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An Investigation of an Automated Humidity Control System for Water and Energy Conservation

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Abstract

The research offers an intelligent irrigation system with water and energy monitoring in order to reduce long-term water and energy use. It also reduces the need for constant human involvement in the field. Agriculture contributes significantly to a country's economic growth. Using water resources properly and efficiently for agriculture will help to conserve ground water supplies in the long run. In addition, energy management is an important component that was considered when creating this system. In a traditional irrigation system, the farmer must constantly monitor soil and weather conditions to ensure crop development. The suggested system measures several factors such as soil moisture, soil temperature, pH value, rainfall, humidity, and so on, and makes a judgement based on the sum of the parameters' values. Sensors for each of the aforementioned parameters generate continuous inputs for the system, which are compared to the reference values to create the system's control outputs. The amount of water and power consumed are continually measured in order to calculate the overall usage per month and warn the user. The land and weather conditions are constantly recorded for the farmer's future use.

Keywords: *Intelligent irrigation, automated water supply, weather and soil based irrigation, rainfall detection, humidity based water flow*

INTRODUCTION

Any country that does not have agriculture would suffer economically. Agriculture is India's backbone. Agriculture accounts for around sixteen percent of overall GDP and ten percent of total exports in India. As a result, the government and the general public are looking for more cost-effective agricultural and irrigation systems. Over 60% of India's land is arable, generating agricultural goods of great economic value; hence, optimizing water and energy resources and expanding productivity are the most pressing challenges for academics.

Water is an essential component of all manifested life on Earth. When water is available in sufficient quantities, it may both sustain life and jeopardize it. Water is thus an important distinguishing asset that should not be squandered. Inadequate rainfall and a lack of land reservoirs are the reasons of the earth's constant extraction of water, lowering the ground water level.

Furthermore, the amount of water sprayed to the ground must be measured in order to preserve the health of the soil and crops. Excessive water consumption can result in runoff, erosion, water waste, and the death of plant life. This will also diminish the amount of minerals in the soil, lowering its fertility. Other issues, such as grass burning, may emerge if too little water is supplied.

The key to optimum irrigation is striking the right balance between moisturizing the soil and making the best use of water. Water conservation may be accomplished using a variety of technologies. Water is provided to the root zone of the plants whenever it is necessary in this project, rather than watering the soil at regular intervals, which will assist to conserve enormous amounts of water during humid, winter, and rainy seasons.

Related Works

Yunseop Kim (2008) proposed employing a distributed wireless sensor network to remotely sense and manage an irrigation system [1]. This is a basic leadership programme for a regulated water system that is simple to utilize.

The framework includes in-field detecting stations for detecting various field land characteristics, as well as climatic stations for detecting tiny size metrological data. It makes use of Bluetooth and TCP/IP technology to deliver data remotely with ease. Despite the fact that Bluetooth eliminates system usage costs, the main limitation of Bluetooth innovation is its limited range of action, which is limited to a few of metres. So, while this technology may be used to remotely monitor and control devices, each controlling device configuration must have a dedicated Bluetooth module. Because a single Bluetooth module is shared by several devices, access delays occur. Another major challenge with Bluetooth innovation is obstruction.

Sankar.p.(2009) suggested a remote sensor network-based framework that may be used for a smart temperature estimation framework [2]. The temperature is estimated using automated multipoint thermometers in the framework. For data transfer, the framework makes use of an advanced RISC CPU and Wireless Fidelity innovation.

An amazing information stockpiling record structure is used for reading and writing SD cards, as well as managing the information document using the FAT16 document framework. Remote sensor systems are less difficult to set up without the need of connections and offer greater adjustability. 8-bit ATmega Series AVR processors with programmable glimmer memory of different sizes are used. It also features a built-in ADC and a 516k EEPROM. It supports ISP mode and I2C BUS.

Mahesh M. Galgalikar. (2010) proposed a Real-Time Atomization Of Agricultural Environment for Social Modernization of the Indian Agricultural System [5] that focuses on persistently observing the dirt dampness, water dimension of the well, temperature, mugginess, dew point, climate conditions, and providing information about the field to the user via SMS. It employs an ARM7TDMI Core 32-bit CPU, as well as GSM services that function via SMS as a link between the ARM processor and the centralised unit.

