# SMART IRRIGATION SYSTEM USING WIRELESS COMMUNICATION

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**ABSTRACT-Effective management of water resources is of key concern in cropping systems in semiarid and arid areas. Distributed sensor-based irrigation systems provide an efficient solution to support site-specific irrigation that allows farmers to maximize their crop growth along with saving water. This paper describes details of the design and instrumentation of a smart automated irrigation, that supports a wireless sensor network, a memory storage for storing the details of the crop and the soil type, and software for real-time sensing and control of a site-specific precision move irrigation system. Field conditions were site-specifically monitored by field sensor maintained in the smart irrigation device based on a soil property map, and periodically sampled and wirelessly transmitted to a base station. An embedded systems based, irrigation machine was converted to be electronically controlled by a programming logic controller that gets updates from a remote Global Positioning System (GPS) and wirelessly communicates with the GPS to get information with about the humidity level and the temperature. Communication signals from the sensor and the GPS system are sent to the irrigation controller are successfully interfaced using low-cost wireless radio communication. Graphic user interface-based software developed in this paper offered stable remote access to field conditions and real-time control and monitoring of the variable-irrigation rate.**

## II. INTRODUCTION

IRRIGATION is the most essential practice in agricultural cropping systems in semiarid and arid areas. The major concern with irrigation activities in arid and semi arid areas is the efficient water use applications and management .The general self-propelled irrigation systems generally apply water

quite uniformly, but, due to the substantial variation in the soil properties in different areas and water availability constraints across most areas, the self propelled irrigation systems fail to provide effective crop irrigation. In these cases, the ability to apply site-specific irrigation management that matches the variable constraints can increase application efficiencies, reduce environmental impacts, and even improve yields. The development of a real-time sensor-based site-specific irrigation system offers the potential to increase yield and quality while saving water, but the integration of sensor fusion, irrigation control, data interface, software design, and communication can be challenging task.

The coordination of control and data is most effectively managed using data networks and low-cost microcontrollers. Adopting a standard interface for sensors and actuators allows reuse of common hardware and communication protocol such as communication interface and control algorithm software. Instrumentation and control standards for communication protocols have been widely applied and well documented for integrating sensors and actuators, particularly in industrial applications.

An advantage of this irrigation system is that, a field sensing system does not take extensive time and costs to install and maintain. As in other systems here it is not required to hard wire the system for long distances as it may not be acceptable to growers because it can interfere with normal farming operations. A wireless data communication system can provide dynamic mobility and cost free relocation. Radio frequency (RF) technology has been widely adopted in consumer wireless communication products, and it provides numerous opportunities to use wireless signal communication in agricultural systems.

Bluetooth wireless technology is an example that has been adapted and used for sensing and control of agricultural systems. Bluetooth radio for different agricultural environments, power consumption, and data transmission rates. Zhang observed 1.4 m as an optimal radio height for a maximum 44-m radio range and reported limitations of significant signal loss after 8 h of continuous battery operation and 2–3 s of transmission latency with the increase of communication range. Oksanen used a personal digital assistant equipped with Bluetooth to connect a Global Positioning System (GPS) receiver for their open, generic, and configurable automation platform for agricultural machinery. Lee explored an application of Bluetooth wireless data transmission of the moisture concentration of harvested silage and reported a limitation of a short 10-m range. However, the limitations reported by reviewed publications about Bluetooth applications in agricultural systems can be solved or minimized by a system design optimization. For example, power shortages can be solved by using solar panels that recharge the battery, and the radio range can also be improved by upgrading the power class and antennas.

The system is planned to be implemented using distributed wireless sensor network (WSN) that utilizes Bluetooth technology for sensor-based variable rate irrigation systems. The WSN eliminates the need to hard wire sensor stations across the field and reduces installation and maintenance costs. The WSN uses an ad hoc network, i.e., a mobile wireless network. Compared with a wireless local area network (WLAN), ad hoc networks have advantages for agricultural applications, because the mobility and self configuration are more suitable for a distributed sensor network in fields. The objective of this paper is to propose a system for automated irrigation system that is user-friendly software for real time in-field sensing and control of a variation along with the support of wireless communication implemented by WSN.

