ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

IOT Based Irrigation System for Methodical Agricultural Practices

Ajay Vishwanathan[1], Makrand Farkade[2], Sajjan Jha[3], Pruthvi Dubey[4], Yogesh Pandit[5]

Undergraduate Student, Dept. of ETRX, Vivekanand Education Society's Institute of Technology, Chembur, Mumbai, India[1,2,3,4]

Assistant professor, Dept. of ETRX, Vivekanand Education Society's Institute of Technology, Chembur, Mumbai, India[5]

ABSTRACT*:* In 2014-15, reports suggested that a massive amount of crops had been lost or destroyed due to poor storage services and unforeseen weather conditions. But it also includes a large amount of crops damaged due to water logging, irregular supply of water and negligent maintenance of the farms. Traditional farming methods though tested and proven need to be updated to the 21st century, an age where revolutionary methods may have to be implemented to increase production and improve quality of farming.With the rapid increase in population and increasing food demands, new ways and methods must be introduced to meet the requirements of the population. The Internet of Things(IoT) is one of the technological advances which can provide a solution to this problem. Constant data logging and sensor devices to measure parameters with the help of mobile devices may provide new scopes for improvement in the field of agriculture.

KEYWORDS*:*Agriculture, IOT, Embedded System, Irrigation, GSM.

I.INTRODUCTION

Agriculture is the backbone of Indian Economy. In today's world, as we see the rapid growth in global population, agriculture becomes more important to meet the needs of the human race. However, agriculture requires irrigation, and with every year we have more water consumption than rainfall, it becomes critical for growers to find ways to conserve water while still achieving the highest yield. But in the present era, the farmers have been using irrigation technique through the manual control in which they irrigate the land at the regular intervals.

Over the past 200 years, farmers have developed simple irrigation systems based on diversion of water from seasonal or permanent streams and rivers. The advances in the technologies related to wireless communication has led to the emergence of several engineering designs to aid the human requirements.As agriculture plays a key role in a developing nation like India, we must leverage the growing mobile network infrastructure to build a system which can be used by the farmer to monitor his field from any remote location. The Internet of Things (IoT) is a technology wherein a mobile device can be used to monitor the function of a device. It can also be used to modify the status of the device.

As a farmer, the principle task is to ensure that the crops are well irrigated, protected from pests and are not damaged by wild animals. This would involve the usage of multiple sensor devices, which need to be placed on the field. These devices will help in monitoring the soil moisture, the quality of the soil and mineral levels. These parameters need to be communicated to a central processing module and so will have a transmission medium such as Zigbee, RF, etc. The central processing unit will also include a communication device to receive data from the sensors and to be relayed to the user's device. This will be done using a higher communication device such as a GSM modem or a Wi-Fi module. The data processed by the central module is converted to meaningful data and relayed to the user. This can be interpreted by the user who can take suitable action. The user can view the data with the help of a handheld devicesuch as a mobile phone or a tablet. This data is displayed to the user through a Graphics User Interface (GUI) which is an Android application. This application will also give the user control over the functionality of the water pump. The functionality of the water pump will also depend on the sensor devices present on field.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