A common set of AT (Attention) instructions governs the GSM model. The prepared accessibility, straightforwardness, and reduced flag disintegration of GSM innovation enhances it for delivering control flags and accepting updates over extended distances. For simple applications needing continuous monitoring, the field condition can be communicated through radio link. The downside of this structure was that GSM has a fixed maximum cell site range of 35km, which is constrained by specific constraints. Finally, the rancher should feel at ease with the entire mind-boggling AT guidelines. The framework does not include parameters for manures and plant diseases.

Vasif Ahmed and Siddharth A. Ladhake (2010) proposed an Ultra Low Cost Cell Phone Based Embedded System for Irrigation that incorporates insurance against single staging, over current, over voltage, dry running, and plausible bearing flaws and alerts the client through missed calls/bells on errand completion. RTC DS1307 and DS18S20 are used to estimate time and temperature.

The framework provides appealing features such as automated control based on parameters indicated however console, SMS, number of missed brings in determined span from client portable however sequential link and based on the directions received and the current sensor conditions microcontroller framework sends flag to turn on-off the engine however starter utilising transfer. RS232 and AT instructions are utilised for interfacing. [6]

The infrastructure depicted in [6] provides optimal water dispersal in fields based on manual settings, multiple missed brings in a specified time range, and SMS from mobile phones. It protects the engine from overburdening and overheating, as well as from unbalanced features, and it also provides robotized restarting. It makes use of bells and missed calls as a handy cause. Because to the utilization of obsolete mobile phone models, the effort is quite low. To encourage the uninformed ranchers, it provides a dedicated voice-based call technique for spoken guidance.
The primary drawback is that it uses the same system administrator for the control framework and client phones to provide a higher possibility of effective association; and it necessitates more capacity memory for integrating diverse sensors.

Gao Guohong and Liu Yi. (2011) developed an application in agricultural and landscape irrigation system based on single chip computer (AT89S52) in [7]. The framework includes various useful components such as a clock unit, an alarm unit, and a presentation module. This way reduces the staff remaining work at hand, improves successful asset utilization, and boosts trim efficiency, lowering the cost of agriculture things. The AT89S52 processor is used. This 8-bit CPU has 256 byte RAM, 8K ROM, no EEPROM, ISP PWM, I2C, and ADC. The irrigation field is monitored and operated automatically in this article utilizing Wireless technology. [7]

The preceding research discusses numerous controllers and technologies that are described in the article. To gather data from numerous types of costly sensors, earlier methodologies were applied using various controllers such as AVR Atmega 16 microcontroller, Arduino controller, 8051 and PIC Microcontroller. Existing wireless technologies, such as Bluetooth and the Zigbee protocol, are only utilized for short-distance communication. The PIC microcontroller is utilized in this research to control the motor and conduct numerous operations at the same time. For effective communication, a GSM modem is utilized.

Proposed System

The system is a long-term solution for efficiently utilizing water in agricultural fields. It provides water to plants based on yield and operates in accordance with the soil wetness status of the plant's root zone. As a result, it reduces the burden on ranchers to pay more water duty. Furthermore, the syphon water system saves money on water syphoning. Furthermore, the automated water system framework enables ranchers to apply the optimal amount of water at the optimal moment. Irrigation requires substantially less human attention. Furthermore, efficient water allocation based on demand might cut energy use on water pumps.

The ebb and flow investigation focuses on precision farming, soil preservation, harvest water system booking, and water amount management to improve water usage proficiency. The framework depicts the design and development of an irrigation controller framework based on the PIC16F877A microcontroller. The PIC controller receives data from sensors that offer the precise field condition and irrigates the water based on the field state. The framework consists of a microcontroller, peripherals such as an LCD, and a driver circuit hand-off to turn on and off an engine. The system measures a variety of characteristics, including soil moisture, soil temperature, pH value, rainfall, humidity, and so on. The soil moisture sensor is to be positioned in the plant's root zone to detect soil moisture content.

