Indian Journal of Science and Technology, *Vol 9(17), DOI: 10.17485/ijst/2016/v9i17/93048, May 2016*
ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645

Automation of Irrigation System based on Wi-Fi Technology and IOT

M. Kranthi Kumar* and K. Srenivasa Ravi

Department of Electronics and Computer Science Engineering, KL University, Vaddeswaram, Guntur District – 522502, Andhra Pradesh, India; kranthi.3019@gmail.com, ravi.kavuluri@kluniversity.in

Abstract

Background/Objectives: The main intention is to develop an automation to supply water for home gardening and irrigation system in farm fields. **Methods and Analysis:** It is done with the help of soil moisture sensor and temperature sensor which are fixed at root area of the plants. The values detected by these sensors are transmitted to base station. The key aim of base station is to collect data from field station and upload those values in internet by using Wi-Fi technology also notify user about any peculiar circumstances like low moisture and high temperature. **Findings:** This irrigation system has been approved under different climates with various levels of moisture contents especially the red chilly weeds. **Application/Improvement:** Home gardening is the hobby of many people and also same works for the irrigation system in the agriculture fields.

Keywords: ARM, ESP8266, Solenoid Valve, Wireless Sensor Network, ZigBee Module

1. Introduction

There are a few methods to achieve water savings and crop irrigation is one such area[1]. For illustration, in a procedure, the status of the plant water was once verified and irrigation agenda established on canopy temperature dissemination of the plant[2], that was like the temperature of plants or the productive cover is normally measured with infrared thermometers. Canopy temperature is generally used to demonstrate productive water status and is used in models for supposing transpiration rates and sensible heat transport from greenery[3]. More systems are developed to program irrigation of crops and control the usage of water with aid of calculating Crop Water Stress Index (CWSI)[4]. This index has been determined using the assessment of infrared canopy temperatures and the atmospheric vapor pressure lost values to resolve at what time the field were irrigate using drip irrigation[5]. Estimating plant Evapotranspiration is an alternating parameter to resolve crop irrigation demands. Water consumed by plants over duration of time is defined by Evapotranspiration (ET)[6]. When water changes to vapor on either plant or soil surfaces evaporation occurs. Water lost through the leaves of plants is given as transpiration. Important factors need to estimate ET are: The first one is local weather conditions and the second one is the cropping system for which evaluation are needed (type of crop, crop development, planting date)[7]. By measuring four weather variables solar radiation, temperature, wind, humidity we can precisely predict ET losses in a given area[8].

There are a lot of ways to calculate the information in the field. The uttermost is communication of data by GPRS system to remote area[9]. Mostly to collect the data in the field from various sensor nodes ZigBee based transmission is used. The automatic irrigation system plays a principal position in assertion of the temperature, evaporation and the soil moisture content values might be sensed from the sensor and forward to the far area[10]. The Wi-Fi module is used to do this. ESP8266 is interfaced to microcontroller. Using this, the values are updated in web periodically. The system receives the sensed values of temperature and soil moisture. Power is the most important factor for sensor, without energy a sensor is basically vain and is not able to decide to the utility of network[11]. The dynamic power management designs leads to better

**Author for correspondence*

battery period. Power harvesting which the access will count on human power, wind, solar and thermal can be converted into electrical energy[12].

WSN is integrated within a system that manages water applied to each field based on the environmental conditions and the response sent by the different sensors. There are several assets in using WSNs and automated controlling systems in agriculture[13].

- Based on the available water supply, the improved estimation and planning of irrigation.
- Deprecation of required human resources, time and endeavor in agriculture production.
- Detection of floods in the field that could be fatal for the crops sufficient pumping of water to ease such cases.
- Creation of knowledge gathered from the disposed sensor networks for future application in the domain of agriculture.

2. System Architecture

2.1 Flow Chart

The algorithm for the proposed design is shown in the Figure 1. The sensor which is placed at field station is power up with DC power. At particular area in field the temperature and moisture of the soil is given by temperature sensor and soil moisture sensor respectively. And the values are transferred to base station in particular time intervals. The base station receives the data sent by field station and correlated with predefined set points are programmed in the base station. When the collected value is higher than the set points the valve of watering system is activated. The value monitored by the sensors is uploaded in web by using ESP8266 Wi-Fi module. Wherever the user, continuous monitoring of the behavior of the soil is possible by Internet of Things (IOT).

2.2 Block Diagram:

The Figure 2 shows how the automation of irrigation system is subsisting of two main blocks one is at field station and other is base station.

Field station subsists of one main micro controller and two sensors temperature and soil moisture is interfaced to it. ZigBee transmitter is connected to microcontroller to transmit the sensed values. To sync the sensed values in web ESP8266 is connected.

