A study on automated drip irrigation system

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Abstract: Agriculture productivity is declining day by day due to the lack of water resources and manpower. An increased demand to save water resource, increase productivity and decrease man power are the reasons for automating system in the field of agriculture to. Variant parameters are considered for automating the drip irrigation system that includes soil moisture, humidity, temperature, and soil pH. Computational component microcontroller, sensors and Wireless sensor network for data transmission. In this paper mainly focused on studying issues in wireless sensor network such as power consumption at nodes in wireless sensor network, technology adopted for data transmission, data traffic in the network. A major issue is to set up a remote sensor and actuator network (WSAN). Utilizing remote innovations in the field of farming have a lot of technical difficulties such as, enhancing battery life, long-range data transmission, network stability, secure data transmission, bandwidth of network, less data loss during transmission, data transmission rate and low cost in the meantime.

***IndexTerms* – sensors, microcontroller, wireless sensor network.**

I. INTRODUCTION

Indian economy is majorly supported by agriculture. More than 70% of the Indian population sustenance depends on the agriculture. Indian Agriculture requires 83% of the overall available water from various resources. Because the water levels in the resources are running out day by day, a necessary action should be taken to develop a system to forestall the wastage of water in agriculture. By adopting a good method to use the water in agriculture by combined action with the sensible technologies, we are able to utilize the water resources properly.

Agriculture in our country depends mainly on monsoon rainfall. Agriculture yield is controlled by precipitation, so the agriculture is alleged to be "the gambling of the monsoon" because the monsoon precipitation is unsure and uneven. More than 75% of the total annual precipitation happens in four months, i.e. between June and Oct. So it is especially important to spare downpour water for whatever remains of the eight months alongside other water resource. Proper arrangement must be accomplished for the utilization of water resource to maintain a strategic plan to avoid wastage of water within the farm land [1].

Internet of things (IOT) has turned out to be exceptionally famous and it is developing quickly in all the fields. The control and monitoring of automated drip irrigation system using the microcontroller for processing, sensors data collection, and wireless sensor network for data transmission. Nodes on the wireless sensor network having sensing and transmission/receiving capabilities. Each node is battery operated nodes as it having small functional capabilities. Large number sensor nodes are placed on the field either randomly or based on the define structure. This paper mainly focus on the different wireless sensor network issues considering such as higher power consumption at the sensor nodes leads to the failure of the node after certain communications, decrease in data transmission rate makes network to suffer, network instability leads to data loss, data transmission long range may comes more energy, node density may increase the traffic at the coordinator node.

II. LITERATURE SURVEY

Wireless sensor network in automated drip irrigation system is implemented by using different techniques such as Bluetooth, GSM, WiFi, Zigbee, LoRa etc. In Automated drip irrigation system the data transmission between nodes and android mobile is implemented using the Bluetooth (HC-05). LPC2148 microcontroller is used for controlling node, which consists of soil moisture sensor, temperature sensor, humidity sensor. As per paper the communication is established only when is mobile available within in a region [2]. The moisture data collected from field by using the soil moisture sensor connect to Arduino board. The communication is processed between the node and mobile Bluetooth terminal is only carried out on field communication [3]. Wireless sensor network is created by using Bluetooth (HC05), where each node is capable of sensing the soil moisture and programmed using Arduino Uno board. The communication between the WSN nodes using Bluetooth with the help of point to point communication makes single node communication for a particular time [4].

Wireless sensor network using Bluetooth is established as show in the Figure 1. WSN is having sensor node and control node is connected by using Bluetooth modules through an access point. Node created using Bluetooth in WSN consumes low power for data transmission and receiving. It is having higher data transmission rate and bandwidth. But the communication is a point to point communication makes other nodes to wait for data transmission leads to incur in delay, it is suitable for Short range data transmission and it is not secure as it is operating using RF. Bluetooth network is suitable for small network with less number of nodes.