A low-effort, high-accuracy IC temperature sensor with a yield relative to temperature in oC is used. The sensor detects field temperature and communicates with the microcontroller. The humidity sensor detects field humidity, which varies depending on the environment and soil type. The tipping bucket rain gauge is used to measure the amount of rain that falls. Furthermore, the system employs GSM (Global System for Mobile Communication) to tell the user of the precise field status. Whenever necessary, the information is sent to the user in the form of SMS. To manage water amount, an algorithm with associated sensor threshold values is designed and implemented into a microprocessor (PIC). The farmer may examine the report on field condition for a week at any time by utilizing an Android application.

Need of Automatic Irrigation

- Simple and straightforward installation and configuration.

- Conserving energy and water

- By automating farm or nursery irrigation, farmers would be able to give the proper amount of water at the right time.

- Avoiding irrigation during inconvenient times of day, decreasing runoff from overwatering saturated soils, and improving crop performance.

- Less reliance on humans. The motor in an automated irrigation system is turned on and off using valves. Motors may be readily automated by employing controllers, and there is no need for labour to turn the motor on and off.

- It is a precise irrigation method as well as a vital instrument for precision soil moisture control in highly specialized greenhouse crop production. It saves you time.

- Removes the chance of human mistake in altering soil moisture levels.

Hardware Design

The PIC microcontroller is utilized to operate the motor and water pump. Meteorological and electrical characteristics are used as inputs to the microcontroller. Soil moisture levels and other field variables are regarded as meteorological inputs sensed by various sensors.

