Agriculture System for Maximum Yield Production Using Fuzzy Logic and IoT

[1]Mr. Sachin Elgandelwar, [2]Suraj Kakade, [3]Gaurav Punde, [4]Shivraj Saindre

Abstract: This paper gives a brief scenario regarding prediction methods to increase the crop yield. Many researchers suggested methods already exist for this purpose. In our proposed model, various parameters were analyzed to monitor overall performance of agriculture field to make a suitable crop decision which leads to increase yield. It is also taken into consideration for make model more reliable and affordable to every user. A combination of decision making and monitoring parameters is achieved with the help of various sensors and modules. We are producing more accurate observations with greater accuracy and minimum time lag. All readings are in approximation manner hence we use Fuzzy Logic Concept here. All Data can be analyzed by microcontroller and sent to the Smartphone via Wi-Fi module. IoT (Internet of Things) collects data from sensors and analyzed it and put it on the internet with the use of MQTT (Message Queue Telemetry Transport) protocol.

Keywords: Crop Yield, IoT, Fuzzy Logic, Microcontroller

I. INTRODUCTION

From rural perspective, The Indian economy is considered as agrarian economy. Huge region of level land, rich soils, climatic varieties and a long developing season are a portion of the prosperous situation that favors different sorts of harvest in India. It has the most elevated level of land under development on the planet. Regardless of this, the profitability of farming is still low. Reliance upon storm downpour and old development techniques are a portion of the key reasons in charge of the low efficiency of farming. Information sources like better nature of seeds, land arrangement, time of sowing, determination of bug, ailment and dietary issue are additionally not utilized by the majority of the agriculturists. Ranchers are not utilizing counterfeit methods for development strategies. Rancher need advance learning to take choice amid land readiness, sowing period, seed choice, seed the executives, compost the board, water system the executives, coordinated irritation the board, and so on for higher yield generation.

A development framework is progressively adaptable and gives the end client more decisions for cultivating strategies. This framework is being utilized in horticulture which helps the ranchers to settle on right choices. This framework has functioned as information distributor among agriculturists and gives an effective and objective arranged methodology for enhancing yield of harvest. This framework is most dominant since it teams up the viable qualities and prescribed qualities required for harvest and gives best reasonable yield to helping the agriculturist to settle on choice.

II. EXISTING WORK

The WSN (Wireless Sensor Network) is most powerful technique to monitor the various fields. It is used in agricultural field also to monitor the real time condition of the parameters and sent data over the wireless network with the help of protocol. It provides low cost solution but require intelligent nodes in wireless network to make data prediction reliable.

For prediction to maximize crop yield, suitable as well as reliable method is needed. As all sensors data is in approximate in nature, accuracy in data prediction is of major concern. Hence fuzzy logic concept comes in picture. Here approximated value is used to determine the accurate output with no delay in constraints. This method is implemented with the help of various software in different countries like Bangladesh, Indonesia etc.

In order to maximize the output, different combinations of inputs are taken into considerations with the help of Fuzzy Logic to maximize the crop yield and to give a costeffective solution. So, it is necessary to develop Fuzzy Logic Interface.

III. METHODOLOGY

In our proposed system following elements plays an important role. Here we use atmega 328P microcontroller along with serially connected Wi-Fi module. Also, various sensors are connected in parallel to the microcontroller. The monitoring of various parameters is done with the help of various sensors and data is monitored via smartphone as shown in the figure 1.

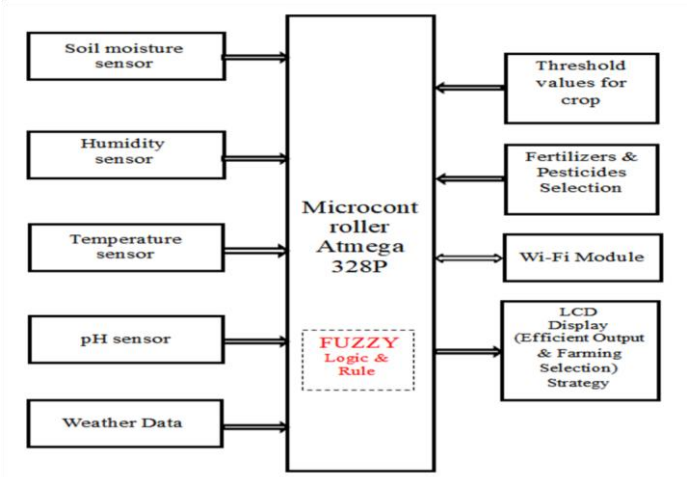

Figure 1. Block Diagram

3.1 Objectives

The objective of our proposed system is as follows:

- Monitor and Record the real time data of all sensors on Dashboard.
- To provides cost effective solution.
- Real time Analysis helps in accurate decision making of crop.

