AGRICULTURA IoT USING CLOUD-BASED BIG DATA ANALYTICS

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ABSTRACT

Numerous IoT applications may be seen in the agricultural sector, which will benefit farmers in unknown ways and ultimately contribute to the successful growth of the country. In order to improve farmers' ability to cultivate crops more effectively, this article investigates prospective IoT applications in the sector of agriculture. The IoT and cloud-based big data analytics is proposed to play a significant role in the feasibility study of smart agriculture. It is believed that intelligent or precise agricultural systems will be crucial to enhancing agricultural operations. Everyone uses mobile devices frequently, including farmers. Information and communication technologies (ICT) are crucial for farmers to use in their daily lives to obtain agricultural information. The Internet of Things (IoT) has several uses in the field of digital agriculture, including crop growth monitoring, fertiliser selection, irrigation decision support systems, etc. In this study, an IoT device is utilised to collect data about agriculture, which is then stored in a cloud database. Big data analysis powered by the cloud is utilised to assess data such as fertiliser needs, crop analysis, market needs, and stock needs for the crop. Our ultimate goal is to use the forecasted information to boost crop productivity and control the cost of agriculture for the products.

Keywords: IoT Technology, wireless sensor networks, Big-data analytics, Precision agriculture

1. INTRODUCTION

One of the biggest issues in the globe is the lack of water. There are numerous strategies used to conserve water. Every crop field, every person, every plant, every animal, etc. needs water. In agriculture, water plays a crucial role in crop productivity. A big issue in agriculture is water waste, which is why fields are given an excess amount of water to increase crop productivity. Therefore, there are numerous methods available to prevent or reduce water waste.[1] Small, low-cost, widely dispersed, wirelessly communicable, and capable of local processing, wireless sensor networks (WSNs) are used for a variety of tasks, including environmental monitoring, habitat monitoring, seismic detection, medical monitoring, industrial monitoring, home automation, and more.

The old method of ditch irrigation involves digging the ditches and planting the seedlings in a horizontally aligned fashion. Siphon tubes are used to direct water to various canals. These were primarily utilised in the past [2]. This approach can helps to conserve water. Water is provided close to the roots so they can gauge how much water they require. Rather

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than permitting water to reach a particular distance from a tree or crop. With this strategy, water may be properly conserved.

The process is quite difficult, the amount of labour required is considerable, and the cost of labour will be significant. The idea behind this procedure is that water will flow down each step, watering each column, while the land is divided into many levels and supported by walls, with plain portions being used for plantations.[3] This kind of automatic irrigation system is useful for providing water to the farm automatically while the user is travelling and stops sending water when the crop is no longer needed.

2. LITERATURE REVIEW

Kanade et al. (2021) have explained to prevent crop loose sand to keep stray animals and people out of the area since they pose a severe threat to farming areas. In addition to protecting farmers from significant financial hardships and preventing them from making needless attempts to protect their farms, such a framework will aid in the preservation of farmers' houses and fields. Similar to how it would help them improve harvest yields, this framework would increase the financial worth [5]. Depending on many factors, the plant zone can be improved and the needs of the interest will be satisfied by successfully using water resources. The optimal part of the boundaries in the specifically created water structure framework varies throughout the year and at various periods.

Kamaruddin et al. (2019) have proposed a technique that successfully regulates plant watering rate in accordance with user requirements and soil moisture. According to customer requirements, the created system administers and operates inside an Internet of Things (IoT) and Wireless Sensor Network (WSN) environment to manually or automatically monitor the irrigation system. The NRF24L01 and Arduino technologies were used in this proposed system as the communication channel's microcontroller and transceiver, respectively. By using this technology, smart lifestyles and smart agriculture can be produced in the future. The cost of recruiting new personnel will be reduced, and water waste from daily demands would be avoided [6].

Rajkumar et al. (2017) have resulted an automated system that can accurately monitor and control the water required on the field. Installing a time- and water-saving irrigation system allows for effective water use [7]. Additionally, this architecture makes use of micro-controllers, which promise to extend system lifespan by consuming less power. The powerful credit card-sized micro-controller Arduino keeps an eye on and manages the entire system. It offers a number of advantages and requires less labour than other methods. When soil humidity falls below the reference, the system just supplies water.