The sensor network is made up of the following sensors. They do,

1. Soil moisture sensor
2. Temperature sensor
3. PH indicator
4. Rainfall detector
5. Humidity sensor

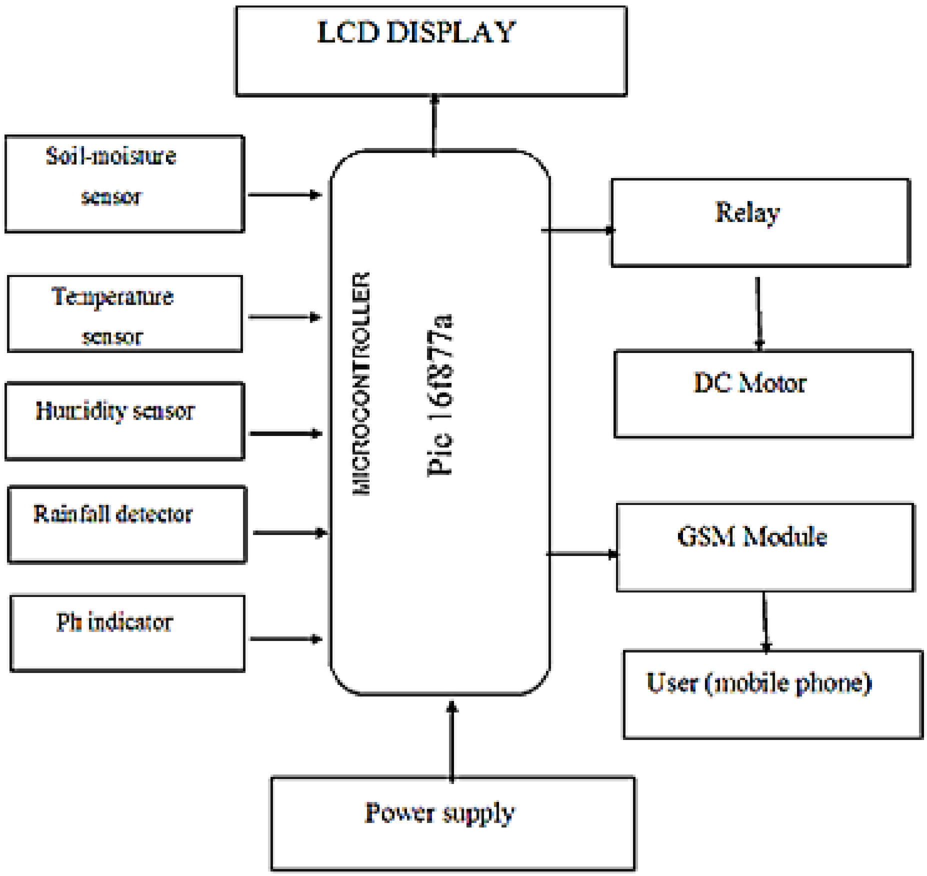

Fig: 1. block diagram of overall system

The hardware components are as follows,

1. PIC (16f877a) microcontroller
2. GSM module
3. Power supply
4. DC motor
5. Interface circuits

Working Principle

The project is intended to create an intelligent irrigation system that switches the motor ON/OFF based on field conditions and delivers a message to the user through GSM regarding the field's state. The system is made up of a soil moisture sensor, a temperature sensor, a pH indicator, a humidity sensor, and a rain detection sensor, as well as a PIC Microcontroller, GSM, and a relay interface board. Through the sensor setup, the microcontroller PIC16f877A receives the input signal of altering moisture, weather, and water condition of the soil.

When the controller gets this signal, it creates an output that activates a relay, which in turn operates the water pump. A microcontroller is also linked to an LCD display, which displays the soil and weather conditions.

The soil moisture sensor detects soil moisture particles in the energetic region prior to each watering event and stops the motor when the moisture level exceeds 30. When the level falls below 30, the motor turns on automatically, and the user receives a notification about the moisture situation through GSM.