3.2 Hardware Explanation

The project consists of hardware and software part. In hardware part various components play an important role as explained as below:

3.2.1 Atmega 328P

We are using atmega 328P as a microcontroller as a decision-making device. It has 28 pin architecture having advanced RISC architecture with 16MHz crystal and it is 8-bit microcontroller. It has 3 ports consisting of 14 digital and 6 analog I/O pins. It is most used board of Arduino family as shown in the figure 2.

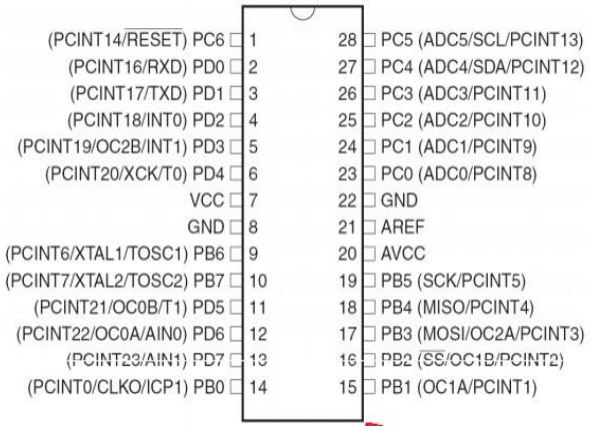

Figure 2. Pin Diagram of Atmega328P

3.2.1 Temperature Sensor

It is used for measure the temperature of surrounding. It gives output in approximate manner. It is interfaced with microcontroller via analog input. It is low cost sensor, hence most preferable, shown in fig 3.

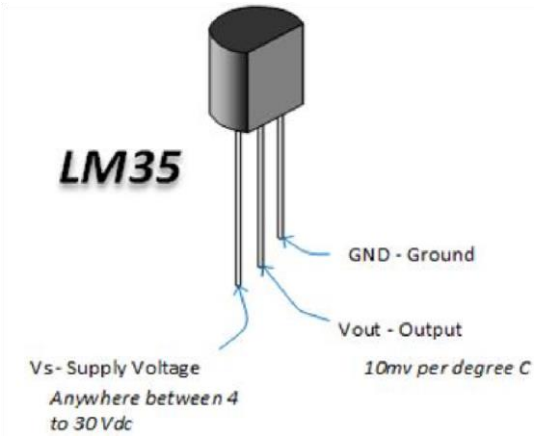

Figure 3. Temperature Sensor

3.2.2 Soil Moisture Sensor

This sensor comes with two copper probes immersed in soil. If sufficient moisture is present in soil, the current flows due to closed loop formation. The amount of current flow decides the moisture content present in the soil.

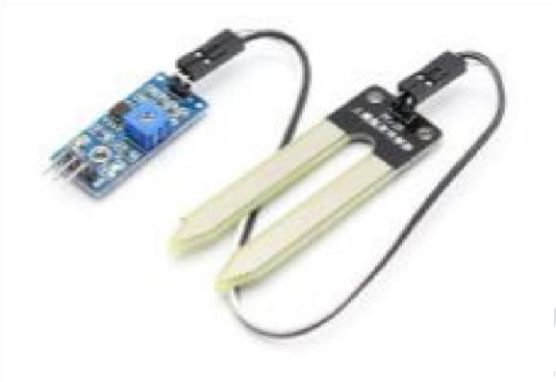

Figure 4. Soil Moisture Sensor

3.2.3 Humidity Sensor

It is used to sense the vapour concentration present in the air. The change in the content gives the approximate value.