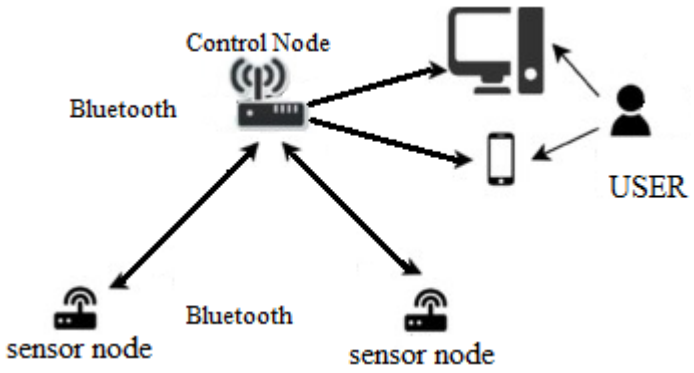

Figure 1: WSN using Bluetooth

Wireless sensor network consists of many wireless sensor units each unit is equipped with soil moisture sensor, humidity sensor, temperature sensor and coordinated using ATmega32 microcontroller. WSU send the data to coordinator node, which is a PC using Zigbee module, the PC is equipped with Zigbee receiver module to receive data and GSM to send a data to a database and mobile. System can be controlled remotely via mobile phone application [5]. The system is implemented and equipped with different sensors of specific field station and all the sensors details are updated by microcontroller and transmitted to base station using Zigbee wireless transmission then the decision control is transfer to the field station based on the sensor data interconnected via relay switch [6]. The automation is implemented with the help of the different nodes as coordinator or receiving node, sensor node and design of server which is designed using raspberry pi. The communication between the receiving node and the sensor node are through the RF transceiver. It will pass the data of the sensor collected by sensor nodes to the coordinator node and hence to transmit the signal from receiving node to the specific device which will be control depending upon the level of various parameters of the sensor [7].

The Figure2 represents the WSN with Zigbee network. The Zigbee wireless access technology is suitable for high-level communication protocols and to create personal area networks (PAN) with low power and low bandwidth network. The network which operates with Zigbee wireless communications always operates in low data transfer rate with better battery life, but the data transmission is not secure when compared with WiFi and data loss is more in the network. Hence the process involved in Zigbee as low power and lossy network and also it affects to device constrained in a networks.

