ISSN No. 0976-5697

Volume 7, No. 1, January-February 2016

International Journal of Advanced Research in Computer Science

RESEARCH PAPER

Available Online at www.ijarcs.info

Multidisciplinary Effective Prediction of Crop using IoT and WSN

S.Sangeetha
Assistant Professor,
Department of CSE,
Faculty of Engineering,
Avinashilingam University for Women,
Coimbatore, TamilNadu

G.Bhavani, Binu Ruby Sunny, Abirami.P, Divya.V
Student
Department of CSE,
Faculty of Engineering,
Avinashilingam University for Women,
Coimbatore, TamilNadu

Abstract: In the modern world, agriculture plays a vital role in Indian economy. Agriculture gets destroyed due to fewer numbers of workers in the crop field and animal intrusions which destroys crop in the field. So, Agricultural lands are becoming plots. The main objective is to improve the sustainable agriculture by enhancing the technology using wireless sensor technology. IoT establishes a connection between the sensed values from the sensor with the internet. WSN involves two levels of prediction such as climate and crop. Temperature, Humidity and pH sensors are used to obtain the characteristic data from the land. Based on temperature and humidity, climate is predicted using fuzzy rules. From the predicted climate and using pH value of the soil, the crop to be grown is predicted. The corresponding decisions sent to the respective land owner's. The sensors are co-ordinated using the GPS and are connected to the base station in an ad-hoc network using WLAN. Sensors are arranged in the form of master slave technique. The master systems can be connected through the WLAN so that the global crop disease warnings can be sent very easily. This system also reduces the time to be spent on the agricultural field and gives the correct suggestion at the right time, so that it helps to attain the high yield.

Keywords: WSN, Prediction, Fuzzy Rule-base, IoT

I. INTRODUCTION

Smart Agriculture is a multidisciplinary approach which focuses on increasing the productivity of crops and also increasing the resilience of farmers to climate change impacts. The Internet of Things (IoT) plays a major role in smart applications such as smart homes, smart agriculture, and smart mall. There are several issues in agriculture such as yield, water management, cost, knowledge. All these issues are addressed by IoT which increases crop production, reduces the cost and manages water effectively. IoT connects all the agricultural obects with the Internet. It connects the sensors cordinated by GPS with the Internet and also used to monitor the crop automatically [5,6]. WSN uses various sensors to measure the agricultural parameters and are cordinated using GPS. It consists of large number of micro sensor nodes which will be of small volume and low cost. The master slave technology is used for the sensory communication through the self organizing communication through the wireless network. The ontology based crop prediction understands and analyzes the knowledge of agriculture. It establishes a semantic network to predict the crop to be grown. Based on Ontology Classification using knowledgebase, the type of crop yielding best can be identified.

II. CLUSTER BASED MASTER SLAVE TECHNOLOGY

The agricultural lands at the different location can be coordinated using master slave technique[11]. Various sensors such as soil moisture sensor, pH sensor and humidity sensors are placed in the agricultural field to measure soil moisture, pH value of the soil and humidity of the soil respectively. One sensor node will act as a slave master and remaining sensor nodes will act as a slave node. The values from the sensors are measured continuously by the slave node. If slave node experiences any difference with the values stored in knowledge base, then it sends the obtained value to the slave master[10,12]**.**The slave master analyses the value with the threshold value and then communicates with the master through GSM technology. The functional flow of slave master is shown in Fig.1.

