Smart Irrigation System based on Renewable Energy

Shirsho Paul
Electrical Engineering
Guru Nanak Institute Of Technology,
Kolkata, India

Anindita Das
Electrical Engineering
Guru Nanak Institute Of Technology, Kolkata, India

Abstract- **An automated irrigation system was developed to optimize water use for agricultural crops. The system has a distributed wireless network of soil-moisture and temperature sensors placed in the root zone of the plants. In addition, a gateway unit handles sensor information; triggers actuators and transmits data to a web application. An algorithm was developed with threshold values of temperature and soil moisture that was programmed into a micro controller based gateway to control water quantity. The system was powered by photovoltaic panels and had a duplex communication link based on a cellular-Internet interface that allowed for data inspection and irrigation scheduling to be programmed through a web page. The automated system was tested in a sage crop field for 136 days and Water savings of up to 90% compared with traditional irrigation practices of the agricultural zone were achieved. Three replicas of the automated system have been used successfully in other places for 18 months. Because of its energy autonomy and low cost, the system has the potential to be useful in water limited geographically isolated areas.**

I. INTRODUCTION

Agriculture is the major backbone of India as it satisfies the need of food for the people. Though many agricultural lands are being destroyed, there are still many who are not willing to sacrifice agriculture as they provide basic requirement for the people. Agriculture is facing many problems as of today and many researches are being carried out in order to improve the agricultural practices. Some researchers have made a Zigbee module to control three sensors to give right amount of water to the plant which also incorporated by transfer of feedback to the user through the mobile app and some have used only a soil moisture sensor for automatic drip irrigation. Then a three level moisture sensor which detects moisture at three different depths and accordingly the water is allowed to the crop. The soil pH was also read using image processing. An attempt to detect water requirement by moisture sensor and used solar panel to pump the motors. Then later fuzzy logic was used which had three sensors (soil moisture, humidity and temperature sensors) and the solar panels are connecting to run the pumps. The automated irrigation is done by using fuzzy logic and the basic controller of all is Arduino as it controls the sensors and the solenoid valve. As per the survey taken, we came to know that the voltage from the solar panel is insufficient to power the pump and it is expensive to buy batteries to store power from solar panel. Thus, we use the solar panel to power the Arduino. The solar panel is an auto tracking system which is made by LDR (Light Dependent Resistor). The plants are grown in both tubs and separation is shown in order give a view on two different lands and the plants are grown using automated irrigation system in one and the normal irrigation on the other. The quality of crops and the amount of water used to grow are compared. The paper is about Renewable Energy based Irrigation System to avoid disadvantages and limitations of present irrigation systems where the main problem is disproportionate distribution of water to crops, hence consumption of excess electricity. This proposed System is designed to increase the efficiency of water and power by solar panels to make it eco-friendly. In addition, this can be implemented on large or small scales. Here, a distributed network of sensors is used to detect the moisture content of the soil. These sensors are connected to a control unit which is responsible for controlling as well as monitoring the whole irrigation process. Depending on weather conditions a decision based on fuzzy logic will be made regarding the need to irrigate the soil. Of late, trends in consumption of more electricity and water were witnessed. Irrigation systems developed in the past were either high budgetary or followed traditional, on-renewable sources of electricity. Moreover, irrigating farms requires high intervention of human, whereas in the proposed system human intervention is minimal. Aim is to develop a wireless three level controlled smart irrigation system to provide irrigation system which is automatic for the plants which help in saving water and money. The main objective is to apply the system for improvement of health of the soil and hence the plant via multiple sensors. Appropriate soil water level is a necessary prerequisite for optimum plant growth. Also, water being an essential element for life sustenance, there is the necessity to avoid its undue usage. Irrigation is a dominant consumer of water. This calls for the need to regulate water supply for irrigation purposes. Fields should neither be over-irrigated nor under-irrigated. The objective of this thesis is to design a simple, easy to install methodology to monitor and indicate the level of soil moisture that is continuously controlled in order to achieve maximum plant growth and simultaneously optimize the available irrigation resources on monitoring software Lab View and the sensor data can be seen on Internet. In order to replace expensive controllers in current available systems, the Arduino Uno will be used in this project as it is an affordable micro controller. The Arduino Uno can be programmed to analyze some signals from sensors such as moisture, temperature, and rain. A pump is used to pump the fertilizer and water into the irrigation system. The use of

easily available components reduces the manufacturing and maintenance costs. This makes the proposed system to be an economical, appropriate and a low maintenance solution for applications, especially in rural areas and for small scale agriculturists. This research work enhanced to help the small-scale cultivators and will be increase the yield of the crops then will increase government economy.

