Automated Irrigation –A Design Proposal

Er. Faruk Bin Poyen, Soumya Roy, Dr. Apurba Ghosh, Prof Rajib Bandyopadhyay
Dept. of Applied Electronics and Instrumentation Engineering
University Institute of Technology, Burdwan University
Burdwan, India
Department of Instrumentation and Electronics Engineering
Jadavpur University
Kolkata, India

Abstract: - Appropriate environmental conditions are necessary for optimum plant growth, improved crop yields and efficient use of water and other resources. Automating the data acquisition process of the soil conditions and various climatic parameters that govern plant growth allows information to be collected at high frequency with less labor requirements can have a far flanged. In the conventional irrigation system, the farmer has to keep watch on irrigation timetable, which is different for different crops. Here in this synopsis we try and present here a new approach towards farming, irrigation and cultivation. The proposed work should bring in agricultural automation trying to bring down to minimum of human interface and requirement and wastage of resources. The approach here undertaken (proposed) should take care of all (nearly all) parameters that influence irrigation and better crop yield. This approach will not only free the farmer (human resource) from keeping a vigil on cultivation but also will help stop wastage of natural resources and also could lead to much higher yield of productivity. The novelty does not lie with any kind of invention but only with applying the known facts and knowledge and utilizing them in appropriate places in optimum amount and bring out an outstanding thing from simple things.

Keywords: *- Automation, Irrigation, Sensors.*

I. INTRODUCTION

We live in a world where everything can be controlled and operated automatically, but there are still a few important sectors in our country where automation has not been adopted or not been put to a full-fledged use, perhaps because of several reasons one such reason is cost. One such field is that of agriculture. Agriculture has been one of the primary occupations of man since early civilizations and even today manual interventions in farming are inevitable. India has basically agrarian economy. The share of agriculture in India's Gross Domestic Products has declined to 20% now from 56% in 1950 with about 52% of the population still depending on the agriculture for their livelihood (FAO). In other words, about 150 million labor forces of total 270 million in India is engaged in agriculture, which includes both men and women. The population is expected to reach 1300 million in the year 2015 and over 1400 million in 2020. Thus, the biggest challenge before the agriculture sector of India is to meet the growing demand for food to feed her increasing population. Since independence, there has been more than fourfold increase in grain production of the country due to introduction of improved technologies package and practices. However, the population has increased at the same pace, so food and nutritional security to its burgeoning population still remains a challenge before the country. Irrigation water is one of the vital inputs to agricultural production system. Although, there has been a significant increase in irrigation level, more than 65 per cent area is still devoid of assured irrigation. The productivity of crops from rain fed areas is poor; hence efforts are on to bring more area under irrigation. The facts remain that quality water is a scarce commodity, it is imperative to make best use of available water and natural resources by developing and adopting suitable technologies of proper and efficient management. For this, it is important to have knowledge about irrigation water from its source to ultimate destination i.e. plant. India is India is a country with very diverse form of agriculture particularly due to varying soil, climate situations, etc. Country has highest rain fall location in Meghalaya at the same time, desert in Rajasthan with lowest annual rainfall. In current scenario, fresh water availability is creating a major concern across the globe looking towards the future generation for survival. India, which still happens to a predominantly agricultural based country, is feeling the heat as well. Presently, major proportion of the fresh water consumed by India, factually 70% of total annual water consumption(about 550 billion cubic meters) is spend for irrigation purpose as agricultural water, 90% of which is again spent only in watering the field. Every year India suffer a shortage of around 300 billion cubic meters of fresh water to water its fields arising to a situation of about 300 million hectares of drought stricken area further creating a shortage of about 150 billion kilograms of its potential yield eventually leading to starvation of millions and suicides of thousands. Due to the old irrigation techniques employed in India, the effective utilization ratio of irrigation water is only 40%, which is half of any other developing or developed country. In developed countries, the grain productivity rate is about 2 kilograms per cubic meter and that in India, it is only 0.87 kilograms per cubic meter. Only by increasing the water utilization rate by 10-15 %, about 40-50 billion kilograms of yield can be increased. Therefore, this sort of advanced irrigation methodologies is always welcome and high time needed at the present time, water resources getting exponentially reduced, water-saving methods have become the inevitable choice to assuage the water crisis. Catching up with the crop-water demand, water-saving routine in irrigation has to be the current issue of interest. Automating irrigation envisages monitoring and controlling of the climatic parameters which directly or indirectly govern the plant growth and hence their produce. Automation is process control of industrial machinery and processes, thereby replacing human operators.

1.1 Definition of Irrigation

"Irrigation may be defined as the process of artificially supplying water to soil for full-fledged nourishment of the crops." In other words, it is the science of artificial application of water to the land in accordance with the 'crop requirements' throughout the 'crop period'. Although water does play the most important role in the process of irrigation but there are many other factors as well which too are of enormous importance when irrigation and crop productivity to the best level are concerned.