## III. FUNCTIONAL DETAILS OF THE SYSTEM

The irrigation system has a sensor to store the details of the soil test conducted. The system consists of a digital interface and a pressure control unit which can provide optimum pressure. A timer with a manual input to provides automatic cut off for the water

supply. Our advancement over the present technology is the installation of a programmed microcontroller consisting the following:

1: a humidity level monitor.

2: a time interrupt device.

3: specific soil information

The humidity level monitor will check the humidity level in the air and will determine the optimized irrigation time. If the humidity levels increase (beyond a specific limit), the time interrupt device will interrupt the functional timer unit thereby halting the process and the original time set for the irrigation will be modified. The data stored in the memory will have all the details of the soil and the amount of water the soil/crop requires. The amount of water released is also recorded. If the water released does match with the carrying capacity of the soil, an interrupt will be sent to the timer and pressure unit and the irrigation will be stopped. The system is compact device that carries out in field sensing conducted by the soil sensor and the microprocessor unit stores the information from the sensor that is required for the irrigation device to carry out the process.

## IV. MATERIALS AND METHODS

The system consists of in-field sensors, an irrigation control station, and a humidity level controller, and also a timer circuit. The in-field sensors monitor the field conditions of soil moisture, soil temperature, and air temperature, whereas a nearby weather station monitors micrometeorological information on the field, i.e., air temperature, relative humidity, precipitation, wind speed, wind direction, and solar radiation. The device contains an in built timer unit that calculates the time it need to run the irrigation device. All in- field sensory data are wirelessly transmitted to the irrigation control station. The control station processes the in- field sensory data through a user-friendly decision making program and sends control commands to the irrigation control station. The irrigation control system sends a starting instruction to the irrigation device. If any highly different changes transmitted by the weather monitor systems relating to the air humidity are transmitted to the irrigation controller, the device sends an interrupt to the timer unit and the irrigation is cut off until it calculates the new values based on the new data received by the irrigation controller.

