Agriculture Design Method Using Computing Architecture on Internet of Things

K. Kasthuri and R. Dharmarajan

Abstract--- Agriculture is one of the most important professions that makes surplus services to the mankind. Without agriculture necessities, the benefits from it cannot be obtained. Therefore, food will not be satisfied. A traditional way of agriculture results in low yielding of crops due to many factors. Hence, Smart agriculture helps in increasing the productivity and solving issues caused due to the critical environmental factors. Meanwhile, technology is taking a tremendous growth across the horizons. So, this technology can be utilized for making agriculture easier. In this paper, we proposed two techniques Polynomial Linear Regression algorithm and Decision Information System to make a perfect decision based on the dataset. Our paper shows the data collected from the sensors and comparing the data with the training dataset to filter the data's for satisfied resulted in data. Then the Decision Information System Algorithm is to make the decision based on the filtered data. The decision is to predict the condition of the growth of crops, environmental condition, water level, soil condition, fertilizers need and to detect anyDiseases affected to the crops and to resolve the defects. In this technique, the analyzed result is to send a information to a farmer and to the agricultural department to make a suitable solution for the growth of crops and detect the effect at starting stage and to resolve it earlier. The aim is to help farmers to develop smart systems both, in current and new facilities.

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Keywords--- Agriculture, Polynomial Linear Regression, Decision Information System.

I. Introduction

Internet of Things

The Internet of Things (IoT) describes the connection of devices any devices to the internet using embedded software and sensors to communicate, collect and exchange data with one another. With IoT, the world is wide open, offering a virtually endless array of opportunities and connections at home, at work or at play. Agricultural Weather Stations is self-contained units that are placed at various locations throughout growing fields. These stations have a combination of sensors appropriate for the local crops and climate. Information such as air temperature, soil temperature at various depths, rainfall, leaf wetness, chlorophyll, wind speed, dew point temperature, wind direction, relative humidity, solar radiation, and atmospheric pressure are measured and recorded at predetermined intervals. This data is compiled and sent wirelessly to a central data logger at programmed intervals. Their portability and decreasing prices make weather stations attractive for farms of all sizes.

IOT Communication

IoT communicates information to people and systems, such as state and health of equipment (e.g. it's on or off, charged, full or empty) and data from sensors that can monitor a person's vital signs. In most cases, we didn't have access to this information before or it was collected manually and infrequently. For example, an IOT-enabled HVAC system can report if its air filter is clean and functioning properly. Almost every company has a class of assets it could track. GPS-enabled assets can communicate their current location and movement. Location is important for items that move, such as trucks, but it's also applicable for locating items and people within an organization.

Collecting Data

In a connected world, a business will have visibility into a device's condition. In many cases, a business or consumer will also be able to remotely control a device. For example, a business can remotely turn on or shut down a specific piece of equipment or adjust the temperature in a climate-controlled environment. Meanwhile, a consumer can use IoT to unlock their car or start the washing machine. Once a performance baseline has been established, a process can send alerts for anomalies and possibly deliver an automated response. Businesses that don't plan carefully for IoT will be overwhelmed with the volume and variety of data that IoT will generate. While each sensor may only produce a small amount of data, a company will be collecting data from thousands to millions of sensors. Firms must build a data collection and analytics strategy that supports this new torrent of information in a scalable and cost-effective manner. Big data technology, such as Hadoop and NoSQL, can give companies the ability to rapidly collect, store and analyze large volumes of disparate IoT data.

Cloud Storage

Through cloud computing technology, we can use the storage resource pool and computing resource pool, and provide high storage service services to users. The data that produced by introducing the information technology is unusually large. The cloud computing services first need to build a large number of computing resources servers, and then orderly link them into architecture.

