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IoT & WSN based Smart Precision Agriculture

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ABSTRACT

Now a days, agriculture plays a vital role in Indian economy. Agriculture gets destroyed due to fewer numbers of workers and animal intrusions 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. Wireless sensor networks and IoT plays a major role in Smart agriculture. IoT attach the sensed values 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.

Keywords: WSN, Prediction, Fuzzy Rule-base, IoT, Internet of Things

1. 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

objects with the Internet. It connects the sensors coordinated 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 coordinated using GPS.

2. LITERATURE SURVEY

Nirosa S et al proposed to reduce the soil pollution and used to identify the amount of fertilizer needed for crop production using soft computing algorithm. Fuzzy rules are used to find the correct quantity of fertilizers like (NPK), Nitrogen (N), Phosphorous (P) and Potassium (K) in the agriculture field to improve the productivity of crops. Various levels of NPK values are found during soil test, which is done using Fuzzy Based Expert System. By applying sufficient amount of fertilizer to the soil helps the farmers yield maximum amount of crop production. This also reduces the fertilizer cost. The methods used in the wireless sensor technology with Fuzzy System are useful for the farmers, especially with the production.

Luftul Karim et al proposed [2] Machine to Machine communication. It consists of low cost, low energy, low computational power and memory sensor nodes. M2M communication plays a major role for agricultural monitoring and irrigation by using sensors. It is a sensor-based agriculture monitoring system and it requires less man-power. Machine type communication (MTC) device is used to send the packet of data. Wireless sensor nodes are used as MTC device in M2M network. Water required for irrigation varies from crop to crop so irrigation should be varied accordingly. This problem can be overcome by using technology based agricultural monitoring system. It helps to maintain the soil nutrients and maximize the productivity of crops. Anjum Awasthi et al proposed [3] sugarcane crop cultivation using Wireless sensor network. Wireless sensor network is the collection of nodes. Each node has their own processing capability. Zig-bee wireless sensor communication is used for system automation and monitoring. Data's are collected and send to Base station. It save the data, store and displayed. Data is collection of temperature, soil moisture and humidity level. If the data exceed the particular limit the message is send to the farmer through GSM. It improves the quality of crop production. Precision agriculture is possible by using WSN. It consume less cost and reliable nodes.

Navarro-Hellina et al proposed [4] Water is the major resource needed for agriculture. Irrigated agriculture by using sensor. Using certain technique for developing crop production. It allow user to analyze information by sensor using devices (mobile, laptop) .It is based on wireless node with GPRS. Wireless node work autonomous .sensor is used to measure the range of soil, plant, atmosphere. The information from the sensor is stored in database .This is technical based irrigation for improve the quality of productivity. It increases the irrigation management strategies such as Regulated Deficit Irrigation (RDI) or Partial Root Drying (PRD).Sensor helps to reach the moisture condition and water needed for irrigation. GPRS is very essential to find out the power of the device.

3. ENHANCING CROP PREDICTION

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.1 shows the function flow of prediction of crop.

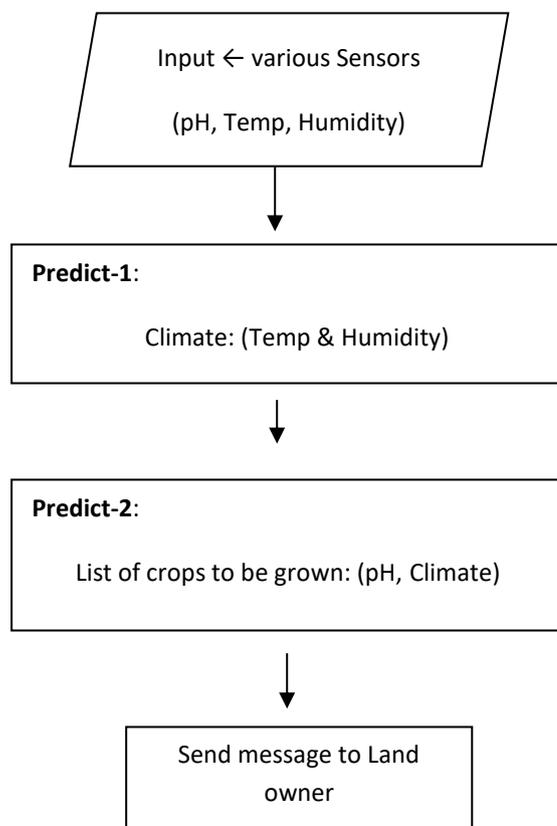


Fig. 1. Functional flow of prediction of crop

4. SYSTEM ARCHITECTURE

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 1 & 2 shows the climate related variables and fuzzy rules respectively.

Table 1. Climate Related variables

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

Table 2. Sample rules for predicting the climate

<i>Rule 1:</i>	If (t == Low) AND (h == Moderate) THEN (Season == Winter);
<i>Rule 2:</i>	If (t == Moderate) AND (h == Moderate) THEN (Season == Spring);
<i>Rule 3:</i>	If (t == Moderate) AND (h == Low) THEN (Season == Winter);

5. GSM (GLOBAL SYSTEM MOBILE COMMUNICATION)

GSM is a cellular network, which means that cell phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in a number of different carrier frequency ranges, with most 2G GSM networks operating in the 900 MHz or 1800MHz bands. Regardless of the frequency selected by an operator, it is divided into timeslots for individual phones [7].

One of the key features of GSM is the Subscriber Identity Module, commonly known as a SIMcard. The SIM is a detachable smart card containing the user’s subscription information and phone book. GSM was intended to be a secure wireless system .It has considered the user authentication using a pre-shared key and challenge-response and over the air encryption.

However, GSM is vulnerable to different types of attack, each of them aimed at a different part of the network. GSM uses several cryptographic algorithms for security [8].

GSM uses General Packet Radio Service (GPRS) for data transmission like browsing the web. GSM is an Open Source Software.

5. 1. Sensor Controller

Sensor controller is used to collect the raw data from sensors. This data's are put into a buffer based on sensor id and the respective data. This raw data is then converted into data packets along with its metrics that is the raw data converted into information and it is then sent to the user as SMS (Short Message Service) using GSM.

5. 2. User interface

The user interface in the industrial design field of human-machine interaction is the space where interaction between humans and machines occur. The goal of this interaction is to allow effective operation and control of the machine from the human end. The user interface design is to produce a user interface which makes it easy, efficient and user friendly to operate a machine in the way which produces the desired output. The user interface in this system is the user's mobile phone to which the information is sent as the message and this mobile phone is used to monitor the sensors and processes as well.

6. 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.

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