# Advance Modeling of Agriculture Farming Techniques Using Internet of Things

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Now a days large number of problem occur in farming, Lack of water availability, poor soil condition, bad weather condition and no proper timings for cultivating crops. These problems arise due to static nature of values that are used for calculating all these problems. The problem can only be resolved by making a system dynamic. This paper presents the emerging IOT techniques that help in resolving such problems by using dynamic methodology. Smart framework will be developed that is having centralized control for water sprinkle, for soil condition a separate module will be developed that will check the soil composition and accordingly allows water intake. For weather condition and crop timings problem advance modeling will be done.

***Keywords:***
*Water availability, soil condition, weather condition, cultivating crops, sensors, IOT Techniques.*

## 1. Introduction

Network of things or objects that is accessible throughout the world supported by Internet is referred to as "Internet of Things (IOT)". As the technology revolutionized, these IOT enable devices helps static or physical objects to think, see, listen and perform various tasks by coordinating decisions and sharing information. Simple object can be easily transformed into smart objects by using IOT technology like embedded devices, sensor networks, pervasive and ubiquitous computing and most important communication technologies.

With the growing of IOT technology, huge numbers of physical objects are connected to internet at very fast and at large amount that leads to diverse range of many applications like smart cities (E, G, & I, 2013) (M & L, 2015) smart homes, health monitoring, remote healthcare, energy management, smart water.

Apart from these applications, IOT lead to the development of efficient and complex new applications with further technological complex challenges. The applications that are being developed using these latest newly evolved technologies must pass through certain phases like they should be tested, make improved real time deployment and verified. There are many simulation tools that are useful because they offer flexible, economical and quick way to test and verify the behavior of application. However there are certain assumptions on many important factors in testing environment which leads to huge uncertainty.

Physical characteristics and unpredictable events very much affect the wireless networks and IOT applications and the major drawback is that during simulation inaccurate results come out. To overcome these problems, there is a strong need to install real-time IOT based systems that conducts hardware experiments and provide tools for proper experimentation. There are several platforms for testing different architectures, topologies and hardware for different applications.

Large numbers of devices are involved in IOT interconnection. These devices are manufactured by different industries and due to this performance capability varies application to application and according to user requirements. A part from all these aspects architecture is also very important and this traditional internet architecture should be modified to IOT based system to meet the today's challenges and needs. ( Al-Fuqaha, Guizani, Mohammadi, Mohammed, & Ayyash, 2015)

There are different architectures that are used for different applications including smart city, smart home, smart industry, healthcare monitoring system based on patient's physiological paradigms. There are many other fields that uses internet of things like energy usage optimization, automating appliances. A part from these fields agriculture is also very important field to use the IOT technology. Many problems arise in farming techniques. There is a need to overcome problems to get maximum output.

Climate change has an impact on agriculture. Extreme weather conditions such as heavy storm, heat waves and heavy rainfall. These all factors can reduce crop production. One of the biggest drawbacks of heavy rain is that it can lead to water logging of soil and floods whereas in some parts of the world extreme hot weather can leads to acute water shortage. Weather conditions have also a drastic effect on environmental values such as seasonal events changes the life cycle of plants and animals. Many plants and animals have extinct and many are about to extinct and are in danger zone.

Agriculture or farming also consumes 70% of fresh water and water management will go hand in hand with assuring food safety. To overcome these problems and challenges, farming sector should be well equipped with innovative techniques and tools and most importantly use of IOT

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technology. Techniques should be used in such a way that leads to achieve better quantity, quality and financial returns.