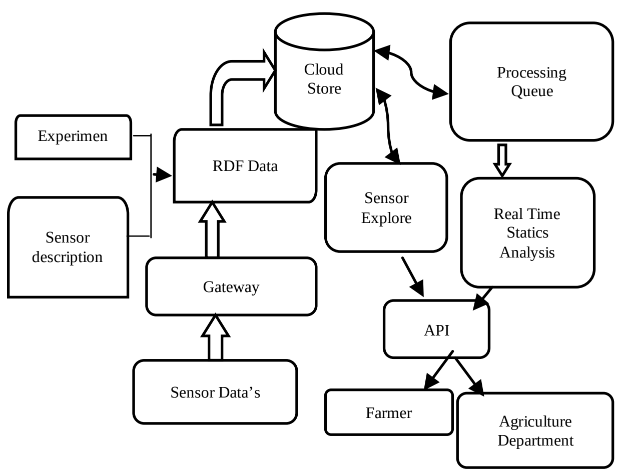

Fig. 1: Smart Forming Structure

Cloud Computing

Cloud storage has emerged as a promising solution for providing ubiquitous, convenient, and on-demand accesses to large amounts of data shared over the Internet. Today, millions of users are sharing personal data, such as photos and videos, with their friends through social network applications based on cloud storage on a daily basis. Business users are also being attracted by cloud storage due to its numerous benefits, including lower cost, greater agility, and better resource utilization.

Cloud Security

Security can improve due to the centralization of data, increased security-focused resources, etc., but concerns can persist about loss of control over certain sensitive data and the lack of security for stored kernels. Security is often as good as or better than other traditional systems, in part because providers are able to devote resources to solving security issues that many customers cannot afford to tackle. However, the complexity of security is greatly increased when data is distributed over a wider area or over a greater number of devices, as well as in multi-tenant systems shared by unrelated users. In addition, user access to security audit logs may be difficult or impossible. Private cloud installations are in part motivated by users' desire to retain control over the infrastructure and avoid losing control of information security.

Cloud Architecture

Cloud architecture, the systems architecture of the software systems involved in the delivery of cloud computing, typically involves multiple cloud components communicating with each other over a loose coupling mechanism such as a messaging queue. Elastic provision implies intelligence in the use of tight or loose coupling as applied to mechanisms such as these and others.

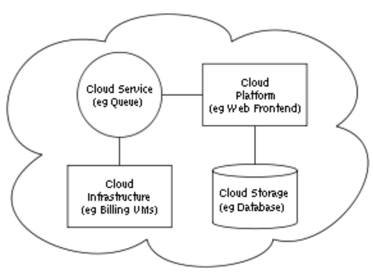

Fig. 2: Cloud Computing Sample Architecture

II. RELATED WORK

The second chapter described to make IOT sensor data collection and predicting the result from the collected data and the results are stored in cloud storage and accessing the data securely. The IOT (Internet of Things) is a network of Internet-enabled objects, together with web services that interact with these objects. Underlying the Internet of Things are technologies such as RFID (radio frequency identification), sensors, and smartphones. Remote monitoring system with internet and wireless communications combined is proposed. At the same time, taking into account the system management, information management system is designed. The collected data by the system provided for agricultural research and management facilities. Research shows the greenhouse monitor system based on IoT technology has a certain precision of monitor and control. It can revise environmental control parameters, this system realizes the operation online, and also have these characteristics: run reliably, high performance, improve easily[1].

Climate changes and rainfall has been erratic over the past decade. Smart agriculture is an automated and directed information technology implemented within the IOT (Internet of Things). IOT is developing rapidly and widely applied in all wireless environments. In this work, sensor technology and wireless networks integration of IoT technology has been studied and reviewed based on the actual situation of the agricultural system. A combined approach with internet and wireless communications, Remote Monitoring System (RMS) are proposed. The major objective is to collect real-time data of agriculture production environment that provides easy access for agricultural facilities such as alerts through Short Massaging Service (SMS) and advice on weather pattern, crops etc[2].

