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A Novel Methodology For Smart Soil Management And Health Assessment System To Support The Contemporary Cultivation Using Ai On Mobile App Environment

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Abstract

The receding rate of agricultural workers is due to improper irrigation system, imbalance in NPK proportion in the soil, presence of toxic gases in the air, etcetera. Hence a system needs to enhance the level of farm mechanization in the country. This can be achieved by implanting smart cultivation. By enouncing smart cultivation we perpetrated automatic irrigation system, suggested the suitable organic fertilizers based on the soil type, detected the presence of noxious gases and persistently monitored temperature and humidity to find any catastrophic changes in the ambience. Further land records are maintained for future production. We designed a mobile application that helps the farmers with suggestion of fertilizers, indication of factors that affect the crop growth, attaining relief funds from the government and wild animal intrusion alert. This application gets the input from the device connected to the cloud from the agricultural field, hence it is easy to maintain the record of soil health and assessment of soil parameter as E certificate based on the E health certificate farmer can prefer the different crop for yield improvement along with qualitative and quantitative as a result the income to individual farmers can be enhanced since the data are uploaded to the IoT servers and easy identifying of the location where the productivity is high and healthier. Along with this we can propose the level of manure to be added to for the betterment of yield and improving the crop health

Keywords:- *Smart Irrigation, Land Record Management, Manure.*

1. Introduction

In focus to Indian economy one of the most important sectors are agriculture and digitalization. These two different sectors are located at the two corners on vertical scale of an Indian economy. With respect to the survey on modernization of agriculture, where connecting the both sectors it is notable that in recent years, farmers have facing problems on using the digitalization such as inadequate land record maintenance, poor measurement of low nutrients and lack in the knowledge of schemes supported by government and how to approach Government for financial effect due to natural disasters. These issues should be taken care for the improvement of crop productions and substantially irrigation must be proper for good crop production. Improper irrigation has a direct effect on crops grown, it leads to blemished crops. So it is advised to use the modernization tools to support the back bone of our nation. In connection to that, this paper implements auto irrigation system using various sensors to measure the parameters associated with the land and it will be updated to the web server for app view ability. Instead of doing irrigation at a constant time on a daily basis, we are measuring the moisture content and auto irrigation system is enabled when needed. Macro nutrient content plays a vital role in crop production. NPK ratio varies for each crop [4]. It should be in

correct proportion for healthy production of crops. The soil health depends on the physical, chemical and biological parameters present on that. Figure shown below assets the soil health parameter.

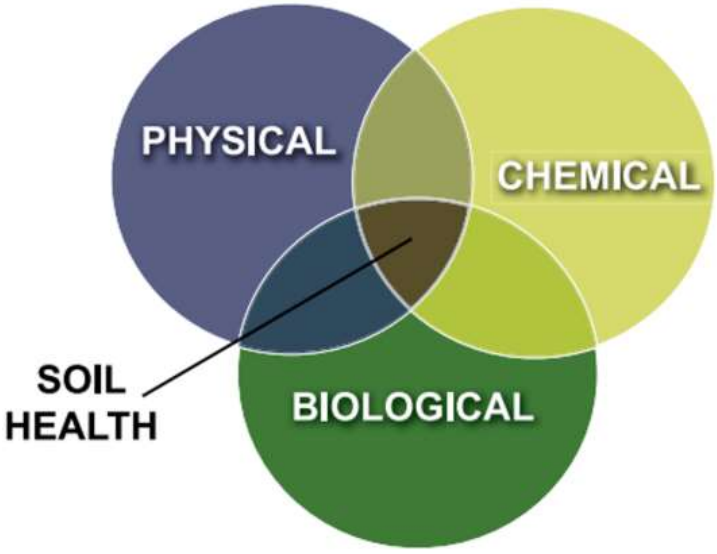

Fig 1: Variables connected to define Soil health

To bring in the correct proportion farmers are using pesticides in a large proportion. The survey by The Times of India dated November 18 states that 65% of Nitrogen, 18% of Phosphorous and 17% of Potassium in the agricultural field is due to chemical fertilizers [6]. Use of more chemical fertilizers in the soil reduces the fertility of the soil. On the other hand this NPK ratio balance must also be taken care. So we used Ph sensor we measure macronutrient content and based on the type of crop cultivated we will suggest organic fertilizers which will produce maximum yield. The crop production can also be damaged by temperature or any atmospheric changes. So we also measure temperature, humidity and presence of toxic gases using sensors. If there is any threat situation we will intimate the farmers via mobile application we developed. The mobile application is further used for land record management and during any natural disaster the farmers can reach government easily for relief funds.