## 2. Literature Review

Due to the efficient and cheap electronic components and increasingly global network, application of Internet of Things infuses to every walk of life. Thus for agriculture commencing automated farming methods, application of IOT is made possible. Many frameworks are presented that can assist in old traditional agriculture farming methods. Various sensors are used to sense different environmental data and similarly to control environmental factors different circuits were used (H, F, h, Q, & S, 2016).
Agricultural Information Technology has become very effective tools and means of enhancing agricultural farming productivity and is broadly applied to agriculture. It is also used for making use of maximum agricultural resources. Another term Agriculture Information Management is the sub technology of Agriculture Information Technology and is directly used to gather agricultural information and also used to make agricultural production decisions (Yan-e, 2011).
Various IOT architectures are accessible in the literature but they are limited to specific application and are not working on modular applications. There are large number of IOT applications in the world such as environment monitoring and healthcare platform (Xu, et al., 2014). Use of IOT in health care becomes dominant during recent years that help in enabling protective and safety medicine. IOT technology provides solution to build networks of connected and informed e-patients and communication among healthcare and patients takes place in real time (krishnan, Sai, & Mohanthy, 2015).
Main advantage of IOT platforms is provide reliable, low cost and portable devices that helps I collecting required information at fast speed with more accuracy ( Yelamarthi, Md Sayedul Aman, & Abdelgawad, 2017).
Another area is precision agriculture where efficiency, profitability and productivity is increased by IOT. To gather information remotely, agricultural environment is used and find out the area where problem is arising and where problem can arise, at the same time data storage takes place related to that particular problem and necessary action takes place according to gathered data. A part from data storage, data monitoring also takes place by using IOT (Li, Gu, & Yuan, 2016).
To control the water consumption, IOT platforms are used in irrigation. Farmers can take guidance from smart cloud based monitoring systems about soil condition and other problems (Sales, Remédios, & Arsenio, 2015). Many architecture are developed that consist of systems that will monitor activities by using triggering and handling methods. These methods will allow computation and communication to take place when an event occurs. This method helps in saving resources and human intervention also minimizes (Sales, Remédios, & Arsenio, 2015).
For providing availability and security, several architectures has been developed that consists of simulators, physical environment and emulators (Tonneau, Mitton, & Vandaele, 2015).
Now a days in agriculture computer based imaging and robotics are used to gain skills. Also science based solutions, technological solutions, GPS technology, climate forecasting and environmental controls are also used that result in maximum efficiency and less water wastage. It is necessary to train the farmers to make best use of these technologies. Smart farming is sensors based technology and its use is well established in many other industries like environmental monitoring for pollution, telematics for fleet management building management for farms and e-health for farming animals (Uday, 2015).
Smart farming is applicable in the following areas fleet management for tracking of farm vehicles, large and small farming, arable farming, stable and greenhouses, indoor farming, livestock monitoring, forestry, fish farming.
Agriculture farming faces many problems and challenges such as productivity growth slows down due to unfavorable conditions, arable land limited availability, change in climate. Need of fresh water increases high prices and availability of fuels and energy, impact of development on rural labor supply etc.

## 3. Proposed Smart Farming Framework

This framework comprises of six modules, sensory module to take input, processor module used to process data, actuators that helps in performing action, memory module helps in storing all data and information. Then the application management module and decision support system.

### 3.1 Sensory Module

Sensory Module is used to take all inputs that are required for processing. Sensory module is subcategorized in several parts. Environment data sensing is responsible to sense the environment and gather all specification. Environment factor control is responsible to control or sense the feasibility of environment and what type of condition is. Soil condition module is used to check the soil condition, either it is moist or dry, how much water is required for the soil and also what type of texture soil contains etc.
Another sub-module of sensory module is weather condition. Weather condition is the most important parameter in smart farming because all other parameters are dependent on weather condition. If weather is dry,

water evaporation takes place and more water is required. Similarly if weather is rainy then less or no water is required for the time being.

Crop cultivation is very much dependent on weather condition. Favorable weather is very important for the cultivation of crop and also water. Water availability is also an important module. Sensors are required that can sense the water quantity, water availability, water storage etc.

### 3.2 Processing Module

Processing module captures the data coming from sensory module and analyzes it. It takes data from data storage location and processes it by taking help from Application management Module (AMM).