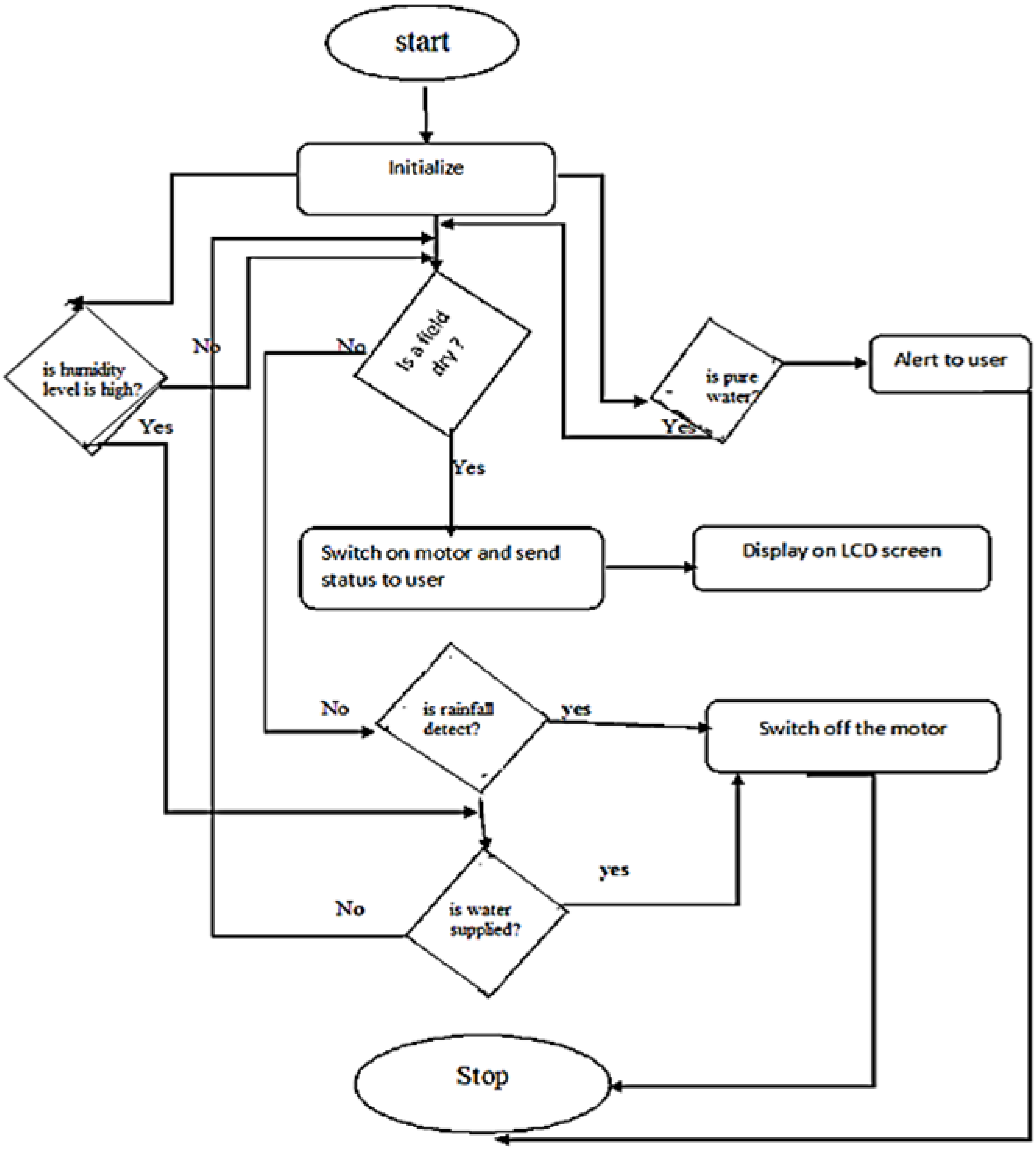

Fig: 2. Flow chart for working principle of the system

Rain sensors are regarded as rain-stopping devices. When it rains, the user receives a notice through GSM, and the motor turns off automatically. The humidity sensor is used to detect the humidity level in the air in order to validate the rainfall. When the humidity level exceeds 130, the user receives a message through GSM about the condition, which can serve as assurance for the rainfall.

The temperature sensor is used to measure the temperature in the field; if the temperature rises beyond 37 degrees Celsius, the user receives a notification through GSM, and the temperature is considered abnormal. The PH level indicator is used in the field to assess the quality of the water; the PH of the water should be 0.7 to 0.8. When the pH level changes, the user receives a warning through GSM, and the motor shuts down immediately, even if water is required in the field.

The dirt dampness sensor will be installed in the plant's root zone to detect the dampness material in the dirt. (LM35) is a low-cost, high-accuracy IC temperature sensor for small temperature ranges, with a yield that corresponds to the temperature (in °C). It detects field temperature and communicates with a microcontroller. The temperature range of operation is -55°C to 150°C. The tipping bucket rain gauge is used to measure the amount of rain that falls. The GSM is utilized in the system to inform the user on the actual state of the field. Furthermore, the farmer may examine the record for a week at any time by using an Android application, and the record includes weather conditions and utilized electricity, which is shown in the form of a graph.

RESULTS

sno	date	soil-moisture	temperature	humidity	Power consume(unit)
1	20/3/16	33	30	88	3
2	21/3/16	14	31	96	2
3	25/3/16	28	28	56	4
4	28/3/16	30	31	39	9
5	29/3/16	25	32	67	5
6	1/4/16	38	28	54	6
7	2/4/16	67	29	89	3
8	3/4/16	31	39	96	2
9	5/4/16	17	38	88	3
10	7/4/16	36	29	70	4

Fig: 3. Table of manual data calculated from the field.

This table displays the moisture, temperature, humidity, and current consumption output values. This sample data is collected manually and aids in improving system performance.

CONCLUSION

The soil dampness and watering framework that was developed was found to be feasible and cost-effective for streamlining water assets for agricultural Production. This system employs numerous characteristics as input to offer the essential data to improve the efficacy of the irrigation system while also saving water and energy. This also decreases the number of human interruptions. This technology may be used to efficiently execute cultivation in water-stressed areas, boosting sustainability. Furthermore, the Internet interface enables surveillance via portable media transmission devices, such as a sophisticated cell phone.