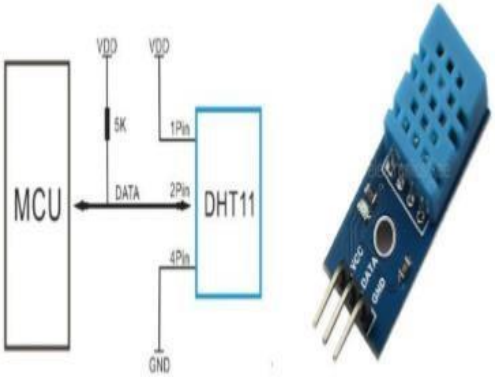

Figure 5. Humidity Sensor

3.2.4 pH Sensor

It is used to measure the pH level of soil that is Hydrogen-ion activity with an accuracy $\pm$0.1pH(25^{0}C). It has LED which works as the power indicator, BNC connector and pH2.0 sensor interface.

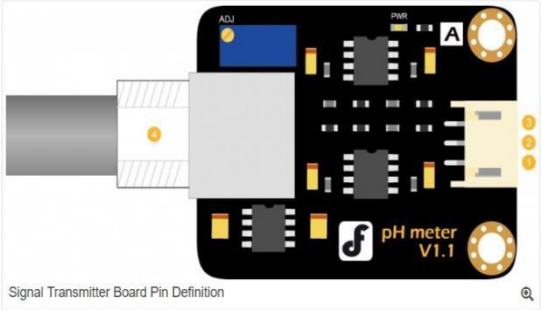

Figure 6. pH Sensor

3.2.5 ESP 8266 Wi-Fi module

The ESP 8266 Wi-Fi module is a low-cost component among all the modules ESP 8266 WiFi module is a system-on-a-chip with capabilities for 2.4GHz range and employs a 32-bit RISC CPU running at 80MHz. It is based on the TCP/IP (Transfer control protocol) It is the most important component in the system as it performs the IOT operation. It has 64 kb boot ROM, 64 kb instruction RAM, 96 kb data RAM.

Figure 7. ESP 8266 (Node MCU)

IV. FUZZY LOGIC

We use Fuzzy logic concept in our project. It is nothing but multi value logic in which truth values may be any number between 0 and 1[12][13]. Steps involved in process is as follows:

1. All outputs of sensors are first converted into fuzzy membership function with the help of technique known as Fuzzify.
2. Then execute all the rules to generate desired output.
3. Then gives the value to Wi-Fi module using Defuzzify principle.

We refer the various data for Fuzzy Logic Interface and it is stored within the controller to predict the desired output. Few data are as shown below:

Crop	Temperature in ^{0}C	Climate condition	Rainfall requirement
Rice **Wheat** **Maize**	21-36 for growth 20-25 for grain formation	Hot and humid	100-15mm
Bajra **Cotton** **Sugarcane**	20-25 for growth 14-16 for grain formation	Cold and Dry	60-90mm
Potato	21-23 for germination 30-32 for growth	Humid	50-80mm
	27-30 for growth	Warm	25-35mm

	16 for seed germination 21-27 for growth 27-32 for fruiting phase	Warm	50-70mm
	32-35	Tropical	250-300mm
	17-20	Cool	10-12mm