## V. SEQUENCENTIAL FLOW OF MODEL

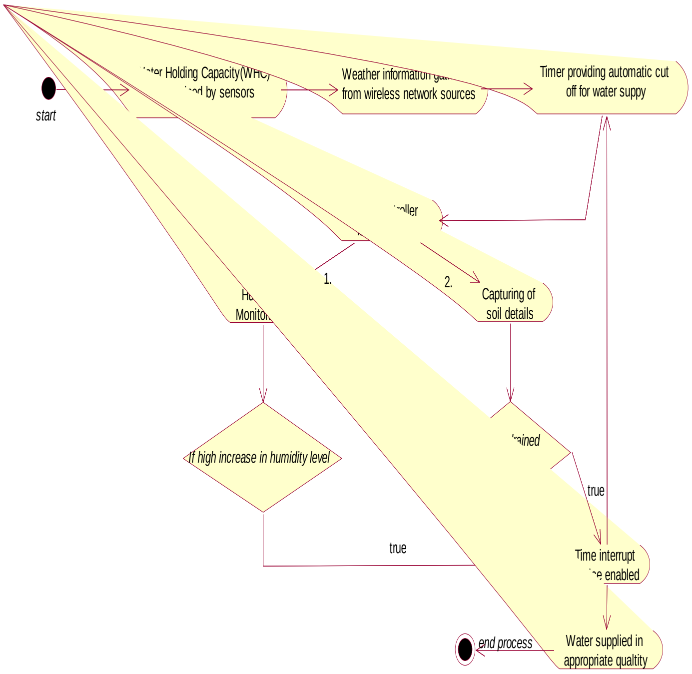


**Fig1: Activity Diagram-Illustrating activities of the system**

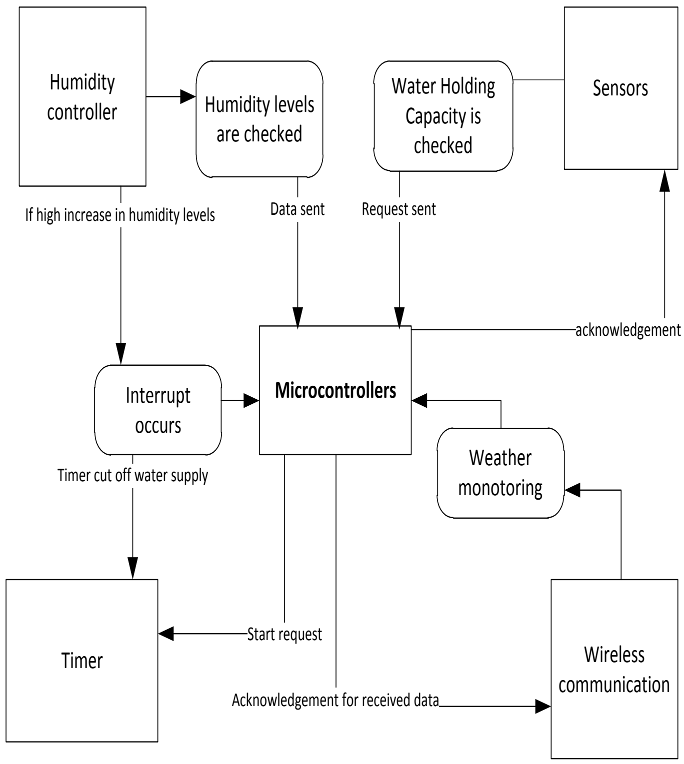


**Fig2: Data flow model-Describing the flow of the system**

## VI. CASE STUDY OF THE PREVIOUSLY INSTALLED SYSTEM USING WSN

The previously implemented system has the following details and application:

The system consists of five in-field sensing stations distributed across the field, an irrigation control station, and a base station. The in-field sensing stations monitor the field conditions of soil moisture, soil temperature, and air temperature, whereas a nearby weather station monitors micrometeorological information on the field, i.e., air temperature, relative humidity, precipitation, wind speed, wind direction, and solar radiation. All in-field sensory data are wirelessly transmitted to the base station. The base station processes the in-field sensory data through a user-friendly decision making program and sends control commands to the irrigation control station. The irrigation control station updates and sends geo referenced locations of the machine from a differential GPS mounted at the cart to the base station for real-time monitoring and control of the irrigation system. Based on sprinkler head GPS locations, the base station feeds control signals back to the irrigation control station to site-specifically operate individual sprinkler to apply a specified depth of water.

## VII. ADVANCES OF THE PROPOSED SYSTEM OVER THE PREVIOUS MODEL

- **Less hardware involved**: The new system requires less amount of hardware use age. This because of the fact that the new system is coupled with the irrigation device (pump) rather than implementing a system that utilises a structured system of wired sensor stations in field.

- **Cost Efficient:** The proposed system is cost effective than the one in existence, this claim is made on the fact that the proposed system does not need the heavy and expensive hardware for implementation. The developments of network of in-field sensor stations are highly expensive moreover the construction of the base station for collecting the GPS information needs lot of skills and expense.

**Power Consumption:** The efficient use of power is critical for a long-term operational system. Wireless sensor nodes are mostly powered by batteries and require efficient power management for both data scanning from sensors and for wireless data communication. Communication protocol is more helpful in reducing power consumption than in hardware optimization. Power consumption was estimated based on two modes: standby mode that draws power to maintain signal connection and active mode that draws more power to execute signal transmission. Due to the presence of in-field sensor systems, the power consumption for the implemented system is drastically high which can be reduced by the proposed system as it optimizes power dissipation.

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