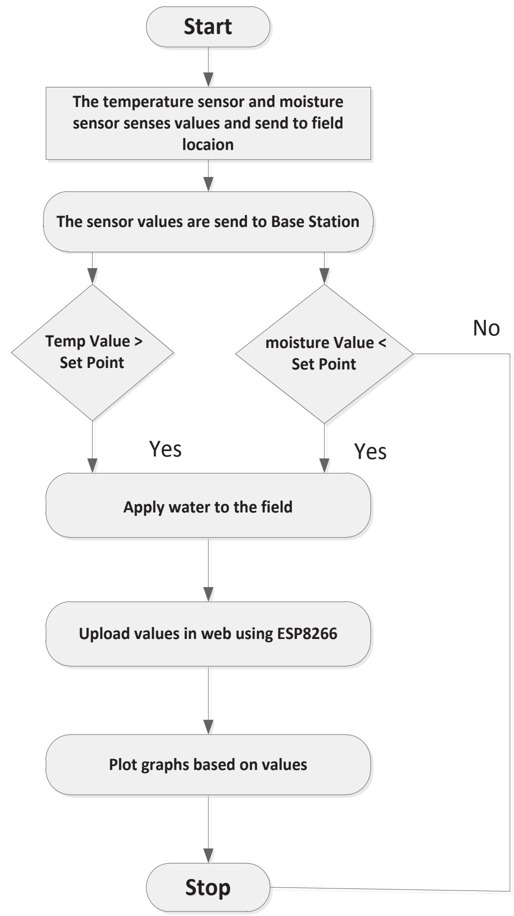

Figure 1. Flowchart.

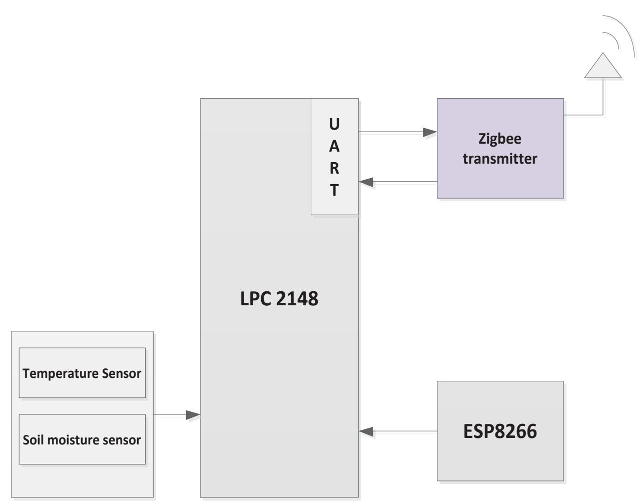

Figure 2. Field station.

Figure 3 describes base station which is the setup of personal computer is used to receive the sensed values by ZigBee receiver. The monitoring of values which is uploaded in web is performed.

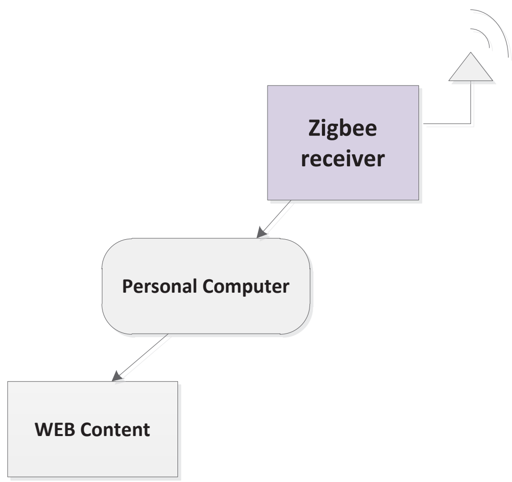

Figure 3. Base station.

3. Implementation

The temperature and moisture of soil is measured at field station. The sensors are placed at root zone of the plants. The depth of setting sensors varies. It relies upon kind of soil and also the crop. The quantity of water that is appropriate for crop relies on the soil. There are numerous types of soils, the black soil and the other, the red soil. Soil moisture sensor is used to review the potential of the soil. For such purpose we imbed two sensors in the farmland. In case the field is said to be moist, we observe the conductivity to be high with low resistance. If the field is said to be dry, we inspect the conductivity to be low with high resistance.

The microcontroller (LPC 2148) reads the values and sends to base station using ZigBee module. The ZigBee receiver is connected to another microcontroller which is at base station. Wi-Fi module ESP8266 is connected to this microcontroller. ESP8266 searches for the Wi-Fi networks in nearby and connects to one of the authorized network, using that network the values received at base station is uploaded in internet by means of static IP address. Using that address the user can verify the values at any place.