Priandana et al. (2020) has created a cayenne pepper (chilli) plant watering system that will be used in the greenhouse at the FMIPA, IPB University's Computer Science Department. Each chilli plant has a solenoid valve and a soil moisture sensor that control irrigation automatically. To assess this strategy, utilised 16 potted chilli plants with various starting soil moisture levels. [8] Based on the findings of the experimental testing, the soil moisture values of 15 pots (91.7% of the test subjects) were successfully read, and the irrigation for these pots was correctly carried out in accordance with the functional needs recommended for chilli plants, namely, 60% - 80%.

Kolvekar et al. (2021) have explained that by using the Cayenne platform, an automated irrigation system enables the user to monitor and control field watering from a distance. This is made possible by the use of IoT and hardware programming tools and technologies. Based on the study done using image processing, it also alerts the farmer to any contamination of the field's tomato production. The sensor values from the field-based sensor used in an automated irrigation system nodes are used to regulate the pump. The microprocessor manages the pump's ON-OFF operation based on these parameters. The user is able to access these sensor data by uploading them to the Cayenne cloud server. Long distance to monitor the field's condition and, if operated manually, deliver control actions accordingly [9]. Using image processing and an artificial neural network technique, diseases were clearly categorised.

3. PROPOSED METHODOLOGY

3.1 Internet of Things (IoT)

The expansion of Internet connectivity into everyday objects and functional devices is known as the Internet of Things (IoT). [10]These devices may be monitored and controlled remotely, and they can communicate and work together with others over the Internet thanks to hardware, Internet access, and various types of equipment (such as sensors). Based on wireless sensor network technology, sensors are utilised in the agricultural sector to analyse numerous characteristics. The soil parameters are gathered using the suggested system and then stored in a cloud database.

IoT technologies feature a variety of hardware and tools for data collection, including the Arduino Ethernet Shield, BeagleBone, Intel Galileo, openPicus FlyportPro, Pinoccio, WeIO, and WIZnet. Internet of Things has the following technologies: Wireless Sensor Networks (WSN), Big Data Analytics, Cloud Computing (CC), Communication protocol, Embedded Systems (ES).

