SURVEY ON AUTOMATED IRRIGATION SYSTEMS USING WIRELESS SENSOR NETWORKS

Ms Shwetha P.S

Student ,Department of Information Science, NIE Institute of Technology, Mysuru, India.

---***---

Abstract - *Irrigation is the artificial application of water to the soil. There are various technological improvements in irrigation including automated irrigation. Automated irrigation implies operation of the system without any manual intervention. An automated system utilizes technologies like timers, sensors, computers, mechanical appliances, etc. Here we are presenting a comparative study of optimizing irrigation using remotely monitored embedded system, zigbee or hotspot, using wireless sensor networks particularly for drip irrigation and a micro controller based optimization that uses cellular internet interface which allows data inspection and irrigation scheduling to be programmed through web page. Implementation of these systems can be potentially used in water limited geographical areas.*

Key Words: drip irrigation, hotspot, remote monitoring, sensors, zigbee, cellular networks, internet, irrigation, wireless sensor networks (WSN).

1.INTRODUCTION

Indian agriculture contributes to 16% of the nation's GDP and 10% of export earnings. Clearly agriculture contributes to the economic development and it is necessary to optimise the yield by utilizing available science and technology. Obtaining good yield depends on various factors such as irrigation, soil pH level, humidity level. Any factor affecting these parameters leads to the diseased and improper growth of plants. This paper provides a review on the automated irrigation by comparing the two papers, using wireless sensor networks and a GPRS module [1] and automated drip irrigation and monitoring of soil by wireless [2].

Automated irrigation implies the artificial application of the water to the soil, without the intervention of human. The proposed systems helps in reducing the farmer's workload by irrigating the land based on the water requirements. It has sensors embedded which helps in monitoring the soil moisture content, humidity and the temperature. It is also possible to apply water soluble fertilizers along with drip irrigation, and thereby minimizes the water and fertilizers usage, as it directly applies fertilizers and water to the root zone due to which large quantity of fertilizers and water is saved.

2. LITERATURE REVIEW

There has been a numerous research and development in the agriculture field and it is increasing at a greater speed. The need of increasing the yield directly depends on the soil pH, soil temperature and various other factors which has become the main area of interest for the researchers.

Using electromagnetic sensors, the soil moisture was detected, based on which the land was irrigated. This has proved to reduce the wastage of water by 53% [3].

Drip irrigation has proved to be advantageous as it minimizes the wastage of water by directly applying water and fertilizers to the root zone. Microcontroller based drip irrigation system using the sensors have been a major advancement in the agriculture. [4][11]

Another important parameter to be considered for irrigation is the evapotranspiration rate of the plant. Abbreviated as ET, evapotranspiration is the water transpiration rate of the plant which mainly depends on the temperature, humidity, wind speed, plant density etc [5].

Utilizing the available solar and thermal energy in order to optimize the battery life can be employed [6].

3. PROPOSED SYSTEMS:

3.1 Automated irrigation system using WSN and GPRS modules.

The proposed system detects the soil moisture and temperature using zigbee technology. It mainly consists of wireless sensor unit (WSUs) and wireless information unit (WIU). The information can be monitored using any internet access devices. It also has a GPRS module which can transmit data to a web server via mobile network.[12]

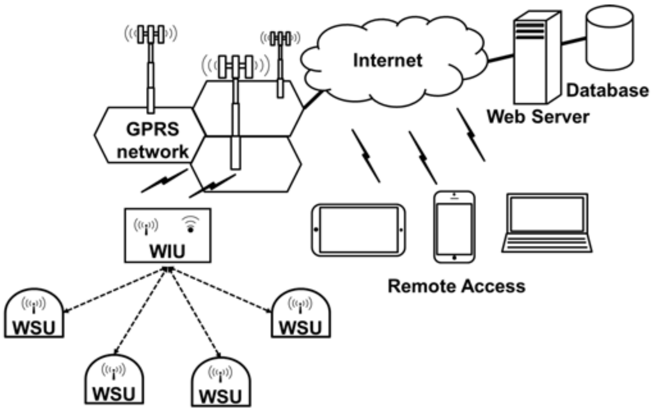


Fig. 1. Configuration of the automated irrigation system. WSUs and a WIU, based on microcontroller, ZigBee, and GPRS technologies.

The component used in the system is as shown in the fig.2

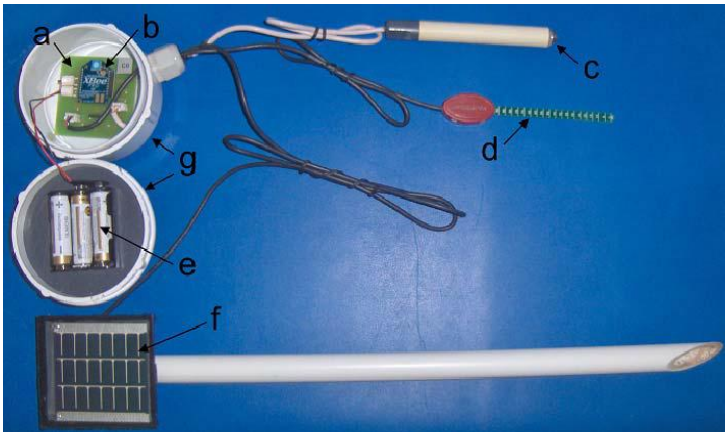


Fig. 2. WSU. (a) Electronic component PCB. (b) Radio modem ZigBee. (c) Temperature sensor. (d) Moisture sensor. (e) Rechargeable batteries. (f) Photovoltaic cell. (g) Polyvinyl chloride container.