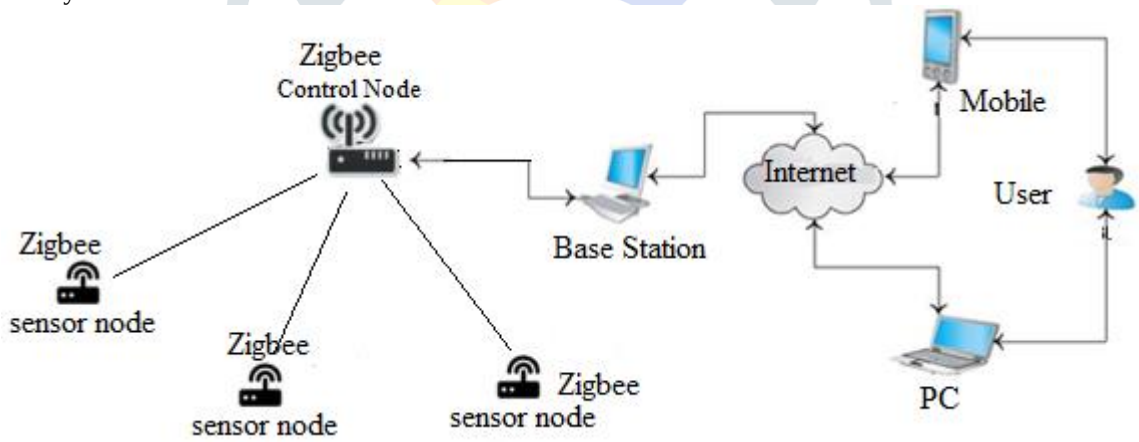

Figure 2: WSN using Zigbee

The system measures four parameters such as soil moisture, temperature, humidity and pH values by using wifi enabled ESP8266 module and the system also includes intruder detecting system that send message to farmer about trespasser and updates information about the crop field at anytime and anywhere to the farmer [8]. Automation of drip irrigation system involves the mitigation of manual intervention by improving the irrigating the plants automatically and the whole information about the agricultural field can be viewed in android application. The sensors like temperature, moisture level sensors, and humidity sensors are sends the data to the Arduino board that updates data to the server using ESP8266 WiFi module [9]. The well-organized water management is implemented by automated irrigation system. The LPC2148 microcontroller-based scattered wireless network (WSN), it has base station and web application. Each sensor node consists of soil-moisture sensor, temperature sensor and humidity sensors placed in the farm field. The WSN nodes are powered up using battery. Control station collects the sensor data using the RF transceiver. Control station sends the sensor data to a database through Wi-Fi module. Web application helps the user for remote controlling of motor and based on the parameters such as soil moisture level, temperature and humidity [10].

Wireless sensor network created using WiFi module helps to send the large data (images and video) easily within short range distance (100m). Network is having high bandwidth and data rate than Bluetooth and Zigbee. Set up of network is easy, the sensor nodes are connected to the router and it is secured than Zigbee. WiFi nodes in the network consume more power than nodes on other network(Bluetooth or Zigbee). Longer the distance higher the power consumption, so battery drains out easily. the Figure 3 represent the working of the WSN using WiFi.