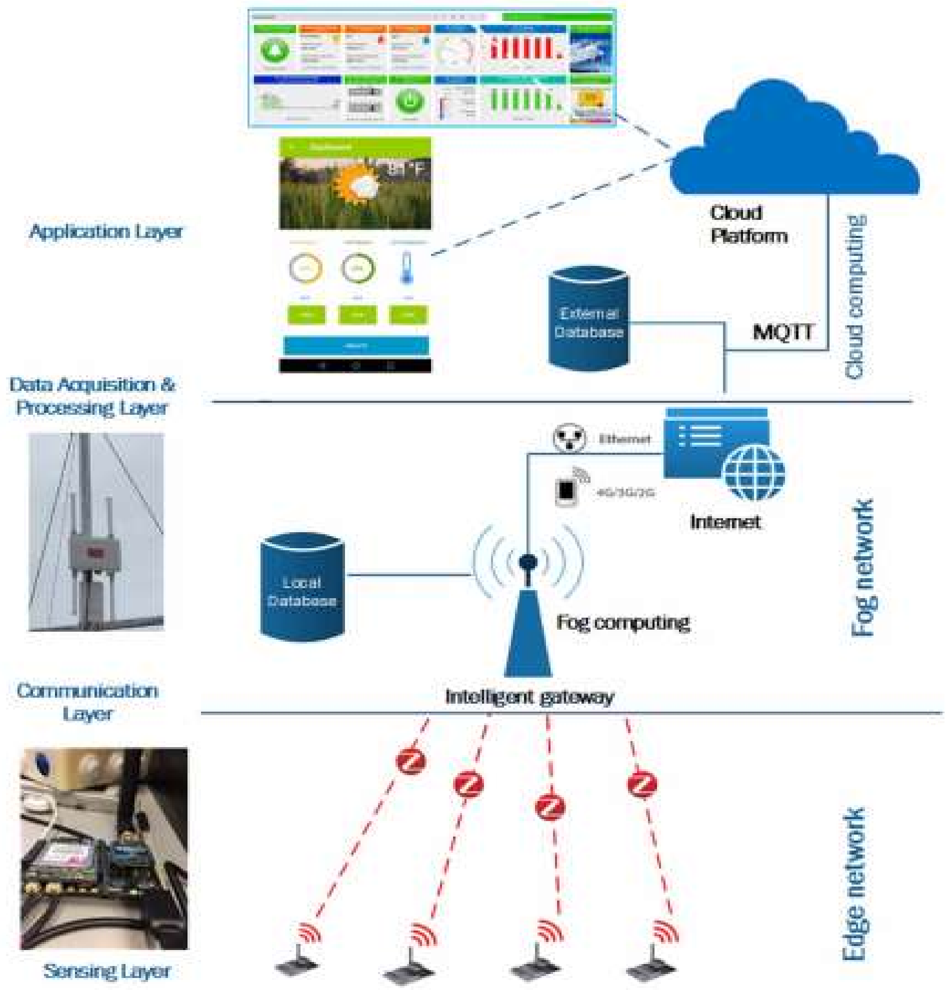

Fig 1: IoT Architecture for smart agriculture

3.1.1 Wireless sensor networks

In order to monitor system, physical, or environmental conditions, a large number of wireless sensors are placed in an ad hoc wireless network called a Wireless Sensor Network (WSN). WSN sensor nodes have an on-board processor that controls and keeps an eye on the local environment. They are connected to the Base Station, which functions as the processing hub for the WSN System. To share data, the base station of a WSN System is connected to the Internet. Several control systems, including those that monitor the environment, automate homes, and find chemical and biological threats, use IoT and WSN. Before being delivered to remote locations, IoT devices and apps process the data that WSN devices have extracted.

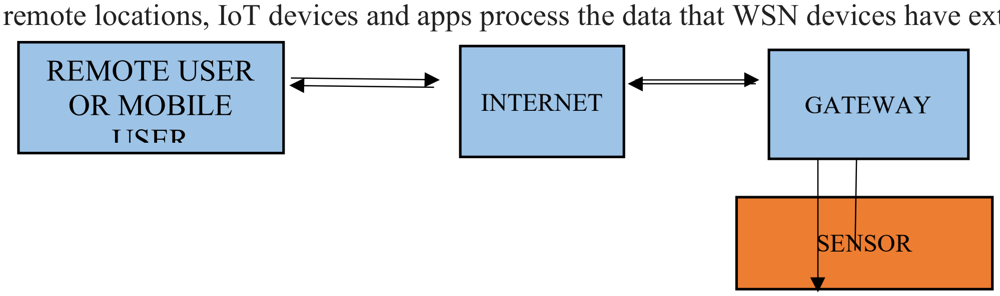

Fig 2: Process of wireless sensor network

3.1.2 Cloud computing (CC)

Resource sharing is offered by cloud computing for a price. The services are provided by cloud computing service providers at a reasonable price. It has served as a storage location for agricultural data. Along with IoT, it is utilised in the agricultural industry.

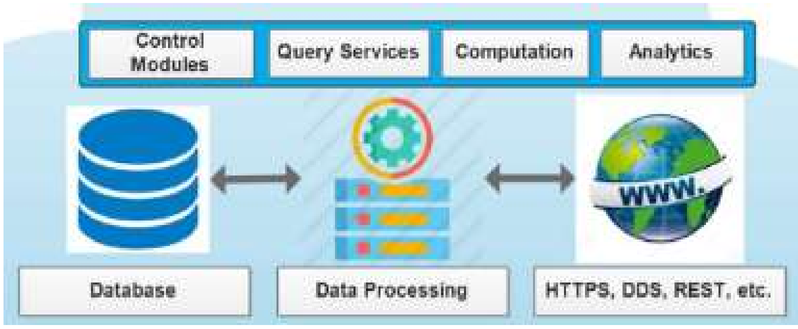

Fig 3: Process of cloud computing

3.1.3 Big data Analytics

Big data is a massive volume of information gathered over a longer period of time from various sources, such as sensor data, social networking data, and commercial data. The main difficulty lies in data collection, storage, analytics, and search. Together with big data analytics, it is used for business data processing to look for undiscovered patterns in the data. Big data is utilised in the agricultural sector to control the supply chain of agro goods and reduce production costs. Big data analytics is the term for the method used to integrate traditional and business analytics. It has the following four sorts of analytics: Descriptive, Inquistive, Predictive, Prescriptive.

Utilize predictive analytics to ascertain the data modeling's potential in the future. This focuses on the analytics and is utilised to generate them. They don't have any. Techniques are applied to the data analysis and prediction. The methods include association rule mining, clustering algorithms, and classification algorithms. SVM, decision tree algorithms, C4.5, RepTree and J48, k-nearest neighbour algorithms, Naive Bayes, neural networks, K-means clustering algorithms, Apriori algorithms, and Fpgrowth algorithms are a few examples of algorithms.