Internet of things is one of the rapidly growing fields for delivering social and economic benefits for emerging and developing an economy. Water quality is a critical factor while culturing aquatic organisms. It mainly depends on several parameters like dissolved oxygen, ammonia, pH, temperature, salt, nitrates, carbonates etc. The quality of water is monitored continuously with the help of sensors to ensure growth and survival of aquatic life. The sensed data is transferred to the aqua farmer mobile through the cloud. As a result, preventive measures can be taken in time to minimize the losses and increase the productivity[3].

Traditional agriculture is transforming into smart agriculture due to the prominence of the Internet of Things (IoT). Every field, from health to environment, education to entertainment and industry to home is embracing the Internet of Things (IoT) revolution. Agriculture has seen many transformations and has adopted many machines to increase the yield. Low-cost and low-power are the key factors to make any IoT network useful and acceptable to the farmers. In this paper, we have proposed a low-power, low-cost IoT network for smart agriculture. For monitoring the soil moisture content, we have used an in-house developed sensor. In the proposed network, the IITH mote is used as a sink and sensor node which provides low-power communication. Power and cost are the two metrics used for evaluation of these networks[4].

In this technique, we propose a method to protect end-device by using RSSI and Hand-Shaking technique using Proprietary Message. One of the frequently used attacks in LoRaWAN is replay attack. It is so easy to sniff packets in a wireless network environment. If an attacker intrudes a service provided by LoRaWAN, the usage pattern of the end-device may be exposed, or a replay attack may cause a problem in connection with the user. In order to complement these vulnerabilities, we propose a method to protect users by using the physical characteristics of a network called RSSI and a new technique called Proprietary Hand-Shaking [5].

Internet of Things (IoT) solutions increasingly being deployed for smart applications. To provide good communication for the increasing number of smart applications, there is a need for low cost and long range Low Power Wide Area Network (LPWAN) technologies. In this study, we perform extensive measurements on a new LoRaWAN network to characterize the spatial and temporal properties of the LoRaWAN channel. This study provides useful results to both LoRaWAN network operators as well as developers of LoRaWAN applications. Network operators can use the characterization results to identify possible weaknesses in the network, and application developers are offered a tool to prevent possible data loss[6].

Internet-of-Things (IoT) is emerging as one of the popular technologies influencing every aspect of human life. The IoT devices equipped with sensors are changing every domain of the world to become smarter. Several existing well-known message exchange protocols like Message Queuing Telemetry Transport (MQTT), Advanced Message Queuing Protocol (AMQP), and Constrained Application Protocol (CoAP) are applicable in IoT communications. In this technique, we designed and implemented an application layer framework to test and understand the behavior of these protocols and conducted the experiments on a realistic test bed using wired, Wi-Fi and 2/3/4G networks. The results revealed that MQTT and AMQP perform well on wired and wireless connections whereas CoAP performs consistently well and is less network dependent. On the lossy networks, CoAP generates low traffic as compared to MQTT and AMQP. The low memory footprint of MQTT and CoAP has made them a better choice over AMQP[7].

The Internet of Things (IoT) technology is currently shaping different aspects of human life. Precision agriculture is one of the paradigms which can use the IoT advantages to optimize the production efficiency and uniformity across the agriculture fields, optimize the quality of the crops, and minimize the negative environmental impact. In this technique, we have presented a cloud-based architecture for IoT precision agricultural applications. We have outlined the three layers of the proposed architecture and explained their implementation details. We have built a prototype to illustrate the different performance aspects of the proposed architecture[8].