The main objective of this paper is to remove the barriers on inadequate Land record Maintenance and minimize the lack in knowledge of various scheme supported by Government and how to approach Government for financial effect due to natural disasters along with poor measurement of low nutrients due to improper fertilizers and measures the increment level on high toxic minerals and suggest suitable Organic fertilizers.
The upcoming sections discuss on the soil health maintenance and effective ways to implement the design with required study of survey and conclusions.

2.Article Survey

India economic survey published in 2018, estimated that percentage of agricultural workers of total work force would drop to 25.7 per cent by 2050 from 58.2 per cent in 2001, various studies on implementing the smart agriculture was surveyed to develop the novel based systems. Most important consideration of IoT based system is selecting the controller for reliable operations. Probably the technical paper focus on the power reduction [1] on multiplier circuit otherwise the improving the computation of the centralized processor [2] which helps in improving the speed of response of a particular device used. Another article focused on the design of floating point [8] with the improving the speed of operation. These papers are taken into the consideration of chosing more suitable controller which consumes lower power and should occupies les space with high rate of response.The paper entitled “IoT and agriculture data analysis for smart

farm" by Jirapond Muangprathuba, Nathaphon Boonnama, Siriwan Kajornkasirata [9]describes how the agriculture was effectively used through IOT technology also in this paper the control box section was introduced and it is placed near to the field to monitor the different parameters such us water, moisture and humidity but fails to define the way to regularize the data management which may cause the series problem on collapsing the flow mechanism of a entire system.

