Modern Irrigation System used in Agriculture

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Abstract-The modern drip irrigation systems, the most significant advantage is that water is supplied near the root zone of the plants drop by drop of water due by using this method a large quantity of water is saved. The conventional process consumes more water or sometimes the water reaches late due to which the crops get dried. Automating farm irrigation allows farmers to apply the right amount of water at the right time to the field, regardless of the availability of labor to turn valves on and off. Automatic Drip Irrigation is a valuable tool for accurate soil moisture, temp, humidity, pH, nitrogen control in highly specialized greenhouse vegetable production and it is a simple, precise method for Automated Irrigation System by using ARM Processor. It also helps in time saving, removal of human error in adjusting available soil moisture levels and to get the net profits. Along with water the other important resources to the plants are the nutrients. Nutrients are helpful for providing the proper food to the plants. If the nutrients are available in the right amount for the growth of crops then will leads to increase in the yield. Soil pH is the measure of soil acidity or alkalinity. The optimum pH range for most of the plants is in between 5.5 and 7.0. Temperature is also important parameter for evaporation of water and increase/decrease yield of product. In the developed system different parameters are inputted and processed in the ARM controller and it will control & maintain the water level. There are many plants that are very sensitive to water levels proper growth.

Keywords - Irrigation; ARM Processor; parameters; yield of product; sensitive to water levels

I. INTRODUCTION

Agriculture is the most important factor of Indian Economy. An increasing the demand of the food requires the rapid improvement in food production technology. An agriculture field is dependent on the monsoon it is not the reliable source of water. An extraction of water from earth is reducing the water level therefore lot of land is coming slowly in the zones of un-irrigated land. The reason is the lack of rains & scarcity of land reservoir water. An important reason of this is because of unplanned use of water due to which a significant amount of water goes waste. In the modern drip irrigation systems used in agriculture, the advantage is that water is supplied near the root zone of the plants drop by drop of water therefore which a large quantity of water is saved. The present era, the

farmers have been using irrigation technique the manual control in which the farmers irrigate the land at the regular intervals. This process consumes more water or sometimes the water reaches late due to which the crops get dried.

Water deficiency can be determined to plants before visible wilting occurs. Because of water deficiency it slowed growth rate, lighter weight fruit. This problem can be perfectly rectified if the use automatic controller based drip irrigation system in which the irrigation will take place only when there will be requirement of water. Irrigation system uses valves to turn irrigation ON and OFF. These valves may be easily automated by using controllers and solenoids. Automating farm or nursery irrigation allows farmers to apply the right amount of water at the right time, regardless of the availability of labor 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 required. Automatic Drip Irrigation is a valuable tool for accurate soil moisture control in highly specialized greenhouse vegetable production and it is a simple, precise method for automated irrigation system by using ARM Processor. It also helps in time saving, removal of human error in adjusting available soil moisture levels and to maximize their net profits. Along with water the other important resources to the plants are the nutrients. Nutrients are helpful for providing the nourishment to the plants. If the nutrients are available in the right amount for the growth of crops then it leads to increase in the yield. The nutrients needed in greatest amount are called macronutrients whereas those required in lesser amount are called micronutrients. Nitrogen, Phosphorus, Potassium, Sulfur are the examples of macronutrients. An Iron, Boron, Copper are the examples of micronutrients. Soil pH is the measure of soil acidity or alkalinity. Soil pH is considered a master variable in soils as it controls many chemical processes that take place. It specifically affects plant nutrient availability by controlling the chemical forms of the nutrient. The optimum pH range for most of the plants is in between 5.5 and 7.0.

1.1 Motivation

Agricultural irrigation is highly important in crop production everywhere in the world. In India, where 60-70% economy depends on agriculture, there is a great need to modernize the conventional agricultural practices for the better productivity. Due to unplanned use of water the ground water level is decreasing day by day, lack of rains and scarcity of land water also results in decrement in volume of water on earth. Therefore, efficient water management plays an important role in the irrigated agricultural cropping systems. The very small amount of water is useful for all living organisms and it's the human being who is mainly responsible for wastage of water. There are many source by which human makes the water hazardous for other living organisms plus there are many ways by which human being is responsible for wastage of water. One major reason is that an unnecessary wastage of water in agriculture field due to unawareness of farmers about sufficient supply of the water. There are so many plants that are very sensitive to water levels and they required level of water supply for proper growth. If water level is not maintained then the plants die or results in improper growth. It's hardly possible that every farmer must possess the perfect knowledge about

growing specifications of plants in case of water supply. This system will help to provide precise level of water to plants. Automated Irrigation System by Using ARM Processor is an artificial application of water to the soil. An irrigation system is a system that delivers water to an area where water is needed but not normally present in the required amounts. It is used for agriculture and landscaping purposes. The effectiveness of the irrigation is determined by a number of different factors, including the type of irrigation system and the conditions at its time of use. Additionally, irrigation also has other uses in crop production, which include protecting plants against frost, suppressing weed growing in grain fields and helping in preventing soil consideration.