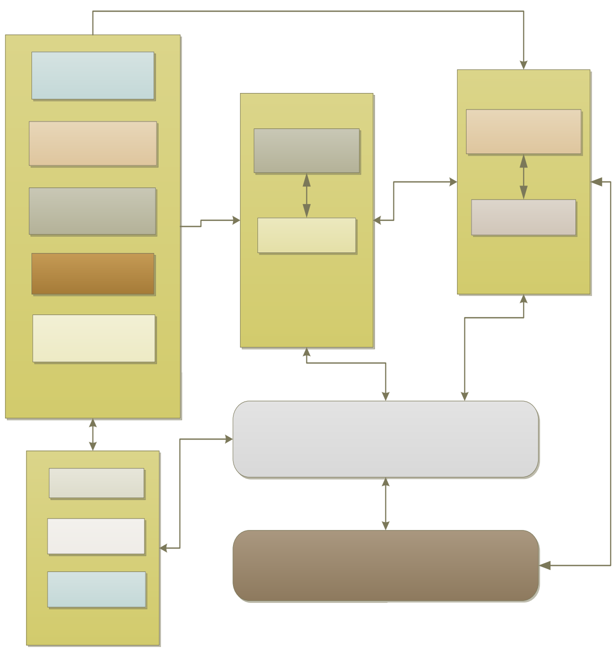

Fig. 1 IoT Based Smart Farming Framework

### 3.3 Actuators

Actuators contain two sub-module i.e. information collection and action. The information is collected from sensors and also taken from Application Management Module (AMM) and Decision Support System (DSS). This information is related to weather condition, soil condition, crop status, environment factors and water requirements. After receiving required output from DSS and AMM, action modules will perform the required action.

### 3.4 Memory

Memory module is very important module. All the data gathered from the sensory inputs, the data that is processed in processing module is stored in memory module. Action also taken on the basis of information already present in memory and on the basis of newly collected and processed data.

### 3.5 Application Management Module

Application Management Module (AMM) is the core part of Framework. It consists of complete server that handles all the tasks in the IOT smart farming. Internet connection that is used to store all manipulated and processed data into cloud and database. Basis data gathered from sensors are stored in Database and processed data is stored at cloud. To handle any bug or error application handler is used.

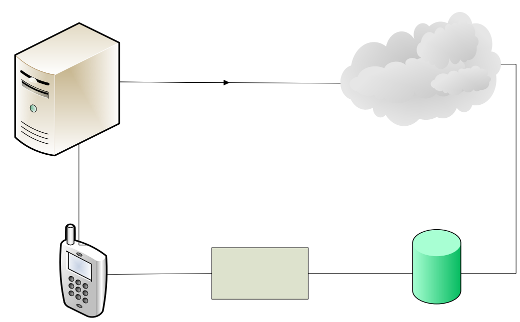

Fig. 2 Application Management Module (AMM)

### 3.6 Decision Support System

Decision Support System (DSS) is used to take decision according to data or information received from AMM and sends the final decision to Actuator module for final action.

## 4. Analysis and Results

Analysis of the following problem solutions were done with the help of using Fuzzy Logic. Fuzzy rule based system is designed to validate the proposed model. Inputs enter the system after passing through social network analysis phase. In this phase, group of networks interact each other to find the best possible solutions. Then this data passes to knowledge base for scaling and designing fuzzy rules and membership functions. Data passes to the input scaling as well as output scaling. Then the next step is the fuzzification and defuzzification of values.

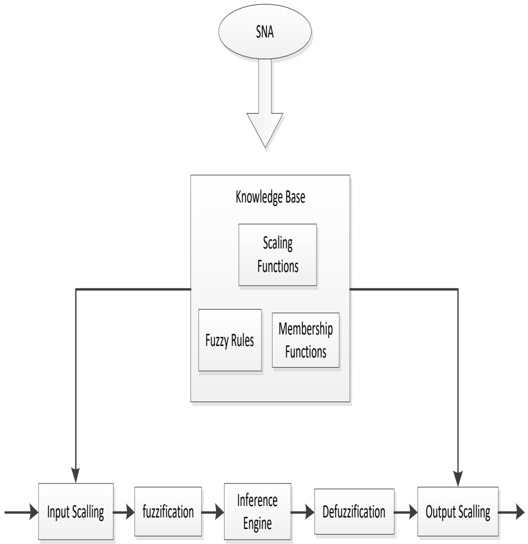


Fig. 3 Fuzzy Rule-Based System

## 4.1 Inputs

There are 5 input parameters Environment Data Sensing, Environment factor, Soil Condition, Weather Condition and water Requirements.