IoT is a revolutionary technology that represents the future of computing and communications. Most of the people over all worlds depend on agriculture. Because of this reason smart IT technologies are needed to migrate with traditional agriculture methods. Precision agriculture sensor monitoring network is used greatly to measure agriculture-related information like temperature, humidity, soil PH, soil nutrition levels, water level etc. so, with IoT farmers can remotely monitor their crop and equipment by phones and computers. In this work, we surveyed some typical applications of Agriculture IoT Sensor Monitoring Network technologies using Cloud computing as the backbone. This survey is used to understand the different technologies and to build sustainable smart agriculture. Simple IoT agriculture model is addressed with a wireless network [9].

loT (Internet of Things) systems are resource constrained and primarily depend on sensors for contextual, physiological and behavioral information. In this technique, we propose a novel method of optimizing the need for loT security enablement, which is based on the estimated privacy risk of shareable sensor data. Particularly, our scheme serves two objectives, viz. privacy risk assessment and optimizing the secure transmission based on that assessment. The challenges are, firstly, to determine the degree of privacy, and evaluate a privacy score from the fine-grained sensor data and, secondly, to preserve the privacy content through a secure transfer of the data adapted based on the measured privacy score. Our results with real household smart meter data demonstrate the efficacy of our scheme [10].

Technology plays a central role in our everyday life. There has been a surge in the demand of Internet of Things (IoT) in many sectors, which has drawn significant research attention from both the academia and the industry. In the agriculture sector alone, the deployment of IoT has led to smart farming, precision agriculture, just to mention a few. In this technique an integrative approach in the field of Internet of Things for smart Agriculture based on low power devices and open source systems. The goal of this work is to provide a repelling and monitoring system for crop protection against animal attacks and weather conditions[11].

The field of Cloud computing is helping in leaps and bounds to improvise our age old business - Agriculture. Practical applications can be built from the economic consumption of cloud computing devices that can create a whole computing ecosystem, from sensors to tools that observe data from agricultural field images and from human actors on the ground and accurately feed the data into repositories along with their location as GPS co-ordinates. This paper proposes an approach combining the advantages of the major characteristics of emerging technologies such as Internet of Things (IoT) and Web Services in order to construct an efficient approach to handle the enormous data involved in agrarian output. The approach uses the combination of IoT and cloud computing that promotes the fast development of agricultural modernization and helps to realize smart solution for agriculture and efficiently solve the issues related to farmers [12].

According to the development of the Internet and embedded technology, Internet of Things (IoT) has applied in many industries and personalized applications such as smart home, smart office, and intelligent agriculture applications. This technique presents end-to-end reliability characteristics of two main IoT communication architectures through the network reliability parameters by employing OPNET. The redundancy devices, load balancing configuration, or increasing transmission bandwidth can directly reduce the retransmission rate and raise the overall reliability of the system[13].

In recent years, the evolving wireless technology, cheaper micro-controllers, smart cities concept and ‘Internet of Things’ (IoTs) have given way to the need of online wireless management systems for smart weather stations (SWS). In this technique, we develop an ‘Online Smart Weather Station System’ for studying the correlation amongst multiple weather parameters data, collected over a period of 18 months. Few important observations are made, for possible applications in agriculture, construction and manufacturing activities[14].

Internet of Things (IoT) is a concept and paradigm that enables interaction among objects pervasively present in an environment. Internet of things today, has reached many different areas, taken different forms and uncovered a multitude of applications. Remote monitoring of soil parameters is an emerging trend which has the potential to transform agricultural practices and increase productivity. The system is integrated with Bluetooth for the transfer of data to a nearby cell phone[15].

Agricultural information technology (AIT) has been broadly applied to every aspect of agriculture and has become the most effective means & tools for enhancing agricultural productivity and for making use of full agricultural resources. In this paper, on the basis of introducing the concept of agricultural information management and analyzing the features of Agricultural data, the designing method and architecture of Intelligent Agriculture MIS was discussed in detail, finally, this technique gives an implementation example of system in agricultural production [16].

The farmers are suffering from uncertain monsoons and water scarcity due to global warming. The integration of standard farming strategies with latest technologies as Internet of Things and Wireless device Networks may result in agricultural modernization. By investigating the occasional information from farmland, Soil Health Report card is arranged and sent to farmer by means of SMS, which helps the agriculturist in basic decision making[17].