The main component, microcontroller was programmed in C, it uses an algorithm with 1-wire communication protocol, for e.g. analog to digital port utilized for monitoring the soil moisture probe and soil temperature probe through another digital probe.

The probe measures the dielectric constant of the soil using transmission line techniques. Soil temperature measurement is made through digital thermometer DS1822 and the corresponding temperatures are stored in 2-B temperature registers.

Zigbee device allows the operation in mesh network topology that can be differentiated into 3 categories

1: Coordinator

2: Router

3: End device

This project requires XBee-PRO S2 because of its reliability of sensor network architecture and long range operation. It uses an RF modem with integrated chip antenna and can be used to connect with WSU and WIU.

XBee radio modem of the WIU configures as end devices to deploy a point to point topology. It also consists of a soil sensors array inserted into the root zone. The array consists of 2 soil sensors, one for measuring moisture and the other for temperature.

The soil moisture and temperature data from each WSU are received, identified, recorded and analyzed in the WIU.

The first task of the microcontroller program is to download the date and time through the GPRS from a web server. This data is transmitted from WIU via XBee to WSU. The microcontroller receives the information packets transmitted by each WSU that confirm the WSN. The packets are encapsulated bits of a unique 64bit address. [14]

The algorithm records a log file with the data in a solid state memory 24FC1025 which has a capacity of 128kB. The log consists of data such as soil moisture and temperature, the battery voltage, WSU ID, the data and time generated by the internal RTCC. It also stores the duration of irrigation, date and time, in a register after the irrigation in provided.

Finally these data and the location ID are transmitted at a predefined time interval to a web server through HTTP via GPRS module, which makes it easy to access data in real time on the internet web application.

When the server receives a request for the web page, it inserts each data to the corresponding field in the database. This link is bidirectional and permits to change the threshold values through the website interface; scheduled watering or remote watering can be performed. The WIU has also a push button to perform manual irrigation for a programmed period and a LED to indicate when the

Information package is received.

The GPRS module includes an internet protocol stack or an embedded transmission control protocol. This brings internet connectivity via UFL antenna connector and subscriber identity module (SIM) socket. The module is interfaced to the microcontroller using AT commands and can transfer data at the rate of 115.2Kb/s. The power consumption is 5V. It establishes communication with the URL of the web server to upload and download data. These signal strength requires to be greater than -89dBm for good connection, if the signal strength is poor all the data are stored in solid state memory of WIU and system tries to reestablish the connection each hour.

The irrigation is performed by controlling the two pumps through 40-A electromagnetic relays connected with the microcontroller via two optical isolators CPC1004N (Clare, Beverly. MA). The pumps have a power consumption of 48 W each and were fed by a 5000-l water tank.

Four different irrigation actions (IA) are implemented in the
WIU algorithm:

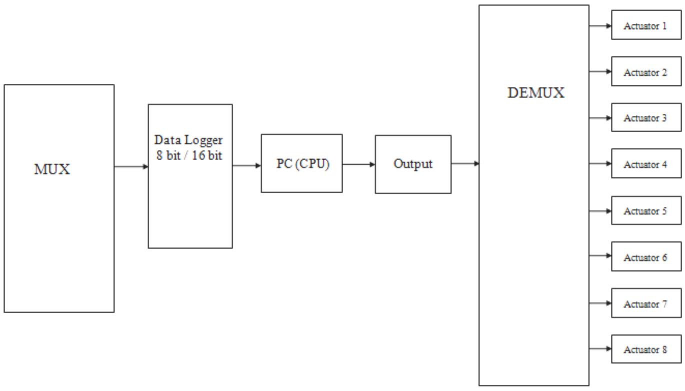
1) Fixed duration for manual irrigation with the push button;
2) Scheduled date and time irrigations through the web page for any desired time;
3) Automated irrigation with a fixed duration, if at least one soil moisture sensor value of the WSN drops below the programmed threshold level;
4) Automated irrigation with a fixed duration, if at least one soil temperature sensor value of the WSN exceeds the programmed threshold level.