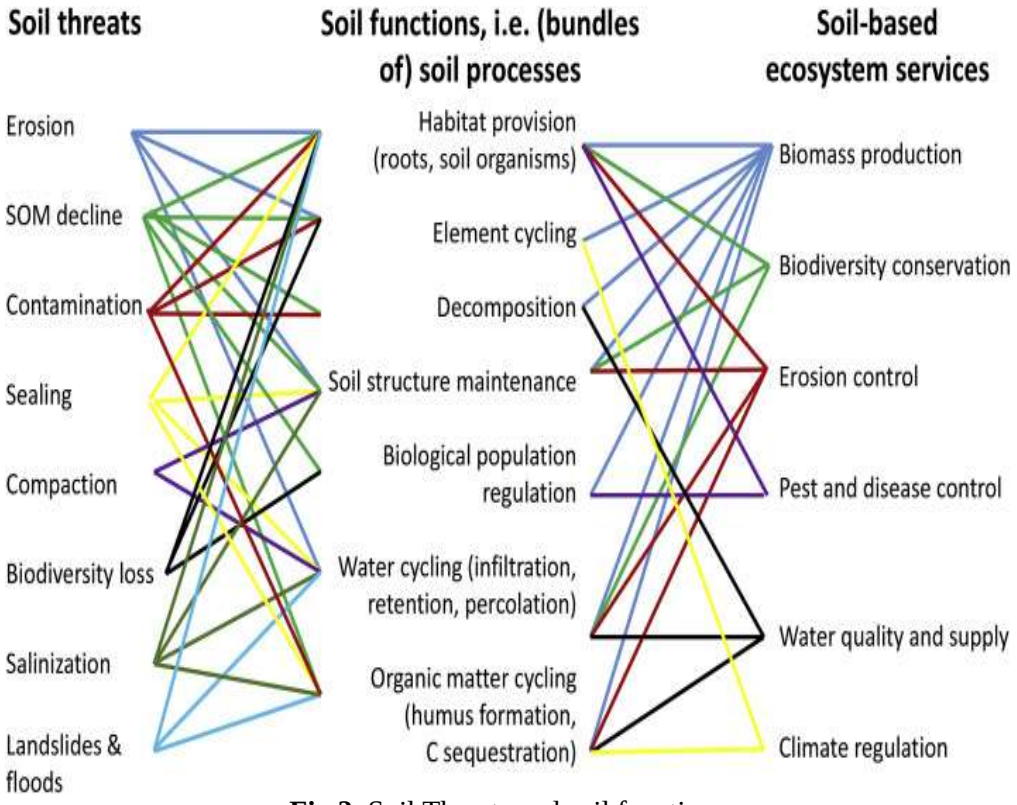

Fig 2: Soil Threats and soil functions

Another paper "An integrated system for regional environmental monitoring and management based on internet of things" [12], this application was developed to monitor the growth of the plant and reduce the cost of the re plantation with improvement on crop yields and this application based on WSN gave the statistical analysis to assist the farmers and to know about the productivity developed by Fang, S. The statistical data only helps the people who are having adequate knowledge on using it else it is complicated and mislead to reduction on crop yields.

Addition to this article "Soil Quality – critical review" [11] insight the ideas about the quality of soil and how to chose the soil for effective improvement on the crop productivity by analyzing the different threats of soli such as SOM decline, erosion and to identify the soil functions like infiltration, retention and percolation on water cycling to support the soil based eco system development. This article fulfills the needs about the creation on database but not connected to the IoT. Some of the research articles focused on the improving the efficiency [5] of the motors connected to the field and controlling the flow rate based on the humidity also few applications was developed to monitor the water level at the constant rate [6]. The present day technologies enabled the communication with clouds.

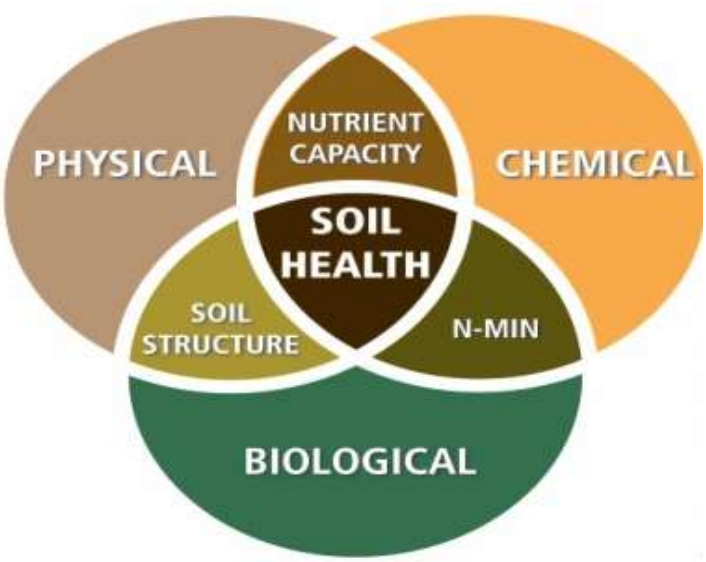

Fig 3 : Soil health assessment parameters

The wireless sensor network [4] makes a proper routing and communicating with the hardware and software to increase the speed and agility of the network and quite number of papers focused on the network resource allocation and utilization associated with them and distributed systems with web based application for the different range of communication. Hence the requirement of defining the system which interconnects the hardware and software is in high demand. The quality of service and the efficiency of the systems should maintain above the threshold level and regions of different fields. This paper provides the solution to the problems on soil health record maintenance and land record maintenance

3. Proposed Methodology

The prototype model of SensAgri- A Smart Soil Management and Health Assessment System has undergone the different process on parametric identification and analysis like temperature and Humidity, which detects any harmful disturbance in the ambience can be observed. Soil moisture, Ph sensor is used to find the macronutrient (NPK). The parameters were obtained through sensors connected to the wireless sensor to detect the variation on the climatic conditions and variables like water, air n humidity level in the field. Every field has the different variations on the humidity and water level on the soil and PH level of the particular field. So the sensor values are converted to digital values which can be easily readable by the centralized controller unit to take the necessary actions. The irrigation modules has three main sections such as Ph module to maintain the proper NPK proportion in the soil, temperature sensor and humidity sensor which is used to measures the level of toxic gases in the soil and moisture section to establish the automatic irrigation system and also the controller unit connected to the cloud via wireless sensor networks connected with that so that the user can access the data and control the action away from the field.