It has been used to classify soil types by examining their characteristics. Additionally, crop prediction and selecting the best crop sequence based on prior crop sequences on the same acreage and the most recent data on soil nutrient levels can both benefit from soil data mining. It is helpful for both controlling field activities and monitoring field data, giving it versatility.

3.1.4 Mobile computing

Due to its accessibility and less expensive cost of communication, mobile computing has had a significant impact on many aspects of our daily lives. It is utilised in practically every industry, including agriculture. A mobile computer system has been suggested providing daily, seasonal notifications to farmers about the products and weather information. The sensor data kept in the IoT gateway's local database is continuously synchronised with an external MySQL database kept in a virtual machine and the Google Firebase cloud. The ability to deploy it to

Microsoft Azure cloud services has also been successfully enabled. However, Google Firebase was chosen for this application because to the cost and storage cap. GreenLink Farming is a mobile application that is currently being developed for Android OS and will eventually support iOS. The GreenLink Farming app's features can be summed up as follows:

Fig 4: Mobile app of Greenlink farming

- An important dashboard menu for the feedback response of irrigation events includes soil moisture content, leaf wetness, and soil temperature.The Arduino IDE serves as a GUI via which basic C language with a few extra keywords, often known as Arduino language, is used to programme microcontrollers. Setup () and loop are the two primary functions in the code (). While loop () defines the primary working routines, the initialization of variables is described by setup ().

ALGORITHM

Begin
Initialize the tank's water level and the soil's maximum dryness thresholds
Definition of a variable
Setup ()
    Set the input and output pins.
End of function
Loop ()

```
          Sensor value ←——— pin reading
          If sensor value>= greatest level of dryness
                    Print" begin watering if the soil is dry."
                    Output pin              HIGH
          Else
                    Print" The ground is damp"
                    Output pin ———→ LOW
End if
Print outcomes on a serial monitor
Output value ←——— reading of the water level
If output value <= after the water level is reached
                    Print "tank is empty"
                    Output pin for alarm ———→ HIGH
Else
                    Print "the tank is full"
                    Output pin for alarm ———→ LOW
End of function
Convert ()
                    To % conversion of a sensor value
                    Print % value
End of function
End
```

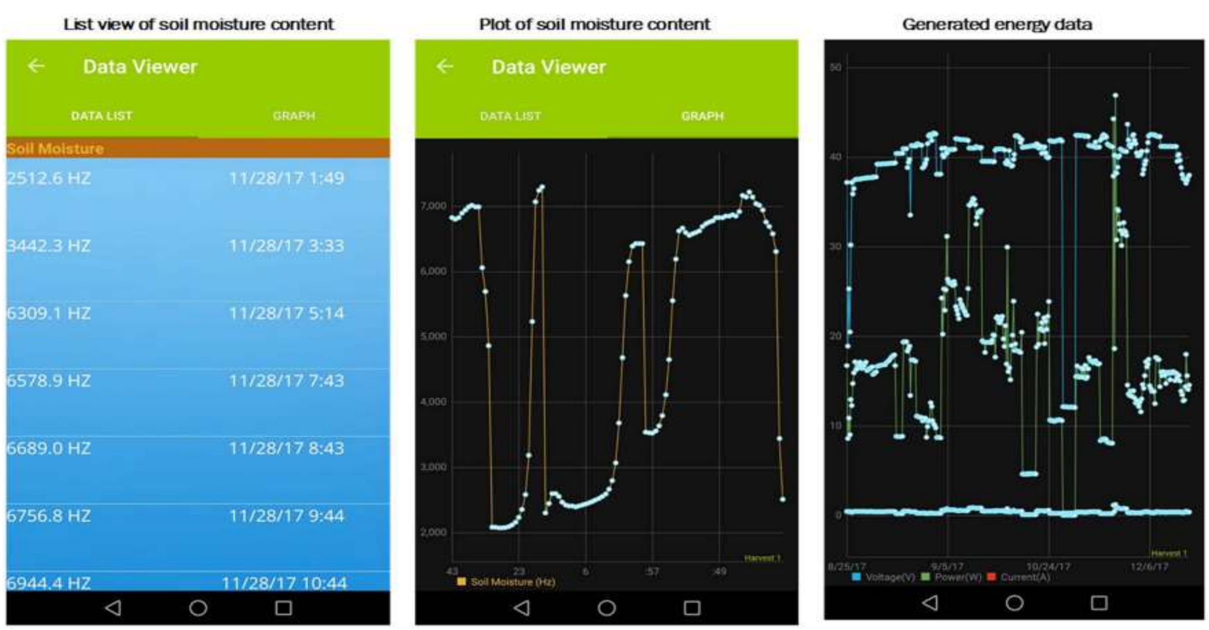

Fig 5: Monitoring through mobile phone

- Insight into both historical and current sensor data. These information is broken out into five tracks: weather, soil, yield, energy, and water.
- Data visualisation capability: sensor data can be seen as a list view or are plotted to obtain insight on trends and patterns into the data.