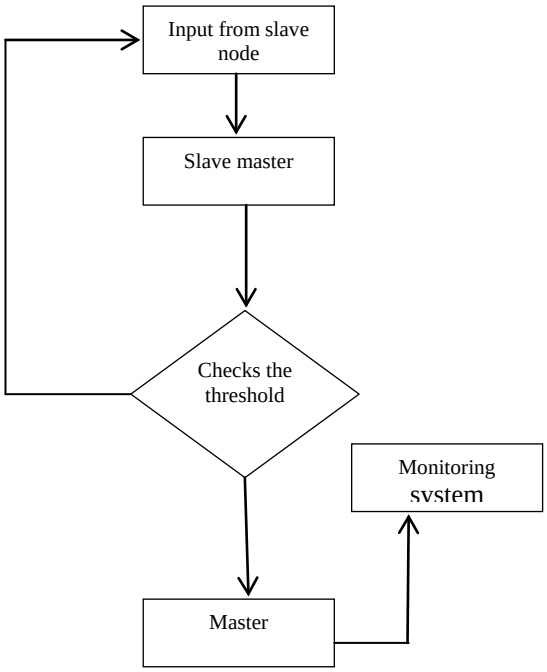

Fig. 1 Functional flow of Slave-Master

III. EFFECTIVE PREDICTION OF CROP

This system works based on wireless sensor networks (WSN) and fuzzy logic and is developed to predict crops from the sensor inputs. A kit is developed to get the data from sensors and the controller converts the raw data into data packets and sends the information to the user as Short Message Service (SMS) through GSM. The inputs are received through a WSN and are sent to a back end which database to store the data for further processing. The obtained data from the sensor is then given to the system as inputs. There are three inputs given that is temperature, humidity and pH values. Based on temperature and humidity, it initially predicts the climate using fuzzification process. Then it predicts the crop to be grown based on climate and pH value of the soil. This predicted crop is sent to the user. Fig.2 shows the function flow of prediction of crop.

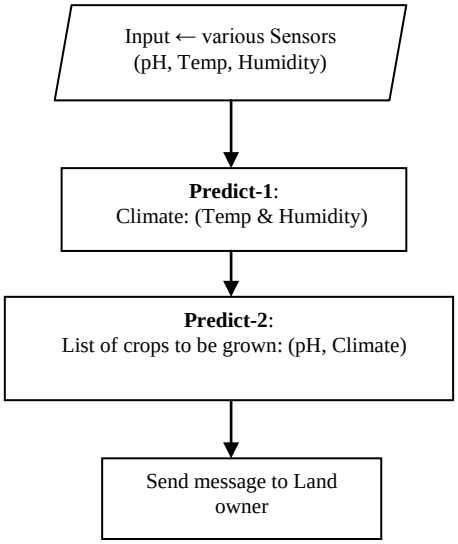

Fig.2 Functional flow of prediction of crop

IV. ONTOLOGY BASED CROP CULTIVATION

The Ontology classifies the crop cultivation based on knowledge base which is shown in Fig.3. It consists of 3 attributes such as Soil, Climate, and life span. Climate is classified into temperature and humidity. Humidity sensors are used to measure the amount of water vapor in air.

Table I. Soil Related variables

Attribute	Types	Crops to be grown
Soil	Alluvial Soil	Rice, Wheat, Sugarcane, Cotton, Jute
	Black Soil	Rice, Wheat, Sugarcane, Cotton, Groundnut, Millet
	Red Soil	
	Laterite Soil	Tropical crops, Cashew, Rubber, Coconut, Tea, Coffee
	Mountain Soil	Tea, Coffee, Spices, Tropical Fruits
	Dessert Soil	Barley, Millet

