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A Survey on Using Fussy System for Smart Agriculture Monitoring.

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Abstract— *Many farmer uses traditional farming technique which is labour consuming and farmer also have to monitor condition of farm, crop time to time. So, by realizing this Iot has introduced smart agriculture using fuzzy logic. IOT technology is used in collecting information like weather, moisture, temperature and fertility of soil, online crop monitoring from any were at any time by using sensor, software and other technologies. To control a pump's switching time according to user-defined variables, it uses fuzzy logic; this concept provides many values between the true and false and gives flexibility to find the best solution to the problem whereby sensors are the main aspect of and contributor to the system.*
Key words: *Fuzzy logic, Internet of Things, sensors, monitoring system.*

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I. INTRODUCTION

Food is a basic need of human being, and this food is cultivated in farms by farmer. Along with the growth of the population, the availability of food becomes a necessity that must always be fulfilled by the agricultural sector. Smart agriculture is a new technique which can help farmer to reduce their efforts. The concept of smart agriculture is future of farming. The term smart agriculture refers to the usage of technology like IOT (internet of things), sensors, Networking, location system on the farm through which farmer gets notifications about condition of farm. The main reason behind smart farming is to improve the quality and quantity of crops while reducing the human labor use.

Fuzzy word means the things which are not clear or are indefinite. In the real world, innumerable times we come across some situations which we can't handle properly because we are not able to determine whether the state is true or false, their fuzzy logic provides more flexibility for reasoning. In this way, we can get that how to deal with inaccuracies and uncertainties of any situation. In the Boolean system, we use truth value, which can be either absolute true which is represented by 1 or the absolute false value which is represented by 0. But in fuzzy logic, there is no any absolute truth value. Fuzzy logic uses value which intermediate value which represent which is partially true and partially false.

Fuzzy logic has two different types of inference system which are Mamdani inference system, Sugeno inference system. As mamdani inference has more intuitive and it is easier to understand rule bases, as well as provides reasonable results with a relatively simple structure. They are well-suited to expert system applications where the rules are created by using knowledge from human expert.

II. LITERATURE REVIEW

In [1] fuzzy irrigation decision making system is introduced.This system uses virtualinstrumentation platform of sensors, data loggers and lab view.The study in [2] gives information of optimized the supply of water to plants using fuzzy logic which increase the yield of crop. In [3] by utilizing fuzzy logic agricultural product estimation is done by taking into consideration three input parameters such as temperature, moisture, and humidity. In [4] considered various technologies, which are related to the IoT, to make agriculture smarter and more efficient. For this purpose, wireless sensors, UAVs, cloud-computing, and communication technologies were used. Researchers in [5] have developed a fuzzy system which controls the pH value, as well as nutrition, and temperature of plant at the farms whose result helps farmer to adjust the quantity of nutrient and proper pH with a specific interval of time. The study of paper [6] shows smart water management by using fuzzy system which create excellent set of decision maker which reduce manual contribution.

III. ARCHITECTURE OF MACHINICAL COMPONENT

For making the design of master controller shown in fig.1 they have used Solid Work design software is designed for fulfilling the need of end user. For better performance of master controller some necessary elements were required such as power system (power bank or solar panel), breadboard, DTH11sensor, capacitive soil moisture sensor and NodeMCU (Node Microcontroller Unit). Here microcontroller was enclosed in plastic casing with huge size to store all necessary components.

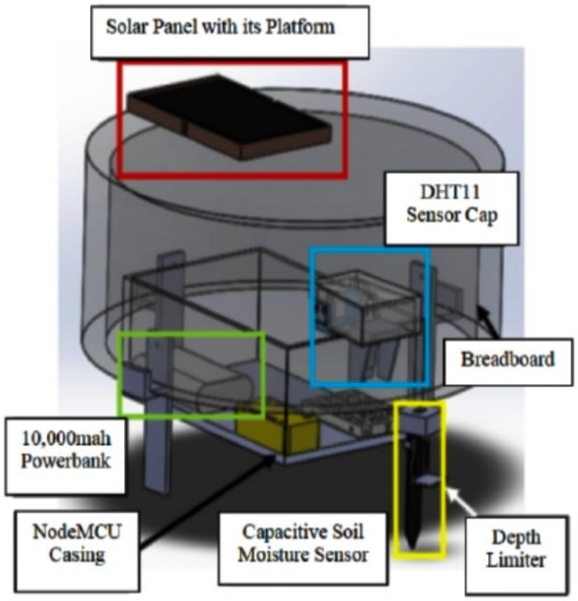

Figure1.solidwork design of master controller prototype

The solar panel is placed at the top of casing and it is fully exposed to sunlight so that it can can generate more power. The hole was made on each side of platform which allows wire to remain in casing and also it will not let the rainwater to accumulate inside the platform during rainy season. The capacitive soil moisture sensor was designed which include depth limiter which prevents moisture sensor from being inserted deep into the soil and short printed circuit board is placed on upper part of sensor. The DHT11 air temperature and humidity sensor was also protected by cap, which was designed by taking into consideration both elements that are exposure of sensor to environment and the need to obtain accurate reading NodeMCU casing was designed to fix the position of microcontroller in plastic casing to improve the functionality and appearance of prototype.