So the values obtained from the sensors were analyzed and with the values obtained is used to suggest the more suitable fertilizer for the betterment of crop, even the changes on the crop filed under different climatic conditions. This application also suggest the suitable organic fertilizer and variant to be added with that to improve the productivity and life of crop on the re plantation process. Further a mobile application is developed for land record management through which the farmers can easily appeal to the Government using the database taken from the cloud storage after any natural climatic conditions.

3.1) Hardware Blocks

The main heart of the sensagri is centralized processor (CPU), It connected to the different modules like irrigation module, Land record module, Module to suggest organic fertilizer and organic manure. The Irrigation module consists of temperature sensor, soil sensor and PH sensor along with the gas sensor.

Fig 4: Organization of all modules connected to the CPU

The functionality of sensor is to detect the physical parameter and covert to its equivalent values which is readable by the CPU. Although the sensors are different in configuration its connected via Centralized controller which works based on categorized different values based on the threshold defined by the user. The levels of temperature and humidity level will be varying for different filed and crops also. So the user can modify the value as per the requirement on the field or crop initially.

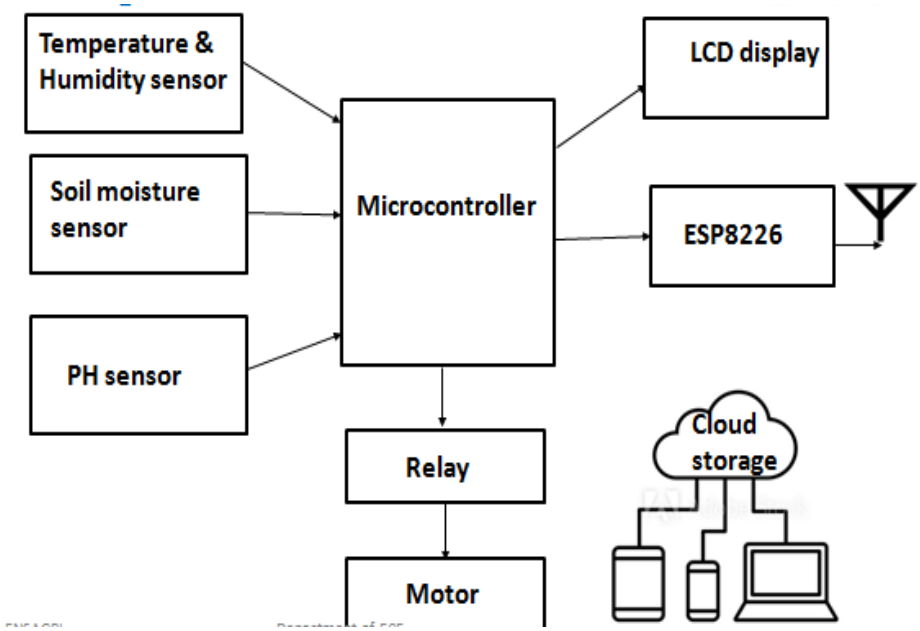

Fig 5: Irrigation Module

3.2) Animal Intrusion Block

Another block of this project work is identifying the animal intrusion in the agricultural field. The important aspect of human who is in field is protecting the agricultural land from the intrusion of animal. The animal intrusion can be viewed as serious issue when the field is located near to mountain or the place where animal intrusion is easily happened via defined routes where animals (Elephants and Fox, deer) follows the same path. So the idea behind is to protect the field from the animals by observing the shape of animal via camera connected to it, After that the image can be extracted as texture. It will be compare with the features available with the database and it could be easily to alert the system and to identify the type of mammals on the field. The below flow graph predicts the way to make alert system