1.2 Brief history

Drip irrigation has been used since ancient times. Fan Sheng-Chih Shu, written in China during the first century BCE, describes the use of buried, unglazed clay pots filled with water as a means of irrigation. Modern drip irrigation began its development in Germany in 1860 when researchers began experimenting with subsurface irrigation using clay pipe to create combination irrigation and drainage systems. Research was later expanded in the 1920s to include the application of perforated pipe systems. The usage of plastic to hold and distribute water in drip irrigation was later developed in Australia by Hannis Thill. Usage of a plastic emitter in drip irrigation was developed in Israel by Simcha Blass and his son Yeshayahu.

1.3 Objective

The objective is to design such a system which will

a) Conserve energy, water resources and man power in agricultural sector.

b) Handle the system automatically as well as manually.

c) Detect different parameter of soil like moisture, temperature, humidity, pH and nitrogen.

d) Build a system which enhances crop productivity.

e) To design, build and test the system which will be economical, efficient and effort reducing of the farmer.

1.4 Literature survey

There are various researches regarding the irrigation system which are helpful to support the concept of automated irrigation system. Some of the references taken from Automated Irrigation System By Using ARM Processor IEEE journal and other international journals helps to explain the possible implementation of our concepts. A wireless sensor network for low cost wireless controlled irrigation solution and real time monitoring of water content of soil based on soil moisture sensors. Data acquisition is performed by using solar powered wireless acquisition stations for the purpose of control of valves for irrigation. The designed system has 3 units namely: base station unit (BSU), valve unit (VU) and sensor unit (SU). The system is energy efficient [1]. Automated irrigation system based on microcontroller and wireless communication by using zigbee protocol and GPRS protocol. Photovoltaic powered system consists of wireless network of soil moisture and temperature sensors. The system can be adjusted according to crops needs and requires less maintenance. Because of energy autonomy and low cost the system can be used for organic crops, which are

mainly located in geographical isolated area where energy grid are far away. The system was feasible and cost effective for optimizing water resources for agricultural production [2]. The variable rate irrigation, a wireless sensor network, and software for real time in-field sensing and control of a site-specific precision linear-move irrigation system. The network consisted of five sensing stations and a weather station. Each of the sensing stations contained a data logger with two soil water reflectometers, a soil temperature sensor, and Bluetooth communication. Using the network information and the irrigation machine positions through a differential GPS, the software controlled the sprinkler with application of the appropriate amount of water [3]. A wireless solution for intelligent field irrigation system dedicated to Jew's-ear planting in Lishui, Zhejiang, China, based on ZigBee technology is proposed in this paper. The system consists of portable controller, a wireless sensor node, a weather station and various wireless actuators. The wireless design made the system installation and maintenance easy. The system helps farmer to maximize their productivity while saving labor force [4]. An innovative GSM/Bluetooth based remote controlled embedded system for irrigation. The system sets the irrigation time depending on the temperature and humidity Automated Irrigation System by Using ARM Processor reading from sensors and type of crop and can automatically irrigate the field when unattended. Information is exchanged between far end and designed system via SMS on GSM network. A Bluetooth module is also interfaced with the main microcontroller chip which eliminates the SMS charges when user is within limited range [5]. Automation in irrigation system for social welfare of Indian agricultural system helps to provide adequate irrigation in particular area. The setup uses GSM technology. The system helps to provide the exact field condition. The system helps to provide faithful irrigation and also inform users regarding field conditions through SMS [6].

II. BLOCK DIAGRAM &CIRCUIT DESCRIPTION

2.1 Methodology

Maintaining appropriate level of moisture in the soil is the main aim of the system. Plants are very sensitive to water level, water deficiency can be hazardous to the plants or excess water is also harmful to plants. Hence the system is designed such that it will help to maintain appropriate moisture level according to the plant requirement. The system senses the soil moisture, atmosphere humidity and temperature and depending on the sensed data the system will take the corrective action whether to start or stop the valve of the drip irrigation system. The valves are controlled by using relay and the relay is drive by using ULN 2003.