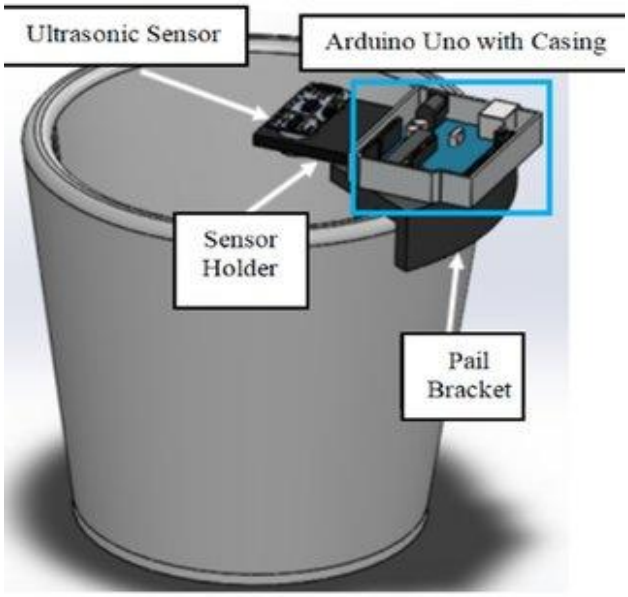

Figure 2. Solid work design of the water leveling system prototype

The water level system in fig.2 was used for measuring the water level of the tank at the farm of end user. The pail bracket was placed with pail and a sensor holder and Arduino Uno was placed at the top of that. The bottom part of Arduino Uno was covered by the casing to prevent the pins underneath from being directly exposed to the external environment which can cause short circuit. A sensor holder was used to ensure measurement of water level after specific interval of time. To prevent the master controller from extreme, condition a shelter was built from PVC basin with 3D printed stand which was placed above the master controller. The prototype of water leveling system was built to stimulate the water pump existing at chilli farm.

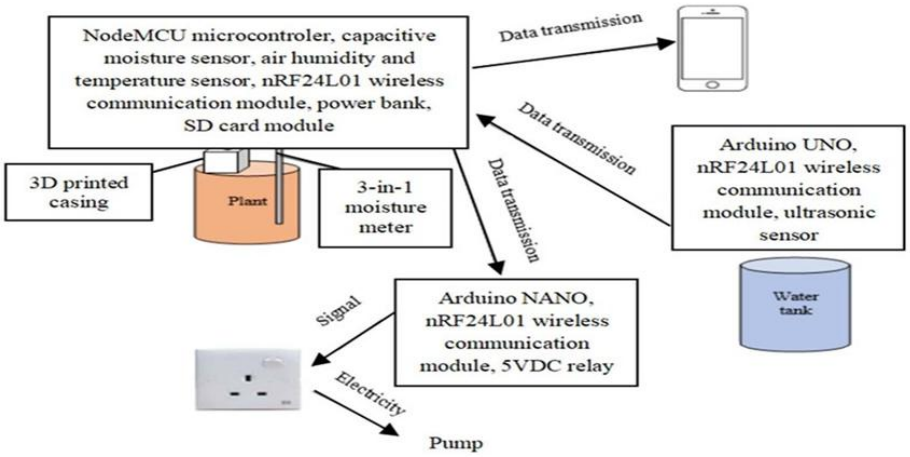

FIGURE.3. COMMUNICATION BETWEEN SUBSYSTEM.

IV. IMPLEMENTATION OF IOT AND SENSORS

In this Arduino Uno is used which is microcontroller board. It is based on ATmega32 microcontroller. It offers many facilities to share information with computer and another microcontroller. It shares information in three ways namely serial, 12C and SPI protocol's. USB port on board develops serial communication. Many people are using Arduino Uno board for developing sensors and instrument which are required in scientific research. Some of its application are Embedded system, security and defense system, home automation, industrial automation, etc. In system developed here it was used to control ultrasonic sensor mounted above the water tank.

In this they have used three sensors which are:

1)Ultrasonic Sensor

2)Capacitive Soil moisture sensor

3)DHT11 air temperature and humidity sensor

Ultrasonic sensors are used in water level sensing.