The updating information through ESP8266 modem when integrated with microcontroller is much simpler when compared to Ethernet module as ESP is a SoC and unified TCP/IP protocol stack.

This module is having on-board processing and storage efficiency that allows it to be combined with sensors and other application specific devices through its GPIO with minimal loading during run time. Also designed for little power consumption thus works in three modes i.e. active mode, sleep mode and deep sleep mode. AT firmware is provided simple to use command set with that it will be designed or operated at numerous Baud Rate.

3.1 Internet of Things (IOT):

Internet of Things (IoT) is a calculating approach that interprets a future where mundane physical objects is connected to the internet and will identify themselves to other devices[14].

In case we had computers that knew everything there was to consider things using data they assembled with no help from us. We would have the ability to track and check everything and extraordinarily reduce waste, adversity and expense. We would know when thing required back up, repairing or checking on and whether they were new or past their best. The Figure 4 shows the architecture of IOT.

Environmental monitoring is one of the applications of the IoT. Predominantly sensors are used to support in environmental protection by monitoring air, atmospheric, soil conditions and water quality.

4. Results

In Figure 5, the values are displayed which are received from sensing unit and transmitted via ZigBee module. Different values are monitored i.e. temperature and soil moisture. The received values are compared with set-point. If soil moisture value exceeds the set-point then the plant is said to be not in a good condition. Whenever

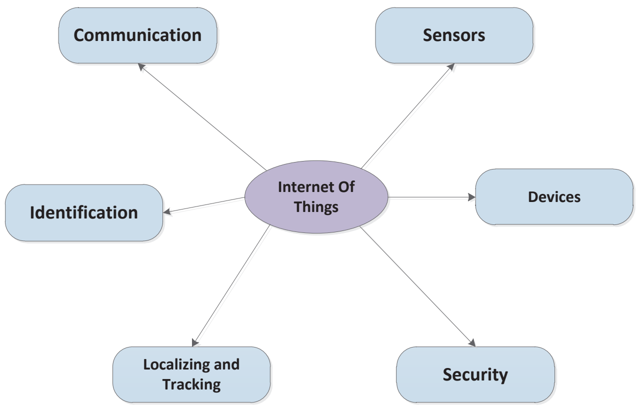

Figure 4. Internet of Things.

the monitored values are more than the set point the water valve will be opened and water is applied to the plants.

Wi-Fi module (ESP8266) which is interfaced to the microcontroller uploads the noted values of temperature and soil moisture in web.

Figure 6 shows the values which are uploaded in web. This process is done based on ESP8266 Wi-Fi module. This module connected to microcontroller searches for available Wi-Fi networks and after authentication to that network it generates one static IP address. This address is used to monitoring of values by the user at any location.

The set points may set based on the values acquired under various conditions. The set points may change from one place to another place since it may not be steady in each area.

From the ZigBee receiver the values are received at personal computer. Using visual basic the graphs are plotted for the temperature and moisture with respect to time. In Figures 7 and 8 the graphs are plotted based on the experimental values shows the temperature and moisture values with respect to time respectively.

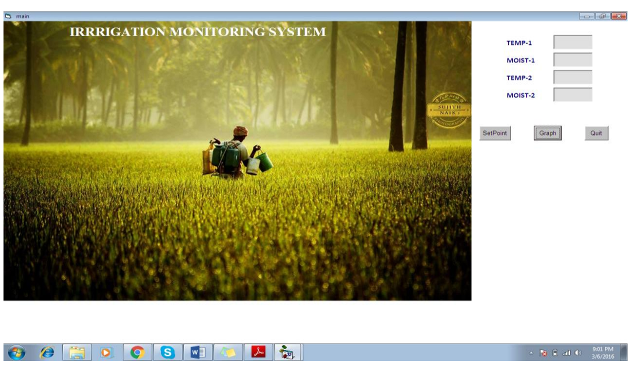

Figure 5. Values received.

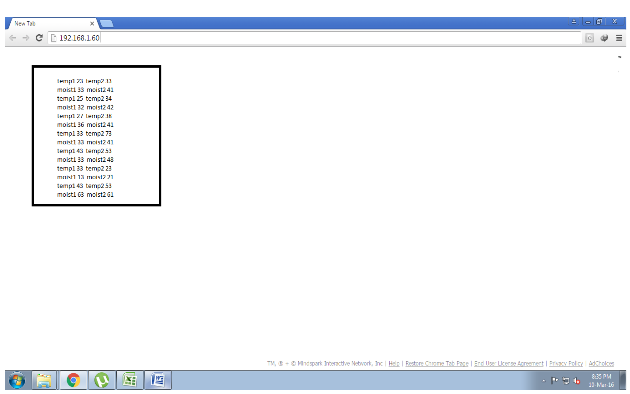

Figure 6. Values uploaded in web.