Internet of thing (IoT) is not only a promising research topic but also a blooming industrial trend. For deployment convenience, a wireless interface is preferred for internet connectivity in the last mile of IoT. For fields with electricity, there are many available wireless technologies such as 3G/4G, WiFi, Bluetooth, and Zigbee. The selection of the wireless interface depends on many factors such as data rate, transmission range, cost, and so on. This technique presents a design of sensor node based on a commercial module to achieve the goals of low power and long range by employing IEEE 802.15.4e Time slotted Channel Hopping (TSCH) [18].

Information and communication technologies (ICTs) has enabled growth in developed countries and urban cities through improvements in communication systems, devices and applications. In rural areas, especially in developing countries, ICT penetration is not as high, often due to lack of available infrastructure and funding. This is built on top of a wireless mesh network (WMN) of low-cost, low-power IoT devices and deployed in areas where there is little to no Internet connectivity. We will show applicability of Near Cloud in improving rural education, health care facilities, disaster response and agriculture [19].

The advances in IT sector, cloud computing, the wide usage of sensors and mobile devices, and the Internet-of-Things (IoT) made our world looks like a small town. These rapid developments keep us connected all the day and seven days a week. we build a multipurpose integrated sensors system. This integrated system consists of networked sensors for different purposes and applications. For example, the sensors can be health sensors to measure the pulse and blood pressure of patients, or it can be sensors to measure the temperature to indicate a fire accident [20].

III. IMPLEMENTATION OF PROPOSED SYSTEM

Polynomial Linear Regression

Polynomial Linear Regression algorithm which is more efficient than AIS by an order of magnitude. The foremost advantage of linear regression is that it incorporates the subset frequency based pruning optimization that means, it only process any item-set whose subsets are frequent also. It utilizes a data structure that is known as a hash tree which is used for storing the counters of candidate item-sets. The main drawbacks of Linear regression are i) It performs n passes in excess of the database, where n is the distance end to end of the greatest frequent item-set. The counts of candidate item-sets of length k are obtained in the kth pass, ii) it follows a tuple-by-tuple approach where counters of candidate item-sets are updated after reading individual transaction of the whole database so that much redundant work is performed after each individual transaction. Based on this algorithm, lots of new algorithms are deliberated with enhancements and modifications.

Block Diagram

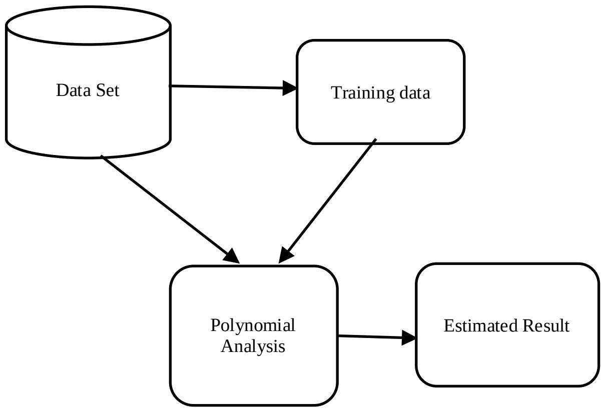

Fig. 3: Polynomial Linear Regression

Algorithm Steps

Step 1: It is loaded the data which will be classified as being ONE, TWO or THREE

Step 2: There are loaded the data's found in the folder data's. The name of the files belonging to class ONE is: "modules", the ones belonging to class TWO are: "modules" and the ones for class THREE are: "modules".

Step 3: It is determined the a priori probability for each class:

P(UNU) = NrTemplateInClassONE / NumberTotalTemplates
P(DOI) = NrTemplateInClassTWO / NumberTotalTemplates
P(TREI) = NrTemplateInClassTHREE / NumberTotalTemplates

Step 4: It is determined the probability that the data from the Step 1 to be in class ONE, TWO or THREE.

```
count1i,j = 0
for k = 1,n ; n – the number of modules in class ONE
        if data1_k(i,j) = 255 then
        count1i,j = count1i,j + 1
        probability1(i,j) =count1i,j / NrTemplateInClassONE
        count2i,j = 0
for k = 1,n ; n- the number of modules in class TWO
        if data2_k(i,j) = 255 then
        count2i,j = count2i,j + 1
        probability2 (i,j) =count2i,j / NrTemplateInClassTWO
        count3i,j = 0
for k = 1,n ; n- the number of modules in class THREE
        if data3_k(i,j) = 255 then
        count3i,j = count3i,j + 1
        probability 3(i,j) =count3i,j / NrTemplateInClassTHREE
```

Step 5: The satisfied regression to send information to cloud and split all the data to make result of the condition.