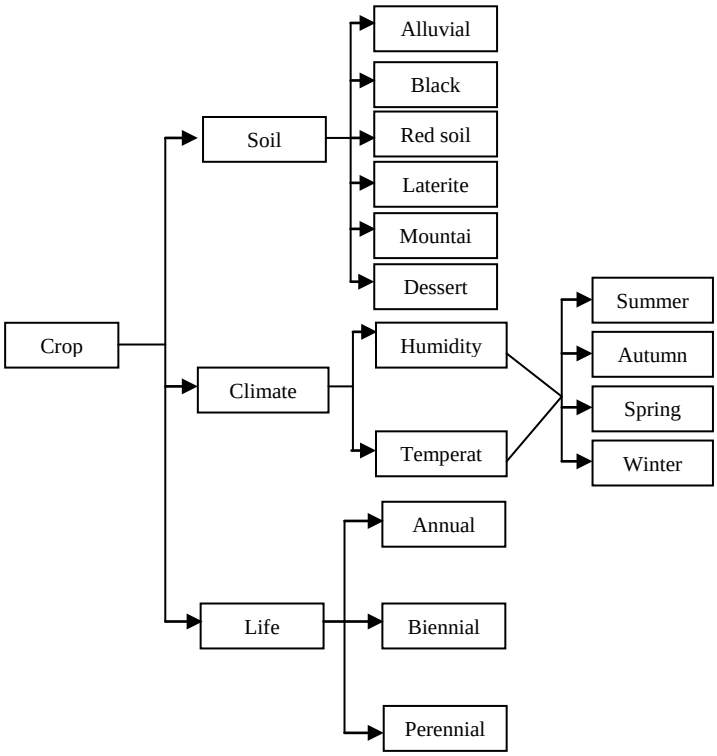

Fig.3 Ontology Knowledge base

Temperature sensors are used to sense the temperature level of air from radiation and moisture. pH sensors measures the pH value and is used to analyze the acid level of the soil, by which the fertilizer usage can be reduced. Based on this pH value of the soil, the crop to be grown can be identified. The attribute & its related variables of crop using Agriculture ontology are represented [13] in table 1 & 2. Based on this Classification using knowledgebase, the type of crop yielding best can be identified.

Table II.Climate Related variables

Attribute	Types	Relative temperature	Relative Humidity	Crops to be grown
Climate	Summer	Very hot ($32°C - 40°C$)	Very High to moderate	Millets, Paddy, Maize, Groundnut, Red Chillies, Cotton, , Sugarcane, Turmeric
	Autumn	Warm days ($< 30°C$) Cool Nights ($21°C - 29°C$)	Low	Maize, Oats
	Spring	Warm days ($> 30°C$) Cool Nights $25°C - 29°C$	Low to Moderate	Wheat, Barley, Mustard, Peas
	Winter	Cold ($10°C - 15°C$)	High	Oats

V. FUZZY RULE FORMATION

WSN stands for Wireless Sensors Networks. Wireless sensor networks are a collection of small sensors. Each node consists of processing capability. It consists of one or more microcontrollers, CPUs or DSP chips may contain multiple types of memory.

Types of sensors used:

- Temperature sensor
- Humidity sensor
- pH sensor

Temperature sensors are used to sense the temperature level of air from radiation and moisture. It measure the amount heat energy or even coldness that is generated by an object or system, allowing us to "sense" or detect any physical change to that temperature producing either an analogue or digital output.

The amount of water vapor in the air is measured by Humidity sensor. The pH value of the crop is measured by pH sensor and is used to analyze the acid level of the soil. If the pH value>7.0 it is alkaline in nature and if pH<7.0 it is acidic in nature. The pH level of soils, substrates or media strongly influences crop performance. Table 3 &4 shows the climate related variables and fuzzy rules respectively.

Table III. Climate Related variables

t / h	High	Moderate	Low
High	Summer	Spring	Rainy
Moderate	Summer	Spring	Winter
Low	Autumn	Autumn	Autumn

Table IV. Sample rules for predicting the climate

Rule 1:	If (t==Low) AND (h==*Moderate*) THEN (Season==Winter);
Rule 2:	If (t==Moderate) AND (h==*Moderate*) THEN (Season==Spring);
Rule 3:	If (t==Moderate) AND (h==*Low*) THEN (Season==Winter);

Si = {A, B, C, D, E, F}
X = {Ai, Bi, Ci, Di, Ei, Fi}

Where A, B, C, D, E, F - Alluvial Soil, Black Soil, Red Soil, Dessert Soil, Laterite Soil, Mountain Soil respectively.

X - Set of crops and Ai, Bi, Ci, Di, Ei, Fi - set of crop to be grown in respective soils.

Climate is predicted based on temperature and humidity using fuzzy rules and is represented as $f_1(x)$. Sample rules are given in the table.2

$$f_1(x) = f(t,h)$$

Where t-temperature and h-humidity

x - crop to be grown and $x \subseteq X$.

$$f_2(x) = f(f_1(x), pH)$$

Where pH - pH value of soil

The following fuzzy rule gives the effective list of crops to be grown.

