an up to 10-bit and also Digital output for 0% moisture giving reading of 1023 and also 100% moisture giving reading as very low value. Output voltage range is up to 0 to 5V, where 0v is required for saturation and 5v no required for moisture. An also Input voltage is 5vVDC, control output is a logic level and also control set point is Thro Trimpot. Operational temperature range is required for -40°C to85°C. High value consists recorded for 0% moisture is 1023 and fully dampened soil as I50. Web application for crawling of IMD AWS data.

### *E. Web Application for Crawling of IMD AWS Data*

For To extract the data from IMD AWS data we have to

A created local server by using WampServer [8]. The advantages of using WampServer is that the ease of its software which automatically installs the Apache server, and configure a MySQL database and also installs Php support application for the easy maintenance and configuration.

- Data Extraction Work Flow

## **IV. DISCRIPTION OF EACH TERM ARE AS FOLLOWS**

### *A. ATmega168 Microcontroller[6]*

It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 16 MHz crystal oscillator, a 6 analog inputs, DC Current for 3.3 V Pin is 50mA, DC current per 110 Pin is 40mA, Flash Memory16 KB, SRAM of 1 KB and EEPROM 512 bytes these contents are required.

### *B. ZigBee Modules*

ZigBee ISO standard is over IEEE 802.15.4 .This technology is based on short range WSN. Range of its up to 1KM. and it was selected for this low power operated sensor network because it has low cost, low power consumption, and with very useful range [7] for the monitoring purpose. Different ZigBee's comes with different range and it is a sensing area from up to 100meters to 1KM. The ZigBee devices operate in scientific, industrial, and medical with radio band frequency is 2.4 GHz and allow the operation in mesh networking architecture, which can be divided into three categories as router ,coordinator or as end device. In our design they can be transmit the data of soil moisture sensor and ZigBee is used as end device. XBee S2 is XB24-Z7WIT-004 module from Digi is used in our system design. Series 2 has improved data protocol and power output and also, allows creating a complex mesh networks based upon the XBee ZB ZigBee mesh firmware. These modules allow a very simple communication and reliable between microcontrollers, systems, computers, really anything with a serial port and its Standard baud rate up to 9600 bps. Point to point and multipoint networks are also supported to these module.

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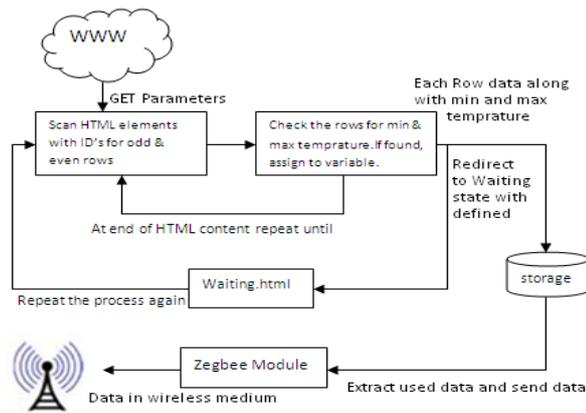
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- Data Extraction Work Flow



“Figure 2. Climatic Data extraction from IMD site”

Php script written gets the current data from of and a computer and extracts from the required data and stores the values in text files also. The Detail information of extraction is show in below Figure 2. [9]

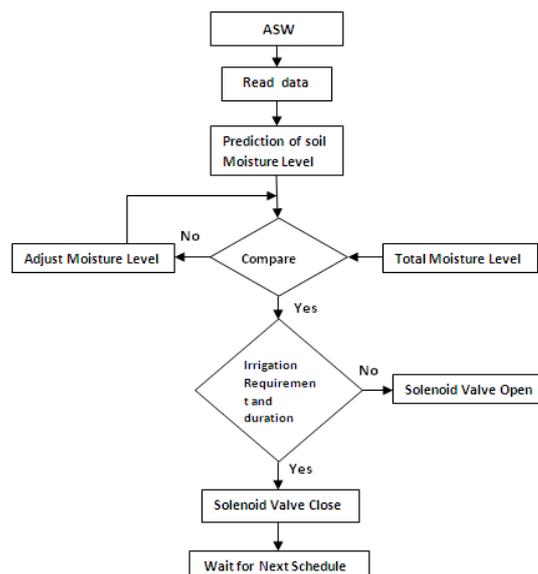
## V. IRRIGATION CONTROLLER

The Central Irrigation Control server is continuously getting input from

- Remote Automatic Weather Station
- Local Soil Moisture reading

Using Inverse Distance Squared Interpolation we can predict real-time local weather with an error correction from a actual real-time soil moisture reading.

### A. Irrigation Control Module Algorithm



“Figure 3 . Decision making of Irrigation Control Module”

## VI. COMPARITIVE STUDY

In existing system accuracy of display result is less, but our proposed system provides accurate results. Also existing system got the results in more time required, but our proposed system provides result in less timing. Data acquisition of existing system is wired but our proposed system provides data acquisition is remotely. Also productivity of existing system is less, but our proposed system gives more productivity. Also implementing of this system our county is top most in farming.

	Time	Accuracy	Data Acquisition	Cost	Productivity
Existing System	More Time	Less Accurate	Wired	More Costly	Less
Proposed System	Less Time	More Accurate	Remotely	Less Costly	More

**“Table 1. Comparative Study”**

## VI. ADVANTAGES

This is highly accurate and gives alternative backup is present for any one of the system failure. This makes increasing productivity and also reduces water consumption reduces soil erosion and nutrient leaching. In summery we have concluded our proposed system has following advantages:

- Highly accurate
- Alternative backup is present for any one of system failure.
- Increase Productivity
- Reduce the power consumption

## VI. CONCLUSION

In this paper we have proposed smart irrigation system which will be best for water resource management. It gives more accurate parameter by using accurate sensors. Due to information carriage loss there is improvement in the life span of the network with very low consumption of power. Our proposed system have very low maintenance, more scalable as well as it is cost effective .Also it improves the accuracy of remote data. Our system gets more accurate result as compare to other existing system according to depth analysis of system and gets a real time interpolated data. Most importantly as our country has farming all over so2 it is very useful in farming for control irrigation and water management.

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