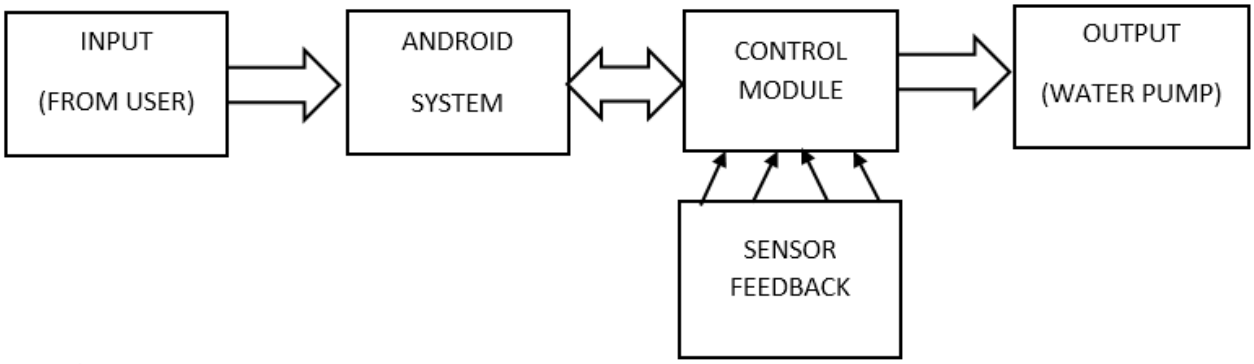

Fig 1.1 Block Diagram of Proposed System

II. LITERATURE REVIEW

In A Survey of Automated GSM Based Irrigation Systems. Chandrika Chanda, Surbhi Agarwal,Mr B.Persis Urbana Ivy, AP(SG) [1] mentioned that a GSM based farm irrigation system has two major technologies behind it, primary being the "GSM" and secondary one is the controller or processor. GSM (Global System for Mobile Communication) is a standard set used to describe protocols for digital cellular networks. This GSM facility serves as an important part for controlling the irrigation on field and sending the results to the farmer using coded signals to a mobile device which indirectly controls the entire farm irrigation system. The processor or the controller works as a central core for functioning of the automated process after it has been initiated by the GSM based device and finally presents the output to the device.

Remote Sensing and Control of an Irrigation System Using a Distributed Wireless Sensor Network.Yunseop (James) Kim, Robert G. Evans, and William M. Iversen [2]. This paper mentioned that self-propelled centre pivot and linear-move irrigation systems generally apply water quite uniformly; however, substantial variations in soil properties and water availability exist across most fields. The development of a distributed in-field sensor-based site-specific irrigation system offers the potential to increase yield and quality while saving water. 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

In Irrigation Control System Using Android and GSM for Efficient Use of Water and Power-Laxmi Shabadi, Nandini Patil, Nikita. M, Shruti. J, Smitha. P & Swati. C [3] automated irrigation system uses valves to turn water pump ON and OFF. These valves may be easily automated by using controllers. Automating farm or nursery irrigation allows farmers to apply the right amount of water at the right time, regardless of the availability of labour to turn valves on and off. In addition, farmers using automation equipment are able to reduce runoff from over watering saturated soils, avoid irrigating at the wrong time of day, which will improve crop performance by ensuring adequate water and nutrients when needed. Automatic irrigation is a valuable tool for accurate soil moisture control in highly specialized greenhouse vegetable production and it is a simple, precise method for irrigation. It also helps in time saving, removal of human error in adjusting available soil moisture levels and to maximize their net profits.

GSM based Automatic Irrigation Control System for Efficient Use of Resources and Crop Planning by Using an Android Mobile by Pavithra D.S, M.S. Srinath [4] mentions that the GSM based irrigation system may offer users the flexibility to regulate and control the operations of their irrigation systems with little intervention to reduce runoff from over watering for improvement in crop yield. This enables users to take advantage of the globally deployed GSM networks with its low SMS service cost to use mobile phones and simple SMS commands to manage their irrigation system. It will be possible for users to use SMS to monitor directly the conditions of their farmland, schedule the water needs of crops, automatically control watering, and set control operational conditions in accordance with the water needs of crops. This will help minimize overwatering and crop production cost.

Global System for mobile Communication (GSM) makes use of cells to provide wireless communication to subscribers who are in the vicinity of these cells. GSM phones may be identified by the presence of a Subscriber

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

Identity Module (SIM). This tiny object, which is about as wide as a finger, is a removable smart card that contains a user's subscription information, as well as some contact entries. This SIM card allows a user to switch from one GSM phone to another. In some countries, especially those in Asia, GSM phones are locked to a specific carrier. However, if a user manages to unlock a phone, he can insert any SIM from any carrier into the same phone. One of the main advantages of the GSM standard is the ability to roam and switch carriers by using individual mobile units [5]. GSM/GPRS module is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc.) for computer. A GSM/GPRS module assembles a GSM/GPRS modem with standard communication interfaces like RS-232 (Serial Port), USB etc., so that it can be easily interfaced with a computer or a microprocessor / microcontroller based system. The power supply circuit is also built in the module that can be activated by using a suitable adaptor [6].