It works by emitting sound waves whose frequency is too high for human ear to hear. They wait for the sound to reflect back and calculate the distance based on time required. The capacitive moisture sensor is a soil moisture sensor. If we compare resistive sensors and capacitive sensors, capacitive sensors do not require direct contact to metal electrodes so it prevents erosion of electrodes. By knowing the quantity of water vapor in the air we can measure the humidity present in air. DTH11 is a temperature and humidity sensor. This sensor can easily be connected with any microcontroller like Arduino, Raspberry Pi, etc. These sensors are small in size and has sampling rate so it is used. It can be used in ventilation, and air conditioning system, and to predict weather conditions, etc.

Finally, devices used to communicate with each other using single hop communication i.e. packets travel from source to their destination using single networking device. NodeMCU ESP8266 is a board which comes with the ESP-12E module which consist of ESP8266 chip which has Tensilica Xtensa 32-bit LX106 RISC microprocessor. IT is ideal for IOT project as it has 12 KB RAM and 4 MB of flash memory which stores program and data and also it has high processing power with Wi-Fi/Bluetooth in built within it and has deep sleep operating feature. It can also be easily programmed with Arduino IDE as it is easy to use. The ESP8266 has Wi-Fi transceiver i.e. it can connect to wi-fi network and also it can set up its own network. Here NodeMCU was used to control capacitive moisture sensor, air temperature and humidity sensor and SD card module. nRF24L01 were used to receive the signal from the ultrasonic sensor, communication for the 5VDC relay and communication for the NodeMCU. Summary of the model proposed is:

1) The master controller consists of components like solar panel, temperature and air humidity sensor, breadboard, NodeMCU, capacitive soil moisture sensor and depth limiter.

2)Water pump consist of ultrasonic sensor and Arduino Uno.

3)The water pump switch controller consists of Arduino Uno, relay module and NRF module, unit versal adapter and water pump.

V. FUSSY LOGIC AND SOFTWARE USED AND RESULT DISCUSS

Human knowledge about complex problem can be represented using natural language, but machine uses Boolean values that are true and false which do not give flexibility in answer. To overcome this theory of fuzzy set and fuzzy logic are developed which is used in mathematical representation and efficient processing of complex information.

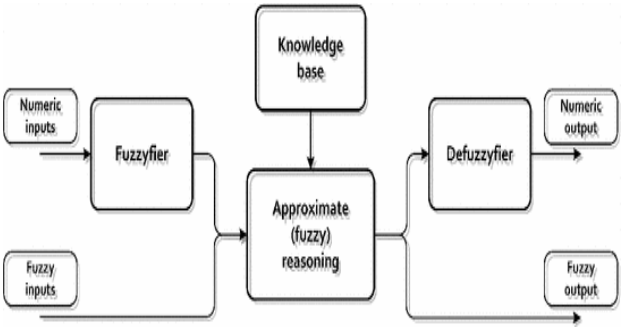

Figure 4) Structure of fuzzy system.

The main characteristic in fuzzy system involves symbolic knowledge representation in the form of fuzzy condition i.e. If-Then rule. In the structure five variables are stored namely air humidity, temperature, water level, soil moisture and hours of current time. The Arduino Nano verifies the hours of current time and water level in tank before preceding to fuzzification of the input variable. As plant, do not require extra water to undergo photosynthesis before 9an and 4 pm. Additionally water pump is not turned on if the water tank do not contain sufficient water. The fuzzy logic based on monitoring is shown in table. 1

Table.1. Development of the fuzzy rules

Rule		
Rule 1	IF	Air Humidity is *Low*
	AND	Air Temperature is *Cool*
	AND	Soil Moisture is *Wet*
	THEN	Watering Time is *Short*
Rule 2	IF	Air Humidity is *Low*
	AND	Air Temperature is *Hot*
	AND	Soil Moisture is *Wet*
	THEN	Watering Time is *Long*
Rule 3	IF	Air Humidity is *High*
	AND	Air Temperature is *Hot*
	AND	Soil Moisture is *Wet*
	THEN	Watering Time is *Short*
Rule 4	IF	Air Humidity is *High*
	AND	Air Temperature is *Cool*
	AND	Soil Moisture is *Moderate*
	THEN	Watering Time is *Very Short*
Rule 5	IF	Air Humidity is *Low*
	AND	Air Temperature is *Cool*
	AND	Soil Moisture is *Moderate*
	THEN	Watering Time is *Short*
Rule 6	IF	Air Humidity is *Low*
	AND	Air Temperature is *Hot*
	AND	Soil Moisture is *Moderate*
	THEN	Watering Time is *Long*
Rule 7	IF	Air Humidity is *High*
	AND	Air Temperature is *Hot*
	AND	Soil Moisture is *Moderate*
	THEN	Watering Time is *Average*
Rule 8	IF	Air Humidity is *High*
	AND	Air Temperature is *Cool*
	AND	Soil Moisture is *Dry*
	THEN	Watering Time is *Average*
Rule 9	IF	Air Humidity is *Low*
	AND	Air Temperature is *Cool*
	AND	Soil Moisture is *Dry*
	THEN	Watering Time is *Average*
Rule 10	IF	Air Humidity is *Low*
	AND	Air Temperature is *Hot*
	AND	Soil Moisture is *Dry*
	THEN	Watering Time is *Very Long*
Rule 11	IF	Air Humidity is *High*
	AND	Air Temperature is *Hot*
	AND	Soil Moisture is *Dry*
	THEN	Watering Time is *Long*
Rule 12	IF	Air Humidity is *High*
	AND	Air Temperature is *Cool*
	AND	Soil Moisture is *Wet*
	THEN	Watering Time is *Very Short*