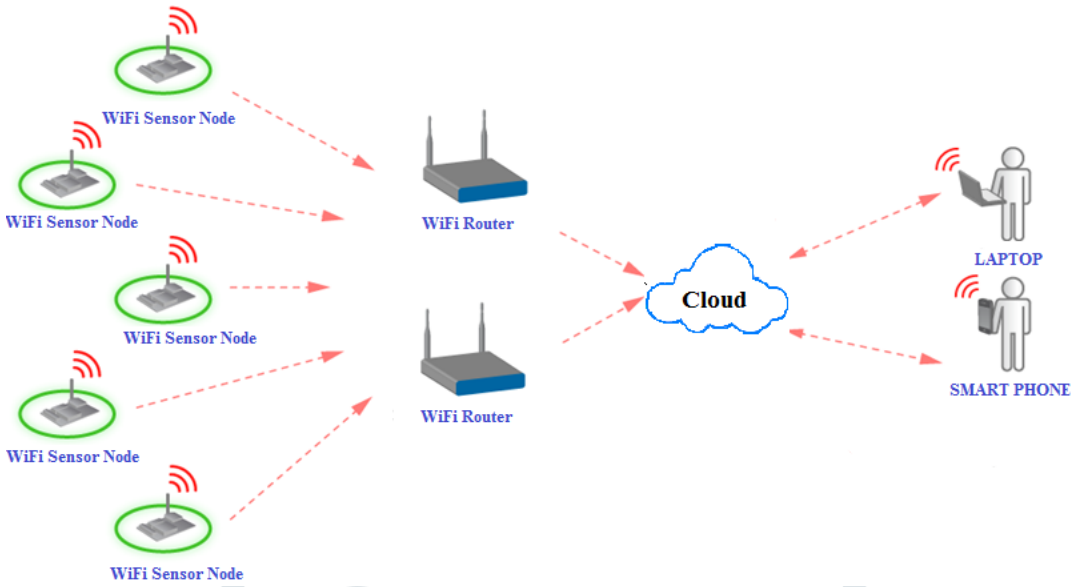

Figure 3: WSN using WiFi

The solution for drip irrigation control system based on the GPRS feature of mobile phone. The actual field condition is given to user through GSM (Global System for Mobile Communication). An SMS is send to the user based on the request from the user or and soil moisture changes happened on the field. This will save the man power and natural resources for future. The status of the soil moisture is continuously monitored to provide the necessary water flow and thereby reduce the wastage of water. By knowing the updated status of soil moisture and temperature of the field through SMS with the help of moisture and temperature data, motor can be controlled by just sending a SMS from user mobile [11]. The communication link is established between farmer and farm field using GSM technology. The 16F877 microcontroller is used for the computation. A threshold value of soil moisture is fixed for an each crop and is programmed in the microcontroller. When the soil moisture value exceeds the threshold value, the GSM module that automatically sends a SMS to the farmer and the motor is turned ON. The proposed system includes a sensor network 16F877 microcontroller, a relay, GSM, LCD display [12]. The smart irrigation system is implemented using the GSM network. The ARM controller is used for computation purpose and the sensor like soil moisture, temperature and humidity provided with controller. The relay is operated based on the soil moisture value and temperature. The fundamental use of ARM controller can optimally lever the soil moisture sensors with low power on demand only. Calculating the soil moisture threshold value using conduction charts and makes a decision to irrigate or not. Various modules are connected with GPS modem to receive the data moisture level and motor status with clock time for start time and time end [13].

GSM modules send the data early to user as its directly operating with the GSM network. GSM module installation is costly. It consumes more battery and even more on the week signal or on signal search. If the number of node increases the cost also increases and not suited for the area without network. The Figure 4 represent the working odd the Network with GSM.

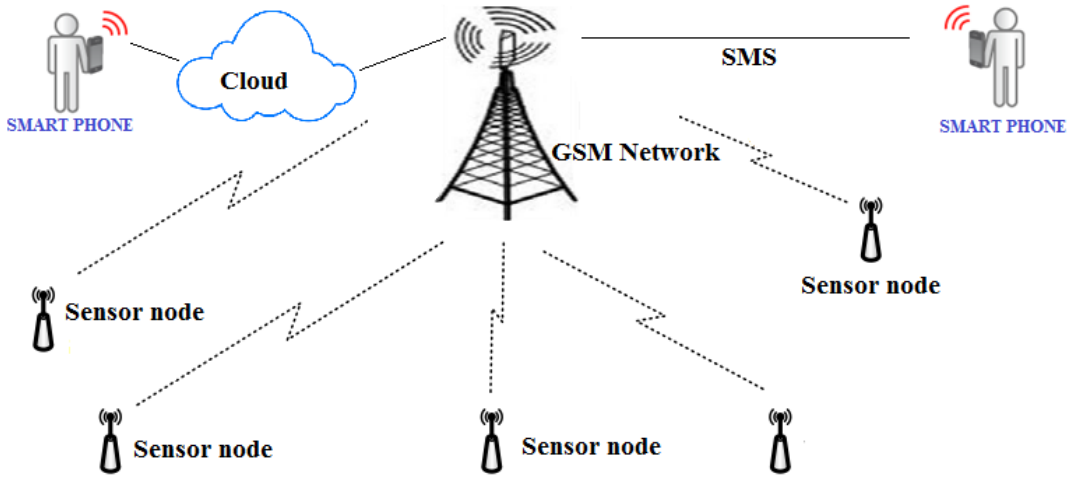

Figure 4: WSN using GSM

LoRa Based Wireless sensor network for Drip Irrigation Systems is Designed and Implemented using LoRaWAN, which is a media access control (MAC) protocol used for wide area networks. The design allows low powered devices to communicate with applications over long range distance connected through Internet. LoRaWAN is mapped to the second and third layer of the OSI model. LoRaWAN is implemented on top of LoRa (ISM) radio bands. Network consists of End Device or Node or Mote - a node with low-power battery operated communication device. The Gateway acts as antennas that receive broadcasts from End node and send data back to End node. The Network Server that route messages from End nodes to the right Application, and back to node. The Application is a piece of software that runs on a server. The Uplink is a message from a Device to an Application and the downlink is a message from an Application to a Device [15].