III. ADOPTED METHODOLOGY

The proposed agricultural system is designed to solve the problems associated with the damage of crops and to find an optimal solution to the water crisis. As mentioned earlier, the design implements IoT technology using an android device, a main controlling unit (MCU), sensors to measure various parameters and a water pump, which will be used to supply water to the farm.

The android application is a simple menu driven application, with 4 options. This includes water pump status and control, water storage level, moisture level and intruder detection system. The water pump control is used to view the current status of the pump and an option to enable or disable its function. The water storage level and moisture level are simply parameter checks, which simply display the value sensed by sensor devices. The intruder detection system is used to detect any possible intrusion by wild animals onto the field. Audio cues are used to alert the user to take appropriate actions.

The MCU is the processing location of all data sensed and relayed by the sensor devices on the field. The Atmega16 Microcontroller is at the core of the system. It is a 16 bit microcontroller with low power consumption and high efficiency. The Atmega16 has 8 inbuilt analogue-to-digital (ADC) ports making it easier to read data from sensors. This Microcontroller is connected to an RF receiver module to communicate with the sensors and a GSM modem to communicate with the android application. The entire MCU is supplied with a 5v supply while the GSM modem uses a 9v supply.

The connectivity between the MCU and the user is established by a GSM modem. The GSM modem and microcontroller are connected using MAX232. The user can therefore control the entire irrigation system remotely with help of a mobile device depending upon the threshold values decided for the moisture content and the water-level. The farmer will also be able to view the parameter values and detection of intrusion by the data relayed by the GSM modem

The RF transmitters are placed close to the field on the sensors. The moisture level sensor, uses a capacitive plate system to measure the level of moisture. The capacitive two pronged plates are placed inside the soil. This measures the water level an analogous range between 0-5V. This data is sent through the RF transmitter which uses an encoding mechanism to send data to the receiver. The receiver has a decoding mechanism to obtain the data from the receiver. Output from receiver is connected to any pin of the ADC port. The microcontroller is programmed in such a way so as to use these digital values to indicate to the user whether the field is moist enough or not.

In terms of function, the water pump is attached to a microcontroller through a relay system. The functioning of the water pump is done by the signals sent by the microcontroller. The water pump works with the help of the inputs received from the sensors measuring the moisture content of the agricultural field and water level in the tanks. The user sends a request to switch on the water pump through the android application on his mobile device. This application is received by the MCU through the GSM modem. On receiving the request, the microcontroller checks for the parameters viz. water level in storage and moisture level. If the water level is high and the moisture level in low, then the water pump begins pumping out water onto the field. Any other case may cause the water pump to switch off.

The intruder detection system is a system which uses a wired loop wrapped around the perimeter of the field to detect intrusion. The wired loop when connected would indicate no intrusion, but on disconnection would trigger a loud and unpleasant sound in the field, whilst alarming the user by giving audio cues.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