Table 1: Input Parameters Scaling

| Input parameters | Low | Medium | High |
|---|---|---|---|
| Environment Data sensing | 0-0.5 | 0.3-0.7 | 0.5-1 |
| Environment Factor | 0-0.5 | 0.3-0.7 | 0.5-1 |
| Soil Condition | 0-0.5 | 0.3-0.7 | 0.5-1 |
| Weather condition | 0-0.5 | 0.3-0.7 | 0.5-1 |
| Water requirements | 0-0.5 | 0.3-0.7 | 0.5-1 |

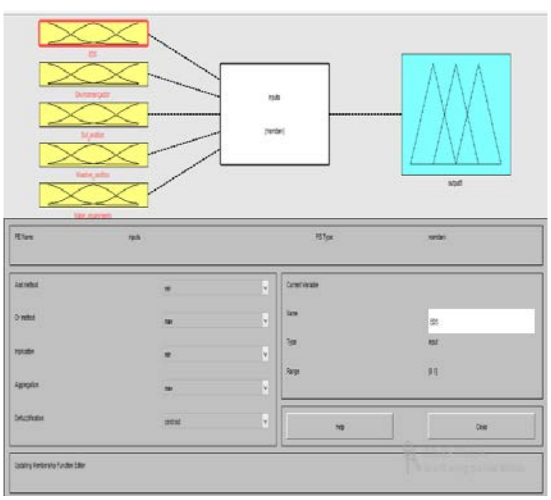

Fig. 4 Input parameters

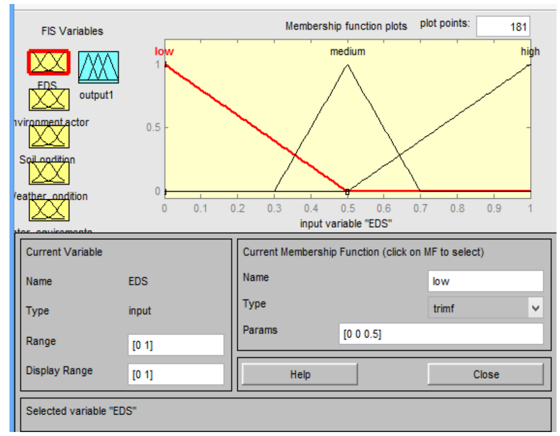


Fig. 5 Range of Input Variables

## 4.2 Rules

By using 5 input parameters 38 rules are designed to gain accurate output according to the running situation.