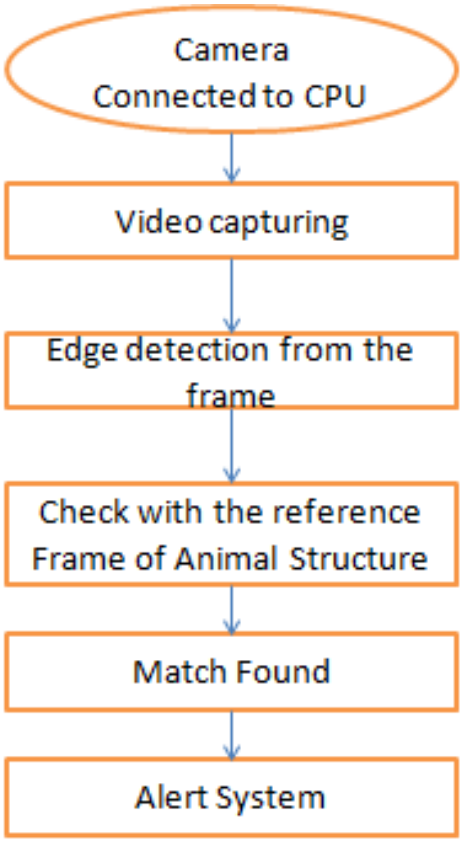

Fig 6: Animal Intrusion

3.3) Block for suggesting Manure

The one more feature block of this system is suggesting the level of organic fertilizer and illustrating the methods to create the manure to be full of enzymes and free from pesticides. This application hold the database where the real time processing of manure is quoted. Hence whenever the need for manure is required this application will be useful to identify the more suitable natural manure also suggest the ways to create the manure from the available resource of data and this method insist the need for manure and a crop to be free of inorganic fertilizer

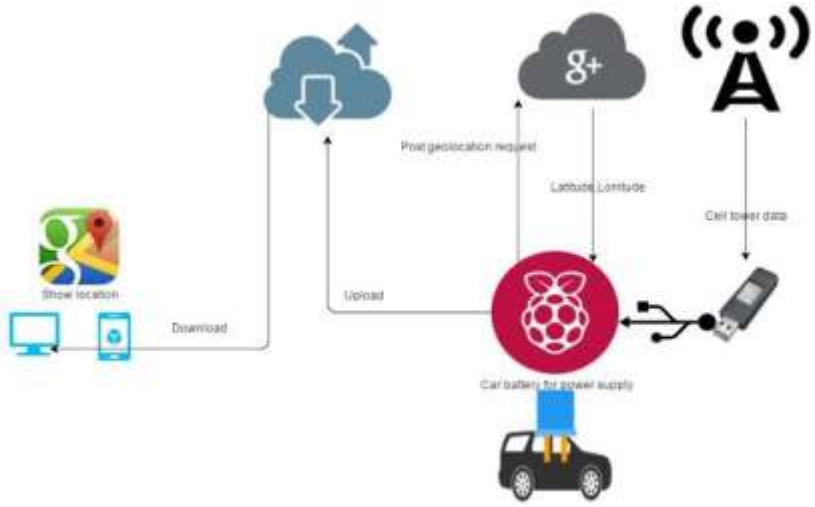

Fig 7: Land Record Maintenance

Since SensAgri is an interface of hardware and software a controller that has an inbuilt Bluetooth and wi-fi features. Hence we prefer raspberry pi3 model that comes with a 4.2 Bluetooth which can provide a much faster and greater connection of Ethernet and a dual-band Wi-Fi which means that can provide both 2.4 GHz wireless and 5 GHz.