Data Flow Diagram

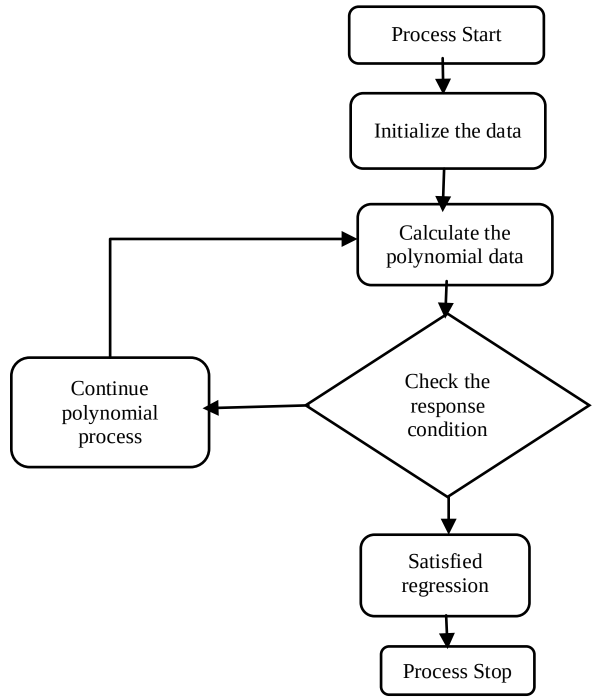

Fig. 4: Flow Chart of Polynomial Linear Regression

Decision Information Systems

Decision Information Systems (DIS) is a class of computerized information system that supports decision-making activities. DIS are interactive computer-based systems and subsystems intended to help decision makers use communications technologies, data, documents, knowledge and/or models to complete decision process tasks.

A decision information system may present information graphically and may include an expert system or artificial intelligence (AI). It may be aimed at business executives or some other group of knowledge workers.

Typical information that a decision support application might gather and present would be,

- Accessing all information assets, including legacy and relational data sources
- Comparative data figures
- Projected figures based on new data or assumptions

- Consequences of different decision alternatives, given past experience in a specific context.

Block Diagram

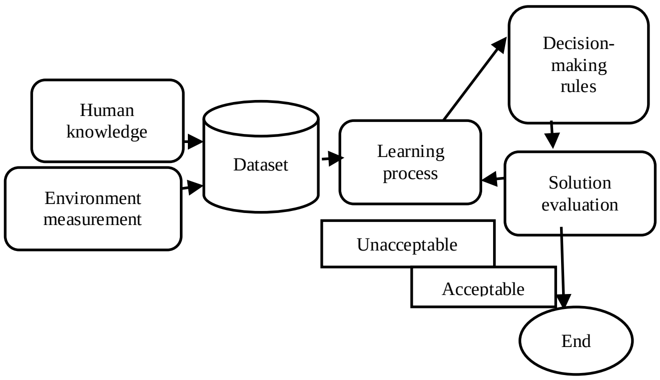

Fig. 5: Block Diagram of Decision Information Systems

Algorithm of Decision Information System

Displacement (M_j, C_k)

// M_j is the sequence of calendar month.

// C_k is the sequence of crop-set

// P_m is the total point of month i.e., $P_m = M_j + C_k$,

// where //$1 \leq j \leq 12$ and $1 \leq k \leq 12$.