Types of Irrigation:
i) Surface irrigation
ii) Localized irrigation

iii) Drip irrigation

iv) Sprinkler irrigation

1.2 Necessity of Modern Techniques of Irrigation:
Irrigation is one of the vital input of agricultural production system and in countries like India, it happens to the economic background as well. Better and higher yield of crops do solve a lot of problem like unemployment, economic growth, higher GDP. It can also influence the price rate of other commodities and stop a lot of death from hunger, starvation and malnutrition. Improved and scientific irrigation methodologies can control and stop a huge loss of very important and scarce natural resources and also can generate new items out of recycling process. Modern techniques can therefore be appropriately said to be the need of the hour.

The excess and unscientific use of cultivation may give rise to several ill effects like

i) Wasteful use of water

ii) Water logging

iii) Soil degradation

iv) Contamination of water and eventually farming land with harmful substances

v) Damp climate and ecological imbalance and many others.

II AUTOMATIC IRRIGATION SYSTEM - A PROPOSAL

Having an in depth study of the current agricultural scenario and drawbacks, short comings and other concerned issues, automatic irrigation techniques or a full fledges automatic irrigation system is of enormous importance in India's perspective will not only remove the current short comings but can also help in better and superior productivity of yield.

Relevance

i) Used in the field of agriculture as a new technology
ii) Used in conventional farming areas
iii) Used in place of traditional and unscientific irrigation methods

III PARAMETERS UNDER CONSIDERATION FOR AUTOMATION

In order to lead towards agricultural automation, firstly we need to point out the parameters to be handled

Few of them have been listed below:
1. Soil moisture level
2. Luminance required for effective cultivation
3. Humidity level
4. Temperature (ambient)
5. Soil alkalinity level
6. Automated watering methods
7. Automated ploughing methods
8. Automated pest control approach
9. Automated tilling
10. Automated mowing
11. Automated scouting
12. Automated harvesting

There can few other parameters which might have gone missing and can be later added in this automated approach

IV GROUND WORK

As a prerequisite, we need to have an in-depth knowledge about the specific requirements that a particular crop requires for optimum growth. For that, a lot of data sheets have be to studied in great depth for most fruitful operation. Considering the parameters under consideration, we have to pick up the most suitable sensors, which again is an indulging job at hand. At the laboratory end, algorithms are to be designed keeping in mind of the objective of the project at hand and check out by simulation techniques how much are they feasible for consideration.

The entire set up requires a lot of hardware involvement which by themselves are tough job to suffice the need. As bottom line to all mentioned above, a lot of home work has to be done before proceeding with the actual implementation.

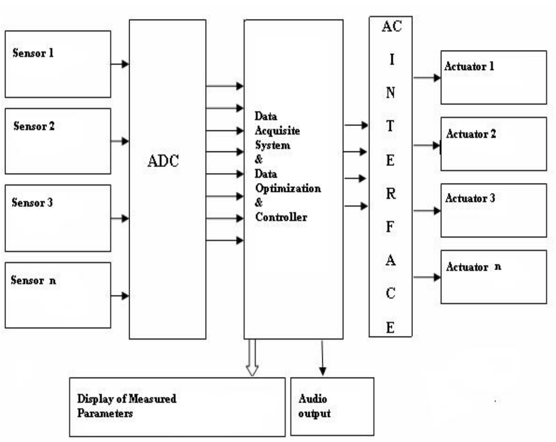

Fig1. Block Diagram of Model Design:

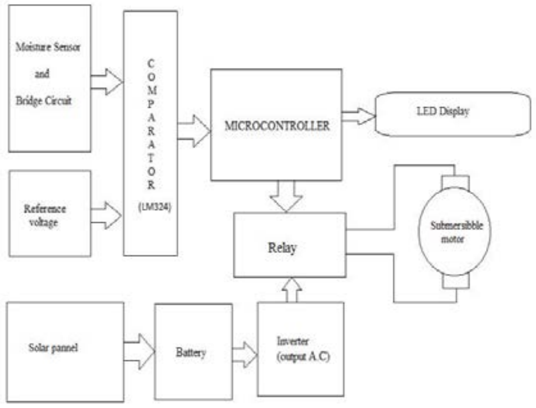

Fig2. Block Diagram Representation of entire Set-Up

Fig3. Snapshot of the soil moisture sensor

V CHALLENGES AND HURDLES

Although the approach towards this automated irrigation system looks simpler theoretically, but real hands-on scenarios are completely a different story altogether. First and one major problem is the choosing of right kind of sensor system to fulfil our demands and requirements. Compatibility among the different kinds of sensor system can also pose a challenge. At the actuator end, proper coupling among all the individual parts is a tough situation to handle. Also the end users need to be properly acquainted with the kind of technology or technique, we are talking about. Funding of the project as a real life implementation is a big concern. On top of all these apprehension, there lies unseen and unpredictable environment.