The system also detects the nitrogen present in the soil in gaseous form. A setup is built which helps to evolve the nitrogen from the soil and which is sensed by the sensor. Nitrogen is one of the important macronutrient which helps for plant growth. Hence it is necessary to monitor the nitrogen content of the soil. Depending on the nitrogen content present in the soil suggestions are given to the farmer whether it is according to requirement or not. The pH of the soil is also detected. It is also one of the important factors which affect the nutrient availability for plants. Hence pH of the soil is monitored. Depending on the pH value suggestions are given to the farmer whether is according to

the requirement or not. The system is interfaced with keypad. Keypad is used to set the threshold points depending where the system is installed. So that system can be used under any conditions. All the sensed data from the soil is send to LCD for displaying purpose. The data from controller is send to personal computer (PC) through serial communication using UART 0. The data fetched on PC can be used for analysis purpose and the database is also maintained. GSM module is used for wireless communication. The module is interfaced to UART 1. All the sensed data can be send to the user through SMS using GSM module. Thus the farmer can get the updates of the field conditions through SMS. Thus the system will help to monitor, control and communicate.
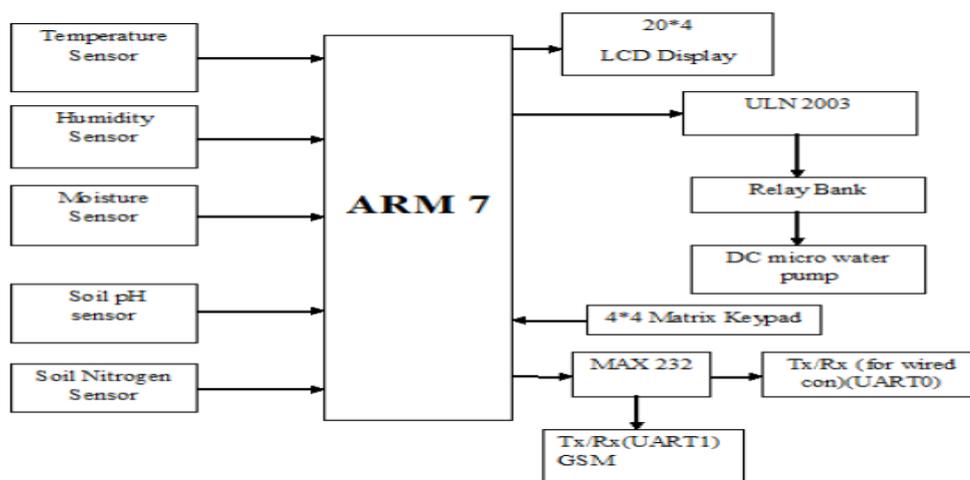

Figure 1. Block Diagram of Modern Irrigation System Used in Agriculture

The system consists of following parts.
1. Different sensors to detect parameters of soil like moisture, temperature, humidity, pH and nitrogen.
2. ARM7 Control module.
3. LCD display
4. Controlling section.
5. Communication section
6. Keypad

2.2 Sensors Used
Sensors are the device which converts physical parameter into the electrical signal. The system consists of five different sensors to detect different parameters of soil like temperature, humidity, moisture, soil pH and nitrogen in the soil. The sensors used in the system are explained below.

a) Temperature sensor:

Temperature sensor is used to detect the temperature of the surrounding. The LM35 has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling.

b) Humidity Sensor:

To measure humidity, amount of water molecules dissolved in the air of environment, a smart humidity sensor is used.

c) Soil Moisture Sensor:

Soil moisture is the amount of water present in the soil. Gaps between soil particles are called pore spaces or voids. These voids contain various amounts of either water or air. Soil moisture content can be expressed in different basis:

1. Gravimetric: the mass of water/mass of solid material

2. Volumetric: the volume of soil/total porosity.

d) Nitrogen Sensor:

Nitrogen is one of the important macronutrient in the soil. It provides overall grass shoot growth, strong leaf growth, dark green color.

e) pH sensor:

Soil pH is a measure of soil acidity or alkalinity. The pH scale extends from 0 (a very strong acid) to 14 (a very strong alkaline or base), but most soils will have a pH range of 4 to 8.5. Pure water is neither an acid nor a base and is considered neutral, right in the middle of the scale at 7.