LoRaWAN nodes are operated at very low power with long battery life (months to years) based on the usage. The data transmission is possible up to 1km to 10kms considering line of sight other properties. LoRa is suitable for the application requires the low data rate. As it is operating on unlicensed ISM (open frequency) get interference on that frequency leads to low data rate and increase latency.

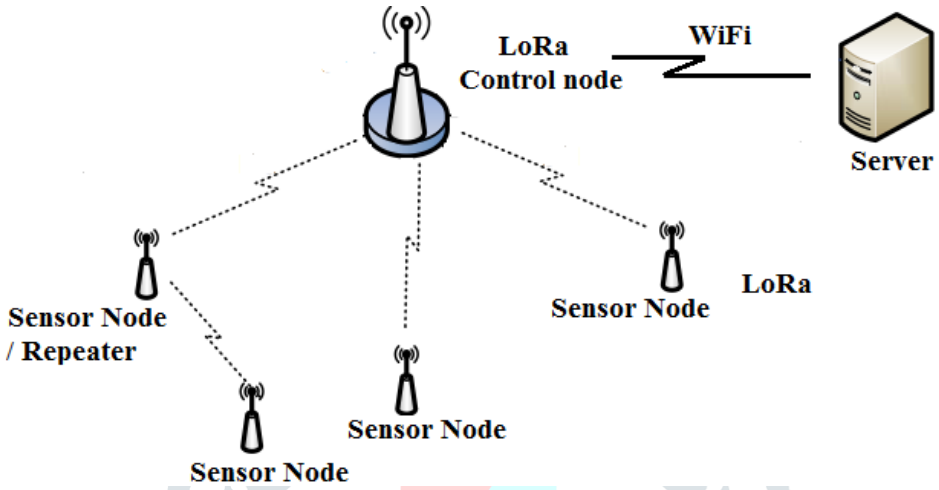

Figure 5: WSN using LoRa

Table 1 gives the comparative view of different wireless technologies used for creating the wireless sensor network.

	Bluetooth	**Zigbee**	**WiFi**	**GSM/GPRS**	**LoRa**
IEEE Standard	IEEE 805.15.1	IEEE802.15.4	IEE 802.11a,b,g	1xRTT/CDMA	IEEE 802.11ah
Type of module	HC-05	Zigbee series 2	ESP8266	2G/3G/4G	LoRa
Data Rate	1Mbps	250Kbps	11Mbps	128Kps-2Mbps	27 kbps
Range	10m	100m	100m	10kms	1km
Frequency Band	2.4GHz	868/915MHz	2.4GHz	880 - 915 MHz	865-867MHZ (India)
Sleep mode	9µA	12µA	10µA	<2.0mA	1µA
Transmitting mode	39mA	52mA	251mA	250 mA (GSM)	24mA
Receiving Mode	37mA	54mA	248mA	380mA (GPRS)	12mA
Power supply	3.3v	3.3v	3.3v	3.3v - 4.2v	3.3v

Table 1: Comparison of different technologies.

III. CONCLUSION

The Wireless sensor network traffic is depends on the number of nodes in the field and topology of the network for example data loss is more in case of star topology than mesh topology, the network stability is depends on the sensor node placement in the field (line of sight), signal strength is based on the node distance from the control node or coordinator node, power consumption is base on the technology (Bluetooth, Zigbee, WiFi, GSM, or LoRa) and also the signal strength. The network has a constraint on better battery life, high bandwidth, shorter range data transmission then WSN using Bluetooth is the option. Enhanced battery life, short range data transmission, low bandwidth WSN using Zigbee is suitable. Network requires large data transmission (image or video), High bandwidth and data transmission rate with no constraint on the battery life then WSN using WiFi is suitable. Network requires high bandwidth and data transmission rate with no constrain on the cost and battery then GSM is an option. Network requires long range data transmission with low power (long battery life) and Low data rate is not an issue then WSN using LoRa is suitable.

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