$f_1(x)$ =Summer AND pH>7.0 then $f_1(x) \cap \text{pH}_i$

VI. CROP MONITORING SYSTEM

Due to scarcity of workers, automatic monitoring system has been established to measure temperature, humidity, pH at different time and from different locations by deploying various sensors. The measured value will be converted to Digital signal using Analog to Digital Converter (ADC). Micro Electro Magnetic System which acts as a processing Unit transmits the data to Wireless Sensor Network. The sensors are co-ordinated using the GPS and they are connected to the base station in an ad-hoc network using WLAN. These values are compared with the pre-defined data set in the Knowledge Base where historical data's are stored in ontology knowledgebase. The corresponding decisions from the Knowledge Base are sent to the respective land owner's mobile through SMS using radio frequency periodically. If rainfall comes, land owners no need to irrigate the land because humidity gets changed. So, water can be saved which in turn consumes power. Also if the temperature or humidity or pH goes beyond the threshold level, then it generates alert to the corresponding land owners.

VII. EXPERIMENTAL ANALYSIS

A. *pH Value Analysis*

Based on the pH value and climate condition, the the crop to be cultivated can be identified and analysed by comparing the obtained values from the sensor with knowledge base. It is sent to the farmer in the form of short messaging service[9]. The maximum and minimum pH value of various soil such as alluvial, black, desert, mountain, red and laterite soil is shown in Fig.3. Graph shows that pH value ranges from 1 to 14. Based on this, type of crop to be grown in each soil is identified and stored in knowledge base[8].

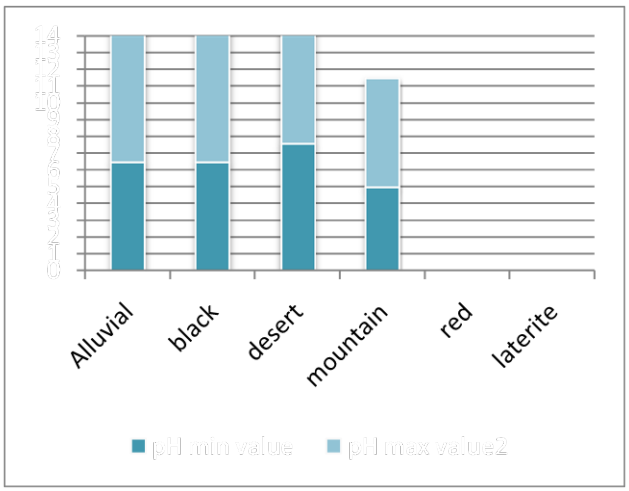

Fig. 3 pH value analysis

B. E nergy Consumption in Master Slave Technology

Energy consumed by normal system and master slave system is measured and plotted as a graph which is shown in Fig.4. In the normal systems, each sensor nodes are connected to the system and all the nodes are active at all time to generate alert during the changes occur in any one of the nodes. So the power consumed by the normal system is high.

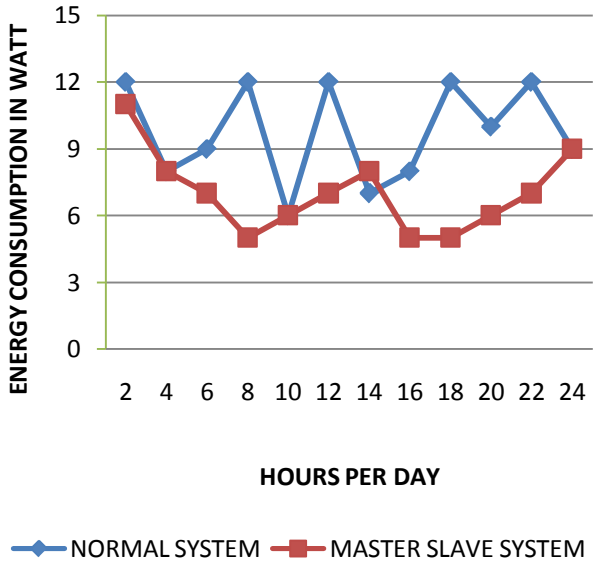

Fig.4 Energy Consumption

Hence, the master slave technology is used to overcome these problems by reducing the energy consumption. In master slave system,only the changes occurring sensor node will be active at a time rest of the nodes will be passive with the previous data until the changes occurs. Thus, Figure.4 shows the use of electricity reduced moderately in master and slave technology.