Table 1. Atmosphere Parameter Condition Requirement for Crop

V. ALGORITHM

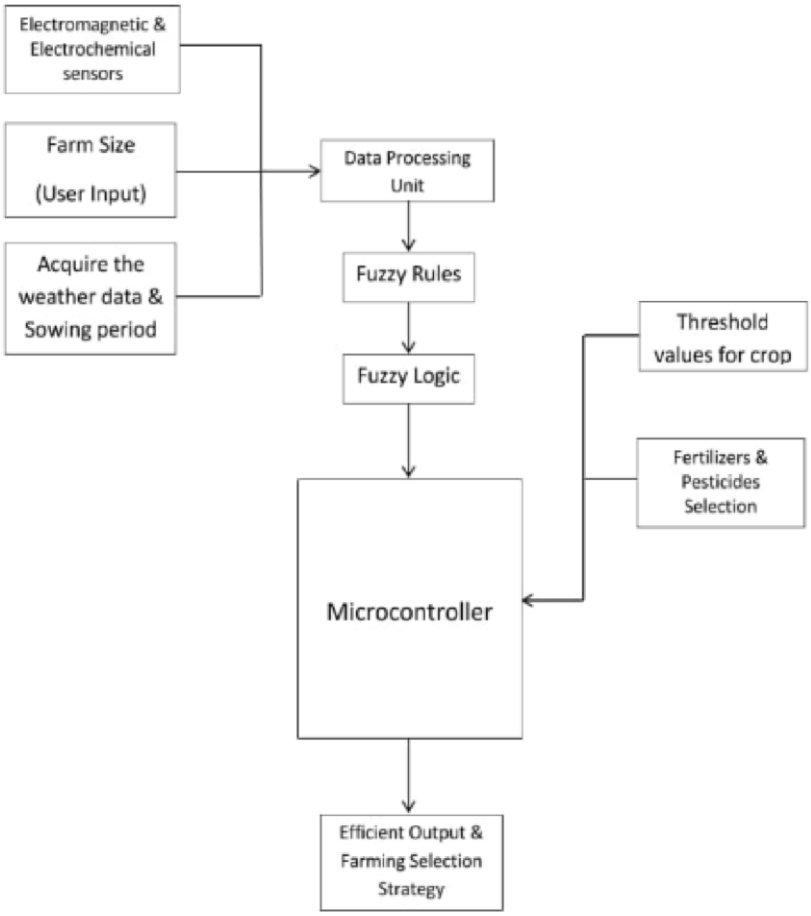

Figure 8. Algorithm

VI. RESULT – DASHBOARD SNAPSHOT

Figure 9. Smartphone Application Snapshot

VII. CONCLUSION

The main goal of the proposed work is to develop a new technique to remotely monitor various parameters and to define suitability of proper crop through a smartphone application, which is further can also used to record annual data with climate conditions.

References

[1] B. Balaji Bhanu, Mohammad Ali Hussain, Prasad Ande, "Monitoring of Soil Parameters for Effective Irrigation using Wireless Sensor Networks," 2014 Sixth International Conference on Advanced Computing (ICoAC).

[2] Mohammad Rafiuzzaman, Ibrahim Cil, " A Fuzzy Logic based Agricultural Decision Support System for Assessment of Crop Yield Potential using Shallow Ground Water Table," International Journal of Computer Applications (0975 – 8887) Volume 149 – No.9, September 2016.

[3] M A Jayaram, Netra Marad, "Fuzzy Interface System for crop yield prediction" Journal of Intelligent Systems 21(4):363 372 · January 2012.

[4] Blaz Bahar, "A Comparison of Different Types of Recommender Systems", EnggD Thesis, Faculty Computer and Information Science, University of Ljubljana, 2012.

[5] S.Helen abd F.M.H. Kaleel (2009),"Information Efficiency Of Agriculture Expert System",Indian Research J. Ext. Edu. 9(3)September ,2009 ,India.

[6] S.Saini Harvinder ,Kamal Raj and Sharma A.N.(2002),"Web Based Fuzzy Expert System for Integrated Pest Management in Soybean ",International journal of Information Technology(August 2002),Vol 8,No.1.

[7] Piotr Jankowski, "Integrating Geographical Information Systems and Multiple Criteria Decision Making Methods", International Journal of Geographic Information System, Vol. 21, No. 3, pp. 251-273, 1995.

[8] T.N. Prakash, "Land Suitability Analysis for Agricultural Crops: A Fuzzy MultiCriteria Decision Making Approach", Ph.D Dissertation, Department of Geoinformatics, International Institute for Geo Information Science and Earth Observation, 2003.

[9] India Water Portal, "Meteorological Datasets: Download Entire Datasets for various Meteorological Indicators from 1901 to 2002", Available at: http://www.indiawaterportal.org/metdata.

[10] Prasad, G.N.R. and Babu, A.V. "A study on various expert systems in agriculture". Georgian Electronic Scientific Journal: Computer Science and Telecommunications, 2006, 5(4), pp. 81-86.

[11] V.R. Thakare and H.M. Baradkar, "Fuzzy System for Maximum Yield from Crops", Proceedings of National Level Technical Conference, pp. 4-9, 2013.

[12] National Informatics Center,"District-wise, season-wise crop production statistics from 1998", Available at: Districtwise, season-wise crop production statistics from 1998, 2015. [13] Naoaki Okazaki, "Crfsuite: A Fast Implementation of Conditional Random Fields (CRFs)" Available at: http://www.chokkan.org/software/crfsuite/.