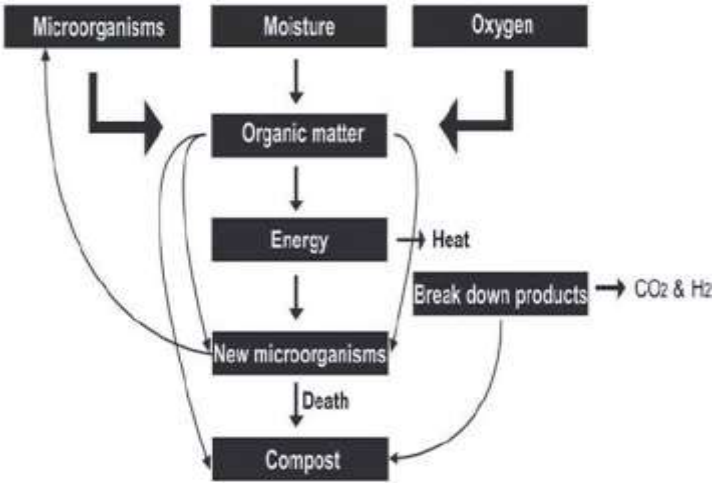

Fig 8: Module for suggesting Organic manure

Fig 9: Centralized controller and Sensor

Fig 9 & Fig 10 Shows the few hardware blocks associated with blocks and experimental setup blocks to maintain control block and how the hardware are connected and placed in the fields. The soil on the field may affect the devices so to protect this using a chamber of closely connected where outlets and pins for sensory unit is communicated with the real time to process the data to the cloud and to control the signal using via mobile connected device

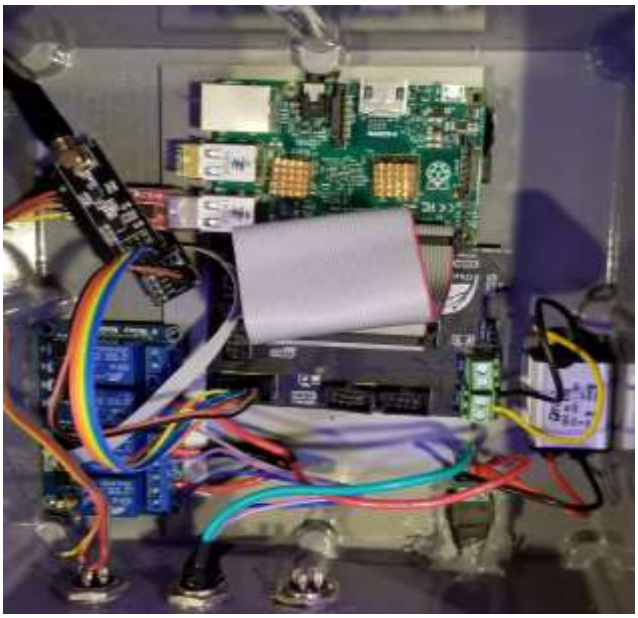

Fig 10: Experimental setup

4. RESULTS & DISCUSSIONS

SensAgri is a user-friendly mobile application compatible in different versions like android and iOS, tends to monitor the crops periodically. Hence the users could read the environment parameters like temperature, humidity and gas sensor and Ph level of soil chosen. User also can compare these metrics for a particular period of week, day, from month to month even for a half yearly productions to assess the status of their crop. The sensor values are available as graphical data.

FEATURES OF THE APP

- Suggestion of Organic fertilizers.
- Weather forecasting.
- Relief fund can be approved for the farmers based on the database.
- Contact details of agricultural authorities are provided.
- Updating of soil parameter (Temperature, Humidity, Soil moisture) for longer period.

The app contains the login page where the users can login into the app by providing their name and password. They can select the type of field needed for the cultivation of crops and can also add and delete fields according to their need.

Fig 11: Screenshots of Mobile app

Also to train the machine learning based algorithms the parameters like temperature, humidity, moisture and ph values of a particular field are taken from the sensors and centralized controller connected to it. The database is created so that the user can communicated to the portal via IoT enabled technology. Table shown below indicates the raw data obtained from the Field and its marked as reference to set the threshold level and used to do a particular operation and to track the field variation based on the different training set.

Table 4.1: Sensory values to train the Dataset.

Temperature		Relative Humidity	PH Value	Moiture contnet	Soil Moisture	
Min	Max				well water	water deflict
24.3	28.3	74.4	8.95	12	19.8	8.2
24	29	70.4	9.64	11.3	19.9	7.4
23.1	27.1	79.1	9.45	11.2	20.4	7.8
27.2	29.4	68.3	8.2	10	19.1	7.1
26.1	32.6	79.1	8.45	11	19.6	7.6
24.1	27.4	62.4	8.5	11	19.2	7.15
23.6	26.7	60.5	8.4	10.9	20.6	7.9
21.1	23.7	63.8	8.1	9.1	18.6	6.2