4. EXPERIMENTAL RESULTS AND DISCUSSION

The experiment was conducted with two variables in mind: the type of plant and the climate. The weather and the various plants used in the experiment affect how much water evaporation occurs. On some days, it was windy and dry, while on other days, it was sunny and windy. Utilizing an automatic irrigation system instead of a regular irrigation system has the benefit of conserving water.

Table 1: Threshold activity for plant growth

Soil PH	Plant growth
Threshold<4.6	Acidic nature of land
Threshold =5.5	Microbial activity reduced drastically for soil
Threshold =6.0 to 7.2	6.0 to 7.5 =default accepted range 6.8 to 7.2 =neutral behaviour
Threshold =7.5	Alkaline nature with less iron
Threshold >8.3	Alkaline nature of land

The primary goal is to measure the parameters and inform the farmer of the appropriate amount to be present in the atmosphere. This work is carried out using a wireless sensor network.

Table 2: Details of water consumption

Days	Water consumption Without sensor	Water consumption With sensor
Day 1	48	43
Day 5	55	45
Day 14	58	48
Day 25	67	50.5
Day 30	69	52

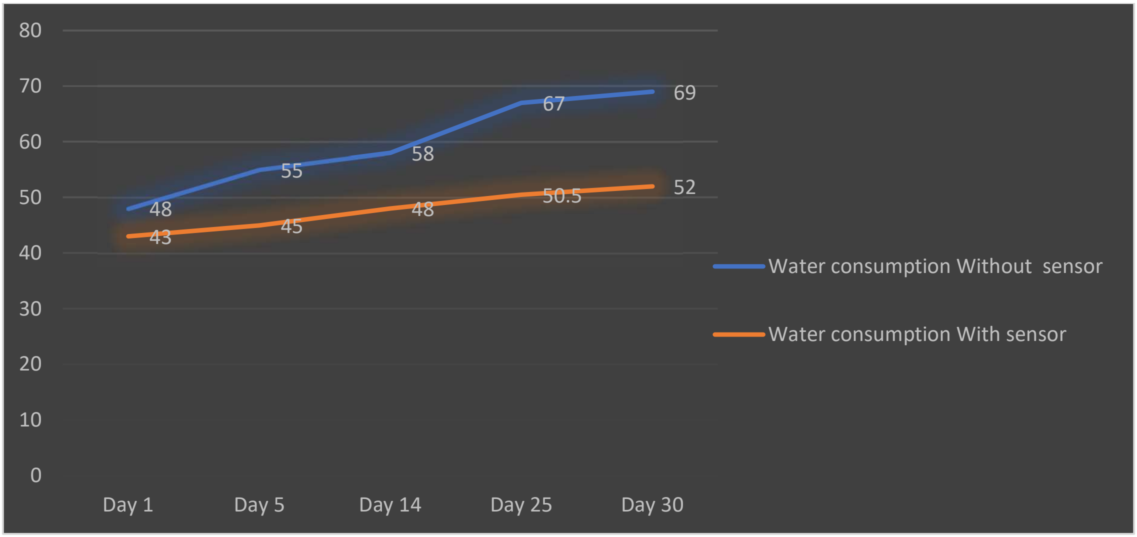

Fig 3: Comparison graph of water consumption with sensor and without sensor

The development of an irrigation system allows for the most efficient utilisation of resources such as water. This method encourages sustainability and helps with irrigation in areas with limited water resources. This method is very unstable, needs minimal maintenance, and is easily adaptable to support many types of crops. Similar strategies can be used to build and implement various modules depending on the research utility, whether it be a green house or an open field. Along with cutting costs, this endeavour helps to protect water, which is essential for life.

In this paper, a big data scenario and a methodology for forecasting weather data are presented. This study aims to improve predicting precision for precision agriculture in the future by using a variety of meteorological data. Big data can be gathered using the scenario. The historical rainfall and temperature data inputs were used for the prediction study, and the year-by-year data from 1 January to 31 December is indicated by different colours.