VIII. CONCLUSION

The proposed system in this paper is designed for prediction of crop using pH of the soil, temperature and humidity. The WSN in agriculture is an emerging technology for farmers to know the best crop for soil. It provides precision agriculture using wireless sensor nodes. Base station act as central server to pass information collected from the sensor. Using GSM network message is send to the farmers mobile. This leads to improve production of crop. Fuzzification process gives accurate prediction. Automatic crop monitoring system has been established to avoid paucity of workers. The master slave technology is used which reduces the energy consumption.

REFERENCES

[1] Nirosha S, Prof.R.Srinivasan**,** **"**Application of Soft Computing Algorithm for the Festination of Horticulture Crops**",** International Journal of Innovative Research in Computer and Communication Engineering (2015) vol.3, issue.2, pp. 854-858.

[2] Lutful Karim, Alagan Anpalagan, "Sensor-based M2M Agriculture Monitoring Systems for Developing Countries: State and Challenges", Global Journal of Computer Science and Technology Network, Web & Security (2013), Vol.13, Issue 7.

[3] By Anjum Awasthi & S.R.N Reddy, "Monitoring for Precision Agriculture using Wireless SensorNetwork-A Review", Global Journal of Computer Science and Technology Network, Web & Security (2013), Vol.13, Issue 7.

[4] H. Navarro-Hellín , R. Torres-Sánchez, F. Soto-Valles, C. Albaladejo-Pérez, J.A. López-Riquelme, R. Domingo-Miguel, "A wireless sensors architecture for efficient irrigation water management ", Agricultural Water Management, Volume 151, 31 March 2015, Pages 64–74.

[5] K. Sriharsha, T.V. Janardhana Rao, A.Pravin, K. Rajasekhar, Monitoring The Paddy Crop Field Using Zigbee Network, International Journal of Computer and Electronics Research Volume 1, Issue 4, December 2012.

[6] Manijeh Keshtgari, Amene Deljoo, A Wireless Sensor Network Solution for Precision Agriculture Based on ZigBee Technology, Scientific Research Journal on Wireless Sensor Network, 2012, 4, 25-30.

[7] Maria Rossana C. de Leona, Eugene Rex L. Jalaob A Prediction Model Framework for Crop Yield Prediction, Asia Pacific Industrial Engineering and Management System, 2013.

[8] Gelian Song, Maohua Wang, Xiao Ying, Rui Yang, Binyun Zhang "Study on precision agriculture knowledge presentation with ontology", Elsevier, 2012, vol.3, pp, 732 - 738.

[9] Liisa A. Pesonen, Frederick K.-W. Teye, Ari K. Ronkainen, Markku O. Koistinen, Jere J. Kaivosoja, Pasi F. Suomi, Raimo O. Linkolehto , "Cropinfra e An Internet-based service infrastructure to support crop production in future", Elsevier, 2014, vol. 120, pp. 92 – 102.

[10] ManijehKeshtgari, AmeneDeljoo "A Wireless Sensor Network Solution for Precision Agriculture Based on ZigBee Technology", 2012, vol. 4, pp. 25 – 30.

[11] Marinus Maris and WinelisKavelaars, "Security Aspects of a Surveillance System using a Sensor Network", IJCER, 2011, pp. 164 - 168.

[12] Sherine M. Abd El-kader, Basma M. Mohammad El-Basioni "Precision farming solution in Egypt using the wireless sensor network technology", Egyptian Informatics Journal, 2013, vol. 14, pp. 221 – 233.

[13] S.Sangeetha, B.Gayathri devi, Dharani, Sathya, „Prediction of Crop and Intrusions using WSN" in Internal Conference on Advanced Computing, Networking, and Informatics,pp.109-115, Vol.44 of the series Smart Innovation, Systems and Technologies.