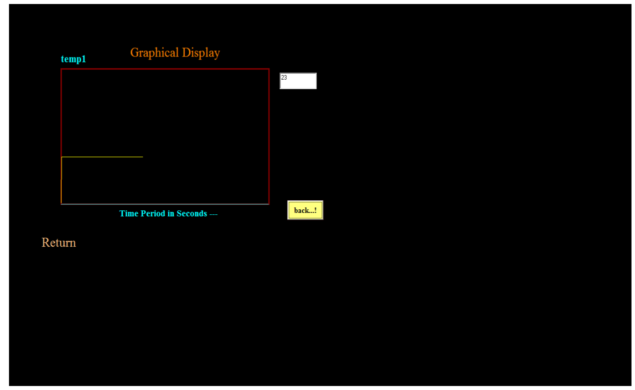

Figure 7. Temperature vs. time.

Figure 8. Moisture vs. time

5. Conclusion

The automation in irrigation system applied was once located to be appropriate and price adequate for accessing water source of supply for agricultural management. This irrigation method permits farming in areas with water scarcity thereby making improvements to hold water.

The irrigation system scheme can be conformed to an assortment of particular harvest needs and requires least preservation. The standard structure of the irrigation system which is automated permits it to be range up for bigger nurseries or open gardens.

As the insistence for water increments, alongside the need to ensure floating natural surroundings, water protection rehearses for irrigation system should be powerful and moderate. Accuracy minimizing so as to water system will enhance irrigation system the misuse of water, and efficiency, while expand crop yields. The best strategy for deciding the water requests of harvests is based on the real time controlling of soil moisture.

6. References

1. Kim Y, Evans RG, Ivesen WM. Remote sensing and control of an irrigation system using a distributed Wireless Sensor Network. IEEE Trans Instrum Meas. 2008 Jul; 57(7):1379–87.
2. Mamun AA, Ahmed N, Ahamed NU, Rahman SAMM, Ahmad B, Sundaraj K. Use of wireless sensor and microcontroller to develop water-level monitoring system. Indian Journal of Science and Technology. 2014 Sep; 7(9):1321–6.
3. Rodriguez-Sanchez MC, Boromeo S, Hernandez-Tamames JA. Wireless Sensor Networks for conservation and monitoring cultural assets. IEEE Sensors J. 2011 Jun; 11(6):1382–9.
4. Gomez C, Paradells J. Wireless home automation networks: A survey of architectures and technologies. IEEE Commun Mag. 2010 Jun; 48(6):92–101.
5. Akyildz IF, Su W, Sankarasubramaniam Y, Cayirci E. A survey on sensor networks. IEEE Trans Instrum Meas. 2011 Feb; 60(2):398–407.
6. Fisher DK, Kebede HA. A low-cost microcontroller based system to monitor crop temperature and water status. Computer Electron Agricultural. 2010 Oct; 74(1):168–73.
7. Corchado JM, Bajo J, Tapia DI, Abraham A. Using heterogeneous Wireless Sensor Networks in a telemonitoring system for healthcare. IEEE Trans Inf Technol Biomed. 2010 Mar; 14(2):234–40.
8. Han DM, Lim JH. Smart home energy management system using IEEE 802.15.4 and Zigbee. IEEE Trans Consume Electron. 2010 Aug; 56(3):1403–10.
9. Nallaniand S , Hency VB. Low power cost effective automatic irrigation system. Indian Journal of Science and Technology. 2015 Sep; 8(23):1–6.
10. Corke P, Wark T, Jurdak R, Wen H, Valencia P, Moore D. Environmental Wireless Sensor Networks. Proc IEEE. 2010 Nov; 98(11):1903–17.
11. Johnson M, Healy M, van de Ven P, Nelson MJ, Newe T, Lewis E. A comparative review of Wireless Sensor Network mote technologies. Proc IEEE Sensors; Christchurch. 2009 Oct 25-28. p. 1439–42.
12. Lee JS, Su YW, Shen CC. A comparative study of Wireless protocols: Bluetooth, UWB, ZigBee, and Wi-Fi. Proc IEEE 33rd Annu Conf IECON; Taipei. 2007 Nov 5-8. p. 46–51.
13. Frankowiak MR, Grosvenor RI, Prickett PW. A review of the evolution of microcontroller-based machine and process monitoring. Int J Mach Tool Manuf. 2005 Apr; 45(4–5):573–82.
14. Internet of Things. 2016. Available from: https://www.techopedia.com/definition/28247/internet-of-things-iot