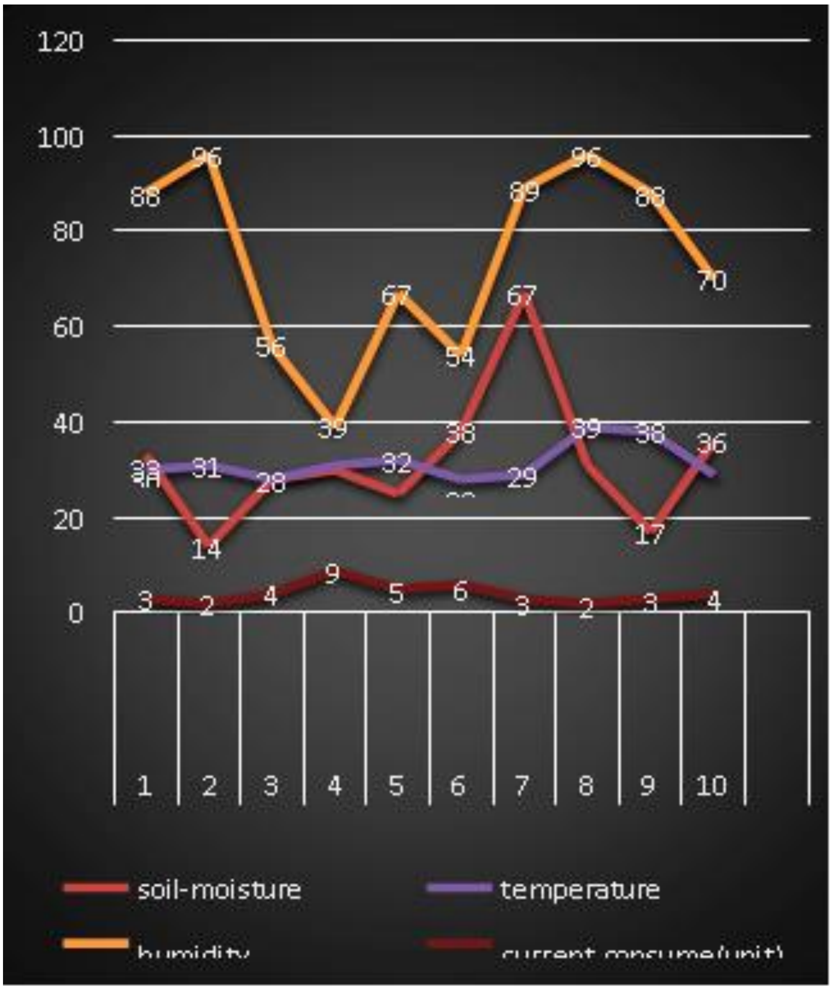

Fig: 4. over all analysis graphs for the data recorded

REFERENCES

1. Yunseop Kim, Robert G. Evans and William M. Iversen, (2007) "Remote sensing and control of irrigation system using a distributed wireless sensor network" IEEE transactions on instrumentation and measurement vol.57, pp-96-97.

2. Sankar, P., Norman, S. R, (2009) "Embedded System for Monitoring Atmosphere is Weather Conditions Using Weather Balloon", International Conference on Control, Automation, Communication and Energy Conservation 2009, pp 1-4.

3. Md. Wasi-ur-Rahman, Mohammad Tanvir Rahman, Tareq Hasan Khan and S. M. Lutful Kabir, (2009) "Design of an Intelligent SMS based Remote Metering System", Proceedings of the IEEE International Conference on Information and Automation pp. 1040-1043.

4. Yan Xijun, Lu limei, Xu Lizhong, (2009) "The Application of wireless sensor network in the Irrigation Area Automatic System", International Conference on Networks Security, Wireless Communications and Trusted Computing.vol.23, pp.21-24.

5. Mahesh M. Galgalikar, (2010) "Real- Time Automization Of Agricultural Environment for Social Modernization of Indian Agricultural System", on IEEE Proceedings, pp 20-23.

6. Vasif Ahmed, Siddharth A. Ladhake, (2010) "Design of Ultra Low Cost Cell Phone Based Embedded System for Irrigation", on International Conference on Machine Vision and Human Machine Interface ,vol.20, pp 40-45

7. Gao Guohong, Liu Y, Fu Junhui and Wang Yingjun, (2010) "Design of time control irrigation system based on single-chip computer" second international conference on communication systems, networks and applications.

8. L. L. Pfitscher, (2011) "An automated irrigation system for rise cropping with remote supervision"- proceeding of international

conference on power engineering, energy and electrical devices, vol. 50, pp 90.

9. Joaquin Gutierrez, Juan Francisco Villa-Medina, Alejandra Nieto-Garraway, and Miguel Ángel Porta- Gándara "Automated Irrigation System Using a Wireless Sensor Network and GPRS Module"

10. R. Yan, H. Sun, and Y. Qian (2013) "Energy-aware sensor node design with its application in wireless sensor networks," IEEE Trans. Instrum. Meas., vol. 62, no. 5, pp. 1183–1191.