// disp is a temporary variable for displacement of any

//crop-//set from ideal state, d is the output

//P_m, d and, disp are declared as integer variables and

// $M_w = 13$ initialize.

{

$P_m = M_j + C_k$;

if (P_m = = M_w) disp = 0;

if (P_m<M_w)disp = P_m –1;

if (P_m>M_w)disp = P_m – T_w;

if (disp ≤ 6){

d = disp;

}

else

{

d = 12 – disp;

}

}

Data Flow Diagram

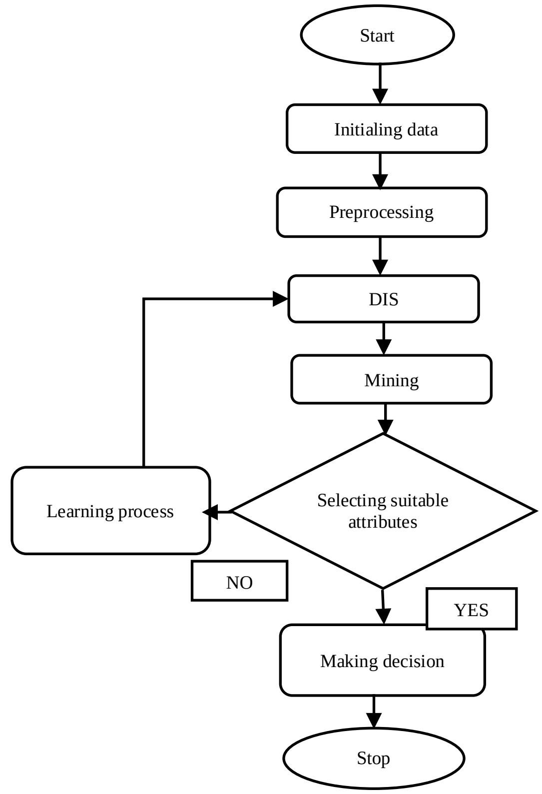

Fig. 6: Flow Chart of Decision Information Systems

Algorithm Steps

Step 1: It is loaded the data’s which will be classified as being ONE, TWO or THREE

Step 2: There are loaded the data are found in the folder dataset. The name of the files belonging to class ONE is: "modules", the ones belonging to class TWO are: "modules" and the ones for class THREE are: "modules".

Step 3: It is determined the a priori probability for each class:

IF (background. soil texture = sandy soil) THEN yield- 13%
IF (background. crop rotation = yes) THEN yield + 20%
IF (background. manager =with experience) THEN yield + 15%

Step 4: It is determined the probability that the data from the Step 1 to be in class ONE, TWO or THREE.

IF (ripening. typhoon =happened) THEN (yield - 30% AND Stop)

IF (heading. typhoon =happened) THEN (yield - 40% AND Stop)
IF (panicle initiation. typhoon =happened) THEN (yield - 25% AND Stop)

Step 5: If all the data are compared and predict the level of farm area and crops level and any defect occurs or not, then DIS makes the decision that the level of crops and Farm condition.

IV. RESULT AND DISCUSSION

In this table shows the daily updates of moisture level and Rainfall level based on this table we can say that if the moisture level increases then the rainfall level also increase.

Table 1: Moisture and Rain Fall Level

Day	Moisture Level	Rain Fall Level
Day 1	20	110
Day 2	25	120
Day 3	15	80
Day 4	30	140