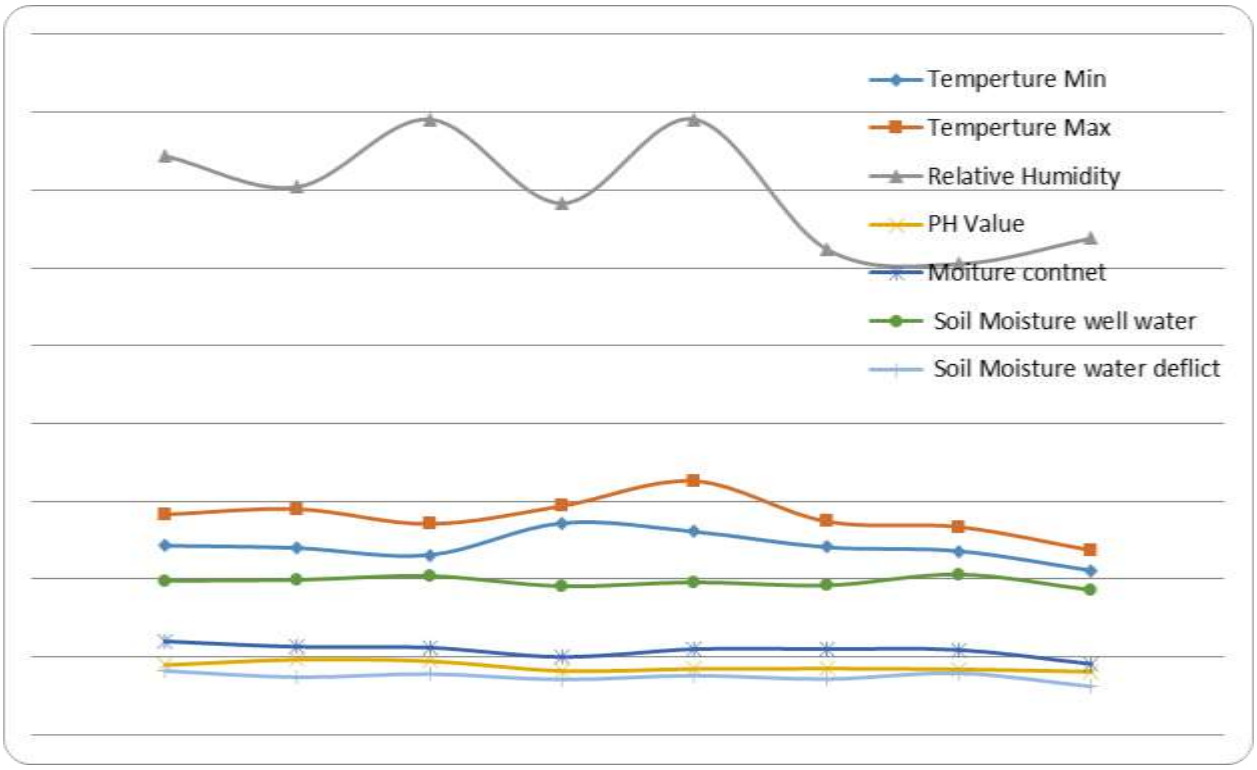

Fig 12: Comparison of real time data

5. Conclusion & Futuristic Improvement

On real time applications this report of analysis shows that an improvement on the quality and quantity of products. The hardware connected block implemented with the cloud and IoT. The real time data are collected via sensory unit and every time it has been updated to the cloud for the decision making. This app can be used for improving the commodity by fixing the price for the cultivated products universally and to know the place where the demand is high. This system is the integration of different modules like irrigation module, land record maintenance module, wild animal intrusion alert system. Through the record of database former can view the growth of crop for a period of cultivation time. Even it is possible to view the changes happened at the crop due to variation in the micro and macro nutrient contents of the soil. This app also suggest the type of manure for the betterment of plant growth and different ways to be considered for the creation of organic manure to overcome the unwanted usage of artificial fertilizers. This system leads to cultivation is more simple and healthier. In future this project can be further made more efficient by including some additional feature like detecting the plant diseases using image segmentation and analysis. Hence we can diagnose the disease at early stage and improve the productivity of the crop.

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