Table 3: Weather Conditions

Months	**Season**	**Temperature**	**Rainfall**
July-Oct	Monsoon	25 > T < 35	10 > R < 50
Nov-Feb	Winter	20 > T < 35	0 > R < 10
Mar-June	Summer	35 > T < 45	0 > R < 10

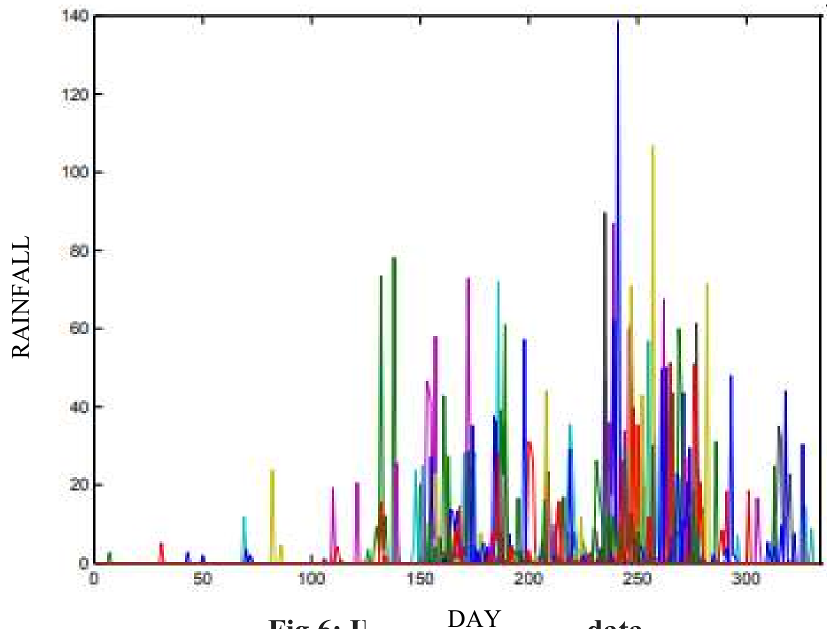

Fig 6: H data

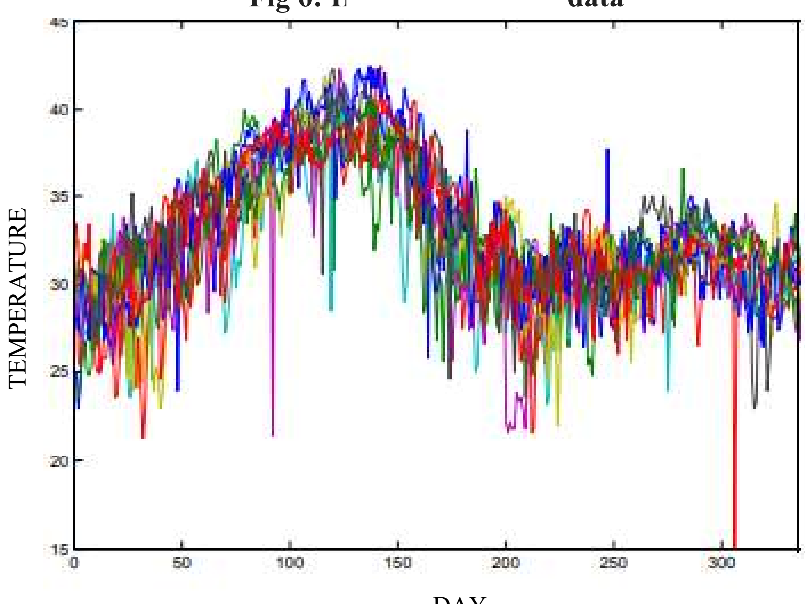

Fig 7: H data

5. CONCLUSION

Agriculture is going through a digital transition, just like many other industries. Farm data collection is gathering increasingly more information. Robotics, drones, the Internet of Things, and AI are all being used more often. The function and benefits of IoT in the sector of agriculture have been examined in the proposed study. This paper reviews a number of IoT-supported technologies and IoT applications in smart agriculture. Remote sensing technology is essential for data collecting and real-time decision assistance in precision agriculture. According to these findings, the case study region's temperature and rainfall are predicted by the model. It offers farmers a variety of options for future crop management and water management decisions. It is a disaster management and yield management tool that would boost food production. This gives the details to farmers some quick advice on how to increase output and care for their crops effectively. All of the applications discussed above have 98% accuracy. This can assist the farmer in increasing crop productivity, hence enhancing national wellbeing.

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