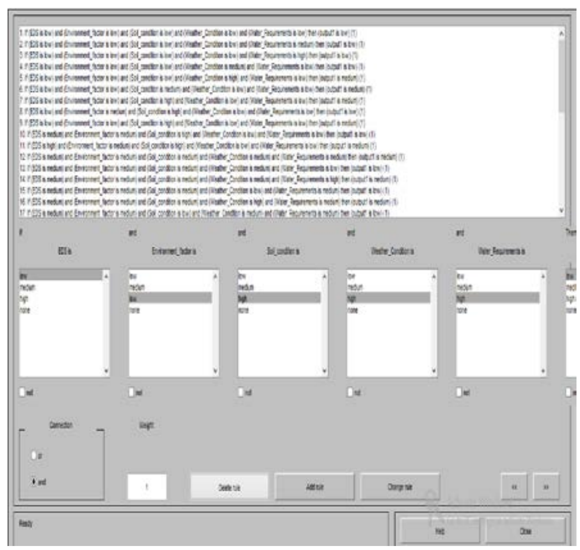

Fig. 6 Rules

Fig. 7 Rules

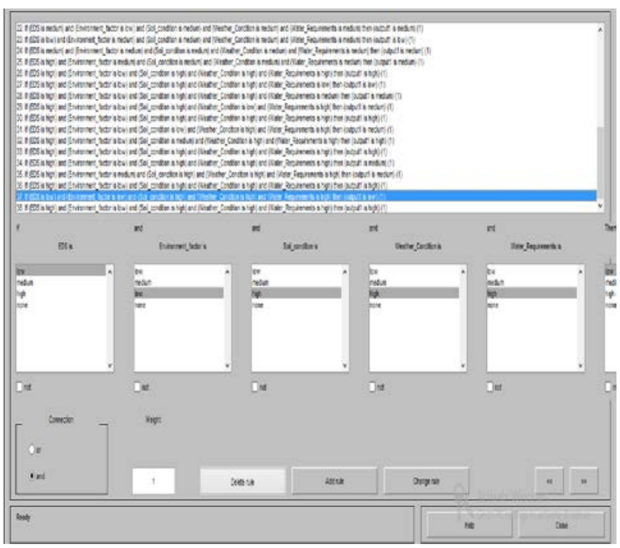

Fig. 8: Rules

### 4.3 Rule Viewer

Below is the rule viewer which shows the exact rule output format that came into being by using 38 custom formulated rules.

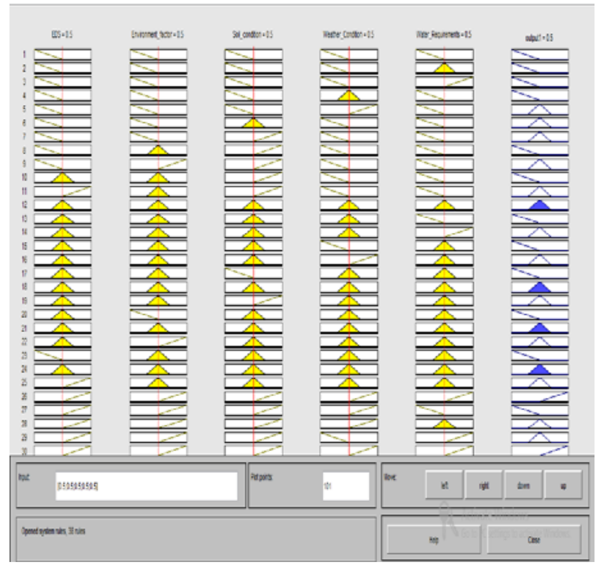

Fig. 9 Rule Viewer

### 4.4 Output

Output will be shown in the surface graph format. This graph is plotted by taking unique pairs of input parameters.

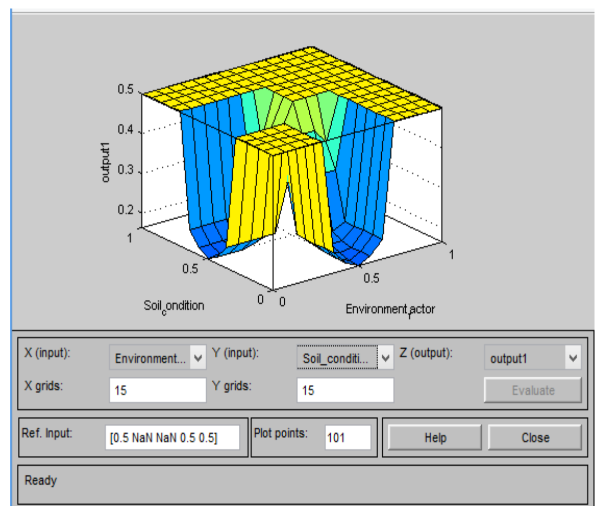


Fig. 10 Results in the form of Graph

## 5. Conclusion

There are large numbers of problems that arise in traditional agriculture farming methods such as lack of water availability, unfavorable environment, poor soil condition, weather condition and timings for cultivating crops. To overcome these problems smart agriculture farming can be used. A traditional method uses static ways that cannot be changed, but by using smart agriculture farming, methodology change to dynamic nature.

This paper presents IOT based framework to resolve agriculture problems. This framework consists of six modules that are connected with one another via internet and share data and information over the cloud. The processing module is responsible to process data that is gathered from sensory module. After processing it is send to actuators for action. Application management module is responsible to handle all the modules and is the core part of the framework. Decision support system is used to make decisions on the basis on processed input.

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