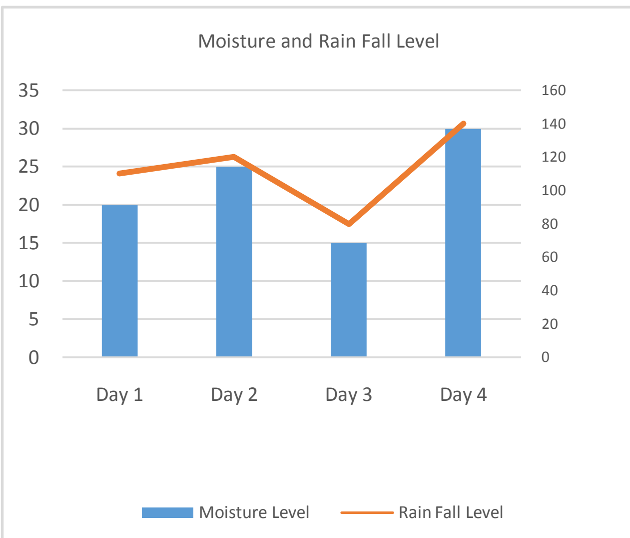

Fig. 7: Graph Representation of Moisture and Rainfall Level

Below table shows the difference between Humidity and Temperature level. From this table, if the Humidity level increases when the temperature level is reduced and the Humidity level decreases then the temperature level will increase.

Table 2: Humidity and Temperature Level

Day	Humidity Level	Temperature Level
Day 1	2	60
Day 2	2.5	55
Day 3	1	65
Day 4	3	45

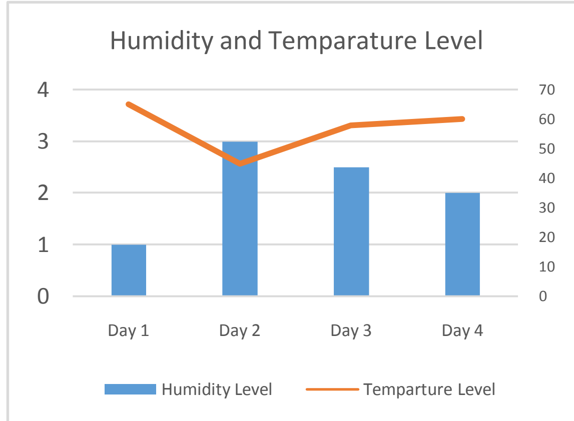

Fig. 8: Graphical Representation of Humidity and Temperature Level

Table III Show the Moisture, Rain Fall, Humidity and Temperature Level as day by day changes. From this table, if moisture, rainfall, and humidity level increases then the Temperature level will reduce.

Table 3: Moisture, Rain Fall, Humidity and Temperature Level

Days	Moisture Level	Rain Fall Level	Humidity Level	Temperature Level
Day 1	20	110	2	60
Day 2	25	120	2.5	55
Day 3	15	80	1	65
Day 4	30	140	3	45

V. CONCLUSION AND FUTURE WORK

In this paper, we proposed two techniques Polynomial Linear Regression algorithm and Decision Information System to make the perfect decision based on the data. Polynomial Linear Regression algorithm which is more efficient than AIS by an order of magnitude. The polynomial regression can become numerically unstable, especially if the degree is high or the function domain is not centered at zero. If the polynomial degree is too low, it will not be able to represent the complexity of the function being learned. Decision Information Systems (DIS) is a class of computerized information system that supports decision-making activities. A decision information system may present information graphically and may include an expert system or artificial intelligence (AI). Our paper shows the data collected from the sensors and comparing the data's with the training dataset to filter the data's for satisfied resulted from data. Then the Decision Information System Algorithm is to make the decision based on the filtered data. In this technique, the analyzed result is to send a information to a farmer and to the agricultural department to make a suitable solution for the growth of crops and detect the effect at starting stage and to resolve it earlier. This paper will produce a result as to it make the next level of agriculture to produce high growth and easy prediction.

In the future, we will try to deploy the actuators in the fields and we enhance the functionality of server by deploying genetic algorithm, artificial neural network and digital image processing techniques on the server. We can diagnose the diseases in a better way if we deploy the cameras in the fields. And include how to secure the access of the data and will develop a mobile application that allows access to the data on handheld devices. Once the agriculture fields are connected. In a few years, a huge amount of data will be connected through the sensors. That would lay the foundation for "Analytics" the core of IoT. The four types of analytics would then play an important role. Descriptive, Diagnostic, Predictive, Prescriptive.

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