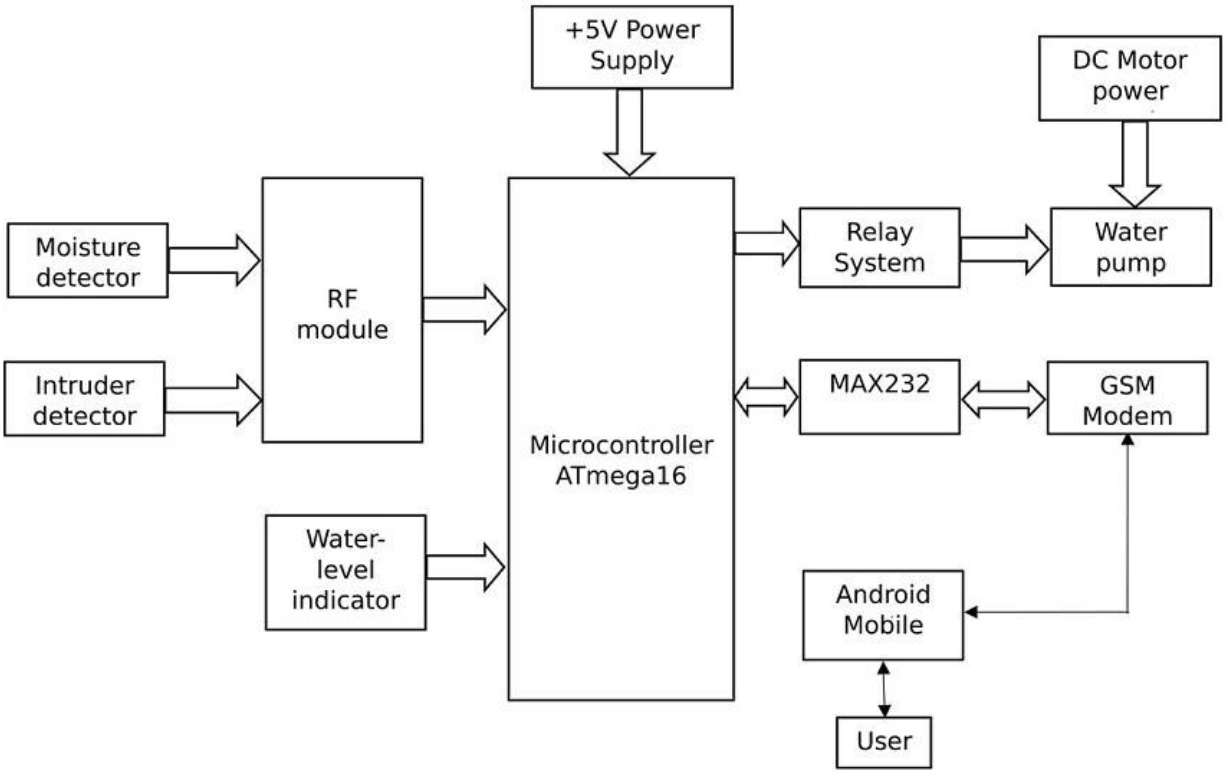

Figure 3.1 System Architecture

The water level indicator is a device which uses a transistor based system to detect the level of water in a storage container. This system is designed in order to prevent the water pump from running in a dry run, thus, saving power in the process.

The system uses a set of probes, on always present deep in the water and another which will be places at the threshold level. When both the wires are present in the water, conduction would take place thus indicating sufficient water to start the water pump.

This system is, to a certain extent, self-sustaining and will be crucial in avoiding water from being wasted. It can easily be monitored from any remote location, giving instant updates and alerts on any possible malfunctions. It can also be used to change the working status of the motor and with feedback from sensors, the system runs efficiently by saving power as well as water.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

IV. RESULTS AND DISCUSSIONS

The Block diagram shown in fig. 1.1 shows the basic workflow of the system and fig 3.1 shows the system architecture with thephysical connections of the individual sub-systems. The tables below give a description as to what type of data is obtained from the sensor nodes and their interpretation.

Water Percentage	Approximate Voltage Levels (in Volts)	Water Level Indicator
0-30% (Below Threshold)	0.7 – 5.0	Low
More than 30% (Above Threshold)	0 - 0.5	High

Table 4.1

The water level indicator is simple transistor based system which with the help of voltage gives the user, feedback of the water level present in the water storage. The water level indicator produces an analogue value in the form of voltage ranging from 0-5 Volts.This is shown in table 4.1. Two probes are used to determine the values of the level of water present. There is a probe placed deep in the storage device while the other is placed at a height decided by the user as threshold. This done so as to avoid complete absence of water. The voltage values are attained as shown in the above table and is sent over to the Microcontroller which uses the Analogue-to-Digital (ADC) pins to convert this data into meaningful data before being sent over to the user. Thus, the user can also determine whether it is necessary to start the water pump.