Graphical user interface software helps in visualizing the data from each WSU using any device with internet. Hence this provides a real time.[15]

4. PROPOSED SYSTEM OF DRIP IRRIGATION SYSTEM AND MONITORING OF SOIL BY WIRELESS

The block diagram of the proposed system is as shown in fig.4. This system consists of data logger, multiplexer, CPU, de multiplexer and actuators. Various sensors can be embedded within the system such as soil sensor, humidity sensors, temperature sensors, pressure regulator sensors in order to monitor the water content of soil, temperature and pressure respectively. In addition a digital camera can be used to take the photographs of the crop growth. The output of the sensors are converted into analog signals using D/A converter at the transmitter side and can be converted back to digital signals at the receiver side using A/D converter. Multiplexers are a combinational logic circuit that accepts 2n inputs and route to the output. The data from the sensors are transmitted to multiplexer using WSN and can implement various technologies like zigbee or hotspot for data transfer.[13]

The data logger has information associated with date and time along with the data to be downloaded on a PC. De multiplexer splits this stream of data from shared medium and feeds them to different actuators such as irrigation pump, fertilizer pump, boring pump etc[8][9]



5. CONCLUSION AND FUTURE SCOPE

The proposed system helps in optimizing the water resources and minimizing use the use of inorganic fertilizer. It is cost efficient and requires minimum maintenance. The usage of internet for supervision through mobile networks helps in ease use of the available technologies. It can also be used for applications such as monitoring of temperature.

The future scope for research in agricultural field is diversifying with the invent of new technologies. The dairy and live stock farmers use RFID to enable tracking for individual animal's health. Development of sensors for hydroponics [10]. Furthermore the advancement of wireless network and IoT has lead to various improvements in the agricultural field.

Few of the advanced agricultural technologies include tractors on autopilot, GPS tractors and sprayers , mobile computing, portable computer and smart phones are destined to widely populate farm tractors , irrigation via smart phones, watering plants based on the request in the form of twitter message is an application that utilities IoT , monitoring crops via digital camera fixed in the field etc are a few advancements.

REFERENCES

[1]Joaquín Guiérrez, Juan Francisco Villa-Medina, Alejandra Nieto-Garibay, and Miguel Angel Porta-Gándara, "Automated irrigation system using a wireless sensor network and GPRS module.

[2] Aniket H. Jade, Dr.M.K.Sengupta, " Automated control of drip irrigation and monitoring of soil by wireless ".

[3]W.A Jury and H J Vaux, " The emerging global water crisis: Managing scarcity and conflict between water users ",ADV. Agronomy , vol. 95,ppl.1-76, sep.2007.

[4] Manish Giri, Dnyaneshwar Natha Wavhal (2013).Automated Intelligent Wireless Drip Irrigation Using Linear Programming. International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)Volume 2, Issue 1

[5] Zhang Z (2004). Investigation of wireless sensor networks for precision agriculture. ASAE Annual International Meeting. p. 041154.

[6] Zazueta FS, Smajstrla AG (1992). Microcomputer-based control of irrigation systems. Appl. Eng. Agric., 8(5): 593-596.

[7] R.G. Allen, L.S Pereira, D.Rae's, and M. Smith" Crop evapo transpiration-guidelines for computing crop water requirements-FAO irrigation and drainage paper 56. Rome,Italy: FAO 1998

[8] W. K. G. Seah, Z. A. Eu, and H.-P. Tan, "Wireless sensor networks powered by ambient energy harvesting (WSN-HEAP)—Survey and challenges," in *Proc. 1st Int. Conf. Wireless VITAE*, May 2009, pp. 1–5.

[9] Y. K. Tan and S. K. Panda, "Self-autonomous wireless sensor nodes with wind energy harvesting for remote sensing of wind-driven wildfire spread," *IEEE Trans. Instrum. Meas.*, vol. 60, no. 4, pp. 1367–1377, Apr. 2011.

[10] Balendonck J, Hemming J, Van Tuijl BAJ, Pardossi A, Incrocci L, Marzialetti P (2008). Sensors and Wireless Sensor Networks for Irrigation Management under Deficit Conditions (FLOW-AID). International Conference on Agricultural Engineering (AgEng2008). Conf. Proc. p.19.

[11] Miranda FR, Yoder RE, Wilkerson JB, Odhiamboc LO (2005). An autonomous controller for site-specific management of fixed irrigation systems. Comput. Electron. Agric., 48:183-197.

[12] Stone KC, Smajstrla AG, Zazueta FS (1985). Microcomputer-based data acquisition system for continuous soil water potential measurements. Soil Crop Sci. Soc. Fla. Proc., 44: 49-53.

[13] Jackson TJ, Vine DL, Hsu AY, Oldak A, Starks P, Swift C, Isham J, Haken M (1999). Soil moisture mapping at regional scales using microwave radiometry: the Southern Great Plains Hydrology Experiment. IEEE Trans. Geosci. Remote Sensing, 37:2136-2151

[14] Miranda FR, Yoder RE, Wilkerson JB, Odhiamboc LO (2005). An autonomous controller for site-specific management of fixed irrigation systems. Comput. Electron. Agric., 48:183-197.

[15] Zazueta FS, Smajstrla AG (1992). Microcomputer-based control of irrigation systems. Appl. Eng. Agric., 8(5): 593-596.