III. RESULT

Table 1. Observation Table of Modern Irrigation System Used in Agriculture

Sr. No.	Temp	Nitrogen	Humidity	pH	Moisture
1.	28	30	63	2	100
2.	28	24	62	2	80
3.	28	21	63	2	80
4.	27	6	69	3	0
5.	28	9	69	3	0
6.	26	36	68	3	60
7.	27	12	69	3	80
8.	27	18	69	3	60
9.	26	15	69	3	0
10.	27	27	70	3	86
11.	27	33	69	3	86
12.	28	42	69	3	0
13.	27	45	69	3	0
14.	31	84	54	4	0
15.	31	93	54	4	0
16.	31	99	54	4	0

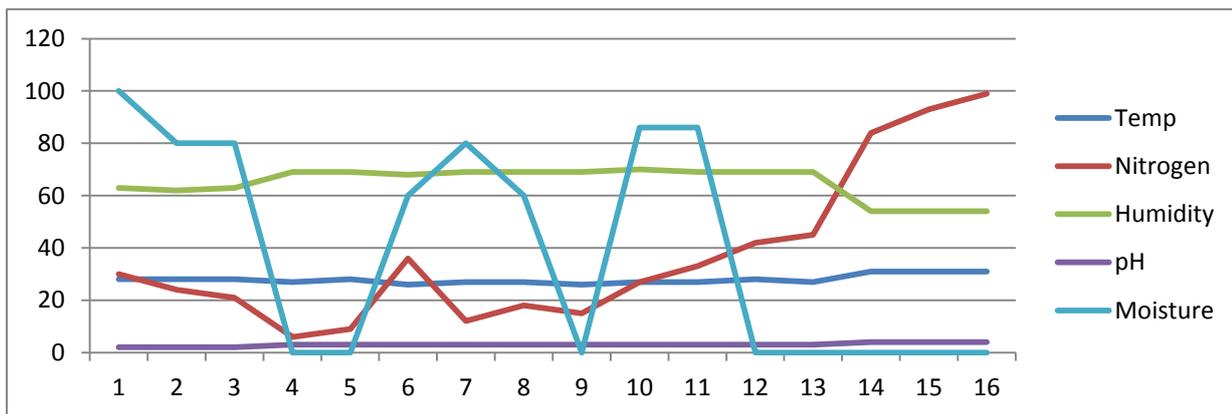Table 1 shows the observations noted while system is working.

Figure 2. Graphical representation of Modern Irrigation System Used in Agriculture

IV. CONCLUSION

The main objective is to design a fully automated drip irrigation system and control the parameter. The system provides a real time feedback control which monitors and controls all the activities of drip irrigation system efficiently by ARM processor. The system valves are turn ON or OFF automatically depending upon the moisture content. The system also provides the efficient information regarding the soil pH and soil nutrients like nitrogen along with the proper suggestions. The system also provides the communication interface. GSM interface helps to provide field conditions to farmer via SMS. The data collected by the system can be sending further for analysis purpose. Thus the system monitor, control and communicate. Using this system, person can save manpower, water to improve production and ultimately increase profit.

REFERENCES

[1] MahirDursun and SemihOzden, "A wireless application of drip Irrigation automation supported by soil moisture sensors", Scientific Research and Essays Vol. 6(7), pp. 1573-1582, 4 April, 2011.
[2] Joaquín Gutiérrez, Juan Francisco Villa-Medina, Alejandra Nieto-Garibay, and Miguel Ángel Porta-Gándara, "Automated irrigation system using a wireless sensor network and GPRS module", IEEE Transactions on Instrumentation and Measurement, VOL. 63, NO. 1, January 2014.
[3] 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, vol. 57, no. 7, July 2008.
[4] Yiming Zhou, Xianglong Yang, Liren Wang, Yibin Ying "A wireless design of lowcost irrigation system using zigbee technology", 2009 International Conference on Networks Security, Wireless Communications and Trusted Computing.
[5] Purnima, S.R.N. Reddy, "Design of Remote Monitoring and Control System with Automatic Irrigation System using GSM-Bluetooth", International Journal of Computer Applications (0975 – 888), Volume 47– No.12, June 2012.
[6] Mahesh M. Galgalikar ,"Real-time automization of agricultural environment for social modernization of Indian agricultural system", 978-1-4244-5586-7/10/$26.00 , M.I.T., MA, 1988.