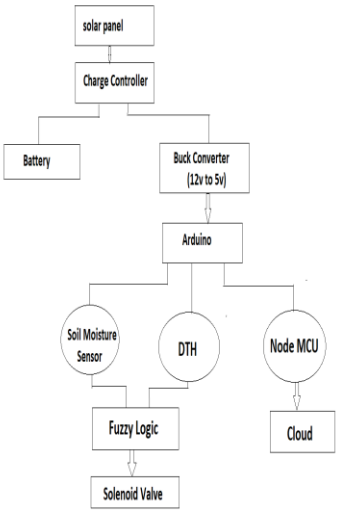
II. RELATED WORK

Joaquin Guitierrez proposed an irrigation system that uses photovoltaic solar panel to power system because electric power supply would be expensive. For consumption of water in an effective and optimal way, an algorithm was developed with threshold value of temperature and soil moisture programmed into a micro controller gateway. G.Parameswaran proposed a system that helps the farmers to irrigate the farmland in an efficient manner with automated irrigation system based on soil humidity. Humidity sensor is used to find the soil humidity and based on this micro controller drives the solenoid valve. Irrigation status is updated to the server or local host usingPersonal Computer. V.Akubattin designed a system to monitor and control the soil moisture and temperature inside a greenhouse. The system controlled by Raspberry Pi detects the soil moisture content and according to which it takes a decision watering the plant or switching the fans of green house.D.Zhang designed a system based on data transmission unit (DTU),wireless radio frequency (RF) module and micro controller, the application of RF module in the acquisition terminal improves the dependability , data of soil moisture are collected by relay station, and then transmitted to the monitoring center by the DTU using GPRS network. A. Kumar presents a smart system that uses soil moisture sensor to control water supply in water deficient areas. The sensor, which works on the principle of moisture dependent resistance change between two points in the soil, is fabricated using affordable materials and methods.

III. COMPARISON TABLE

System	Moisture Sensor	Temperature Sensor	LDR	Self-irrigation
GSM based Agriculture Monitoring and Controlling System	Yes	No	No	No
Plant Monitoring System	Yes	Yes	Yes	No
Plant Moisture Monitoring System	Yes	No	No	No
Agriculture Monitoring System	Yes	Yes	No	Yes (User must command)
Plant Communicator based on Arduino	Yes	Yes	Yes	Yes

IV. SYSTEM DESIGN



Operation modes- The smart irrigation system designed above is programmed to run under the following three modes.

1.Local control mode: In this mode, the user can control the water pumps manually via the Start/Stop switches presented on the controller. This mode has the highest priority and will halt the operation in any other mode (described below), so the user can manually control the water pump. Once the user has ended the manual control, the system resumes the operation in the mode it was in earlier.

2.Mobile monitoring and control mode: In this mode, the user can view the status of the sensors on the farm and make a decision to control the water pump remotely using a smart phone or a laptop over the Internet. This mode makes use of a web/mobile application stored on a server to send a control signal to the controller. Therefore, the user can monitor and control the water pump(s) over the Internet while she/he is on the move.

3.Fuzzy logic based control mode: In this mode, no manual input or monitoring by the user is required. The controller makes decisions to turn on/off water pumps based on sensor readings and a fuzzy-logic based control algorithm. Details related to this mode are described in the next section.

Results- Ada fruit IO header files contains many API s such as to connect to a dashboard. A dashboard can contain up to maximum of 8 feeds. We have three feeds namely Soil Moisture percentage, Room Temperature, Humidity percentage. Moreover,Ada fruit IO logs the values and server responses in the cloud so that even troubleshooting is made effective.

Discussion- By implementing the proposed system there are various benefits for the government and the farmers. For the government a solution for energy crisis is proposed. By using the automatic irrigation system it optimizes the usage of water by reducing wastage and reduce the human intervention for farmers.The excess energy produced using solar

R. Sathish Kumar etal 346 panels can also be given to the grid with small modifications in the system circuit, which can be a source of the revenue of the farmer, thus encouraging farming in India and same time giving a solution for energy crisis. Proposed system is easy to implement and environment friendly solution for irrigating fields. The system was found to be successful when implemented for bore holes as they pump over the whole day.Solar pumps also offer clean solutions with no danger of borehole contamination. The system requires minimal maintenance and attention as they are self starting. To further enhance the daily pumping rates tracking arrays can be implemented. This system demonstrates the feasibility and application of using solar PV to provide energy for the pumping requirements for sprinkler irrigation. Even though there is a high capital investment required for this system to be implemented, the overall benefits are high and in long run this system is economical.

REFERENCE-

[1] Garg, H.P. 1987. Advances in solar energy technology,Volume3.Reidel Publishing, Boston, MA.

[2] Halcrow, S.W. and Partners. 1981,Small-scale solar powered irrigation pumping systems: technical and economic review. UNDP Project GLO/78/004.Intermediate Technology Power, London, UK. A. Harmin et al., “Mathematical modeling of a box-type solar cooker employing an asymmetric compound parabolic concentrator,” Solar Energy, vol.86, pp. 1673–1682, 2012.

[3] K. K. Tse, M. T. Ho, H. S.-H. Chung, and S. Y.Hui, “A novel maximum power point tracker for PV panels using switching frequency modulation,” IEEE Trans. Power Electron., vol. 17, no. 6, pp. 980–989, Nov.2002.

[4] Haley, M, and M. D. Dukes. 2007. Evaluation of sensor-based residential irrigation water application. ASABE 2007 Annual International Meeting, Minneapolis, Minnesota, 2007. ASABE Paper No. 072251. [5]Prakash Persada, Nadine Sangsterb,Edward Cumberbatchc, AneilRamkhalawand and Aatma Maharajh, "Investigating the Feasibility of Solar Powered Irrigation for Food Crop Production.