VI APPLICATIONS

1. The primary applications of this project are for farmers and gardeners who do not have enough time to water their crops/plants.
2. It also covers those farmers who are wasteful of water during irrigation.
3. The project can be extended to greenhouses where manual supervision is far and few in between.
4. The principle can be extended to create fully automated gardens and farmlands.
5. Combined with the principle of rain water harvesting, it could lead to huge water savings if applied in the right manner.
6. In agricultural lands with severe shortage of rainfall, this model can be successfully applied to achieve great results with most types of soil.

VII .SCOPE OF FURTHER IMPROVEMENTS AND POSSIBILITIES

1. The performance of the system can be further improved in terms of the operating speed, memory capacity, and instruction cycle period of the controller. The number of channels can be increased to interface more number of sensors which is possible by using advanced versions and even more effective controllers.

2. The system can be modified with the use of a data logger and a graphical LCD panel showing the measured sensor data over a period of time.

4. This system can be connected to communication devices such as modems, cellular phones or satellite terminal to enable the remote collection of recorded data or alarming of certain parameters.

5. The device can be made to perform better by providing the power supply with the help of battery source which can be rechargeable or non-rechargeable, to reduce the requirement of main AC power.

6. Time bound administration of fertilizers, insecticides and pesticides can be introduced.

7. A multi-controller system can be developed that will enable a master controller along with its slave controllers to automate multiple greenhouses simultaneously.

CONCLUSION

A step-by-step approach in designing the controller based system for measurement and control of sever al essential parameters for plant growth, i.e. temperature, humidity, soil moisture, light intensity and many more is under purview. The results obtained from the measurement after sensing of parametric values; needs to be reliable and accurate. The system has to overcome quite a few many shortcomings of the existing systems by adequately handling the complexity, at the same time providing a flexible and precise form of maintaining the environment. The continuously decreasing costs of hardware and software, the wider acceptance of electronic systems in agriculture, and an emerging agricultural control system industry in several areas of agricultural production, will result in reliable control systems that will address several aspects of quality and quantity of production. Further improvements will be made as less expensive and more reliable sensors are developed for use in agricultural production. The required technology and components are available, many such systems have been independently developed, or are at least tested at a prototype level. Also, integration of all these technologies is not a daunting task and can be successfully carried out.

REFERENCES

[1] G.Vellidis, M.Tucker,C.Perry, C.Kvien, C.Bednarz, A real-time wireless smart sensor array for scheduling irrigation, computers and electronics in agriculture 61(2008)44–50.

[2] R. M. Faye, F. Mora-Camino, S. Sawadogo, and A. Niang, 1998 IEEE. An Intelligent Decision Support System for Irrigation System Management

[3] Vories, E.D., Glover, R.E., Bryant, K.J., Tacker, P.L., 2003. Estimating the cost of delaying irrigation for mid-south cotton on clay soil. In: Proceedings of the 2003 Beltwide Cotton Conference National Cotton Council, Memphis, TN, USA, pp. 656–661.

[4] Bernard Cardenas-Lailhacar, Michael D. Dukes, Grady L. Miller, Sensor-Based Control of Irrigation in Bermudagrass.An ASAE Meeting Presentation Paper Number: 052180.

[5] Zazueta, F.S., A.G. Smajstrla and G.A. Clark, 1994. Irrigation system controllers. Institute of Food and Agriculture Science, University of Florida (AGE-32).

[6] Burman, R. and L.O. Pochop, 2004. Evaporation evapotranspiration and climatic data. Elsevier, Amsterdam.

[7] Or, D., 2005. Soil water sensors placement and interpretation for drip irrigation management in heterogeneous soils. In: Proceeding of 5th International Microirrigation Congress, pp: 214 222.

[8] Ioslovich, I., P. Gutman and I. Seginer, 2006. A nonlinear optimal greenhouse control problem with heating and ventilation. Optimal Control Applications and Methods, 17: 157-169.

[9] Bahat, M., G. Inbar, O. Yaniv and M. Schneider, 2000. A fuzzy irrigation controller system. Engineering Applications of Artificial Intelligence, 13: 137-145.

[10] P. Javadi Kia, A. Tabatabaee Far, M. Omid, R. Alimardani and L. Naderloo. Intelligent Control Based Fuzzy Logic for Automation of Greenhouse Irrigation System and Evaluation in Relation to Conventional Systems. World Applied Sciences Journal 6 (1): 16-23, 2009 ISSN 1818-4952.

[11] Hatfield, J. I. 1990. Methods of estimating evapotranspiration. In: Stewart, B. A., & Nielsen, D. R. (editors) Irrigation of Agricultural Crops: Agronomy 30. American Society of Agronomy. Madison.

[12] Richard, G.A., S.P. Luis, R. Dirk and S Martin, 2006. FAO Irrigation and Drainage Paper, No. 56: Crop Evapotranspiration.