If water level in tank is high enough then input parameter given are air humidity, temperature, and soil moisture which is processed by making use of given fuzzy system and gives output in terms of watering duration. The output is used to set the duration for which water pump will turn on, and process is repeated.
Example:
Input Variables:
Air humidity-Range:50-100
Air temperature-Range :20-40°C
Soil moisture-Range :0~90%
Output:
Watering time-Range :0-15 s
So, the water will begiven to the plant as per requirement on the basis of air humidity, temperature, and soil moisture. This will lead to water management and monitoring the farm which will save water and keep farmer updated about his farm.
Software used to get the output are Thing Speak, Blynk etc. Thing Speak is a Iot platform in which we can send sensor data to cloud. It includes web services in which we can collect and store sensor data in the cloud and develop internet of things. Figure 5. Gives information about soil moisture level against time and Air humidity against time. Result got by using software is given below.

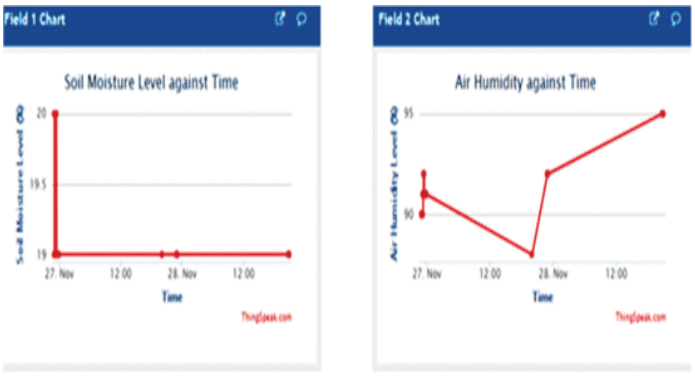

Figure. 5. The windows from ThingSpeak.com displaying field chart related to soil moisture, and air humidity against time.

Blynk is a platform that allows us to interact for controlling and monitoring hardware project from Android devices. From this Farmer, can monitor their farm from anywhere using mobile.

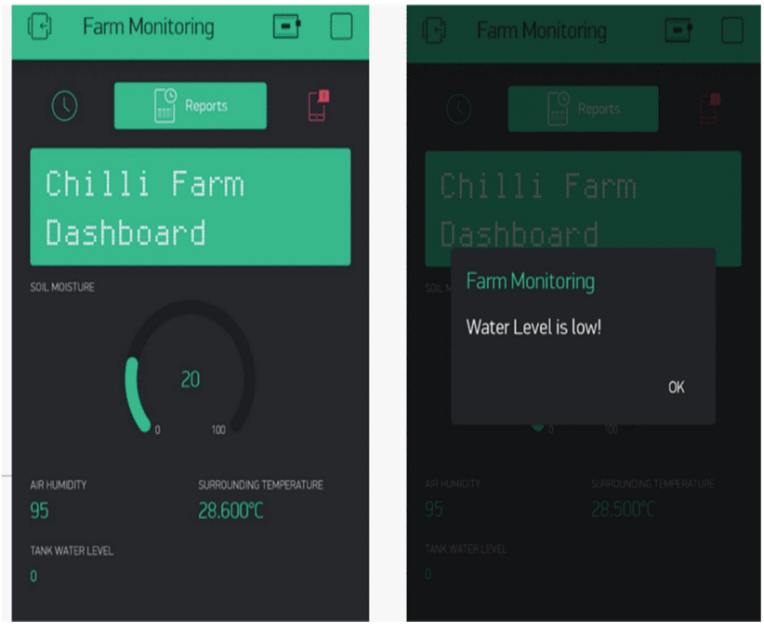

Figure.6. Information displayed from Blynk application.

VI. CONCLUSION

Agriculture monitoring is important for the farmer. So, this technique is developed which helps farmer to monitor the farm and reduce the labor use. Due to use of fuzzy logic system can create perfect set of decision maker and help in water management. Smart farms can improve the application of nutrition to the soil and regarding the amount of pesticides and water used in irrigation.

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