Moisture Percentage on soil	Approximate voltage levels (in Volts)	Moisture Level Detector
0 - 50%	2.5 – 5.0	Low
50% - 100%	0.0 - 2.5	High

Table 4.2

The moisture level detector works in a method similar to that of the water level indicator, where a capacitance based two-pronged probe is placed inside the soil such that the probe's top is visible on the soil. The probes are connected to a hygrometer which has the ability to return either a digital value or an analogue value depending on the user's choice. The value obtained from the hygrometer is sent over to the Main Control Unit by means of a RF transmitter. The value from the moisture detector is converted into meaningful data by the microcontroller before being sent to the user. The value from the hygrometer on the analogue scale ranged between 0 Volts to 5 Volts. This is shown in table 4.2.

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

User Command (via Android Device)	Water Level Status	Moisture Level	Water Pump Status Final
WATER PUMP ON	LOW	LOW	OFF
WATER PUMP ON	HIGH	LOW	ON
WATER PUMP ON	HIGH	HIGH	OFF

Table 4.3

The user issues a command to the user from the Android device application. The user has only two controlling options viz. water pump ON and Water Pump OFF. We assume that the user will be giving the command to switch on the water pump. At this point the microcontroller checks for the parameters to switch on the water pump, the water level and the moisture level. The above table shows the possible outputs from each sensor and their effect on the final output of the system. Thus, depending on the combination outputs from the sensors the water pump will either turn ON or turn OFF which is shown in table 4.3.

V.CONCLUSION AND FUTURE SCOPE

As Agriculture gains importance in human life, technological advances must be employed in order to keep up with the needs of the human population. Technological advances suggests their implementation in the industry will significantly improve the production yield and also help prevent wastage of resources. The system employs wireless connectivity between the sensory nodes on the field and the main controller unit (MCU) and also between the User and the controller unit. RF Transceiver modules are used for the former's communication while General Packet Radio Service (GPRS) is used for the latter. Security of the field is also maintained by using the Intruder Detection System.
With more advancements in the field of IoT expected in the coming years, these systems can be more efficient, much faster and cost lesser. In the Future, this model can be made into an intelligent system, wherein the system predicts user actions, rainfall pattern, time to harvest and many more features which will make the system independent of human operation.Systems can all be upgraded to Real Time systems, such that users receive real time updates and status of condition of the field. Thereby, enabling the user to take immediate action in case of any problems.
Thus, the system avoids over irrigation and under irrigation, detects intrusion and reduces the wastage of water. Thereby achieving the objective of agriculture using minimalistic approach to resources and setting up new openings for further growth in irrigation.

REFERENCES

[1] Chandrika Chanda, Surbhi Agarwal Proposed scheme "A Survey of Automated GSM Based Irrigation Systems" ISSN 2250-2459, Volume 2, Issue 10, October 2012.
[2] Yunseop (James) Kim, Member, IEEE, Robert G. Evans, and William M. Iversen, "Remote Sensing and Control of an Irrigation System Using a Distributed Wireless Sensor Network", IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT, Volume 57, Number 7, JULY 2008.
[3] Laxmi Shabadi, NandiniPatil, Nikita. M, Shruti. J, Smitha. P & Swati. C, "Irrigation Control System Using Android and GSM for Efficient Use of Water and Power", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 4, Issue 7, July 2014
[4] Pavithra D.S, M. S .Srinath, "GSM based Automatic Irrigation Control System for Efficient Use of Resources and Crop Planning by Using an Android Mobile", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X, Volume 11, Issue 4 Ver. I (Jul-Aug. 2014), PP 49-55
[5] What is Global System for mobile communication (GSM)? https://www.techopedia.com/definition/5062/global-system-for-mobile-communications-gsm
[6] What is a GSM/GPRS module? http://www.engineersgarage.com/articles/gsm-gprs-modules