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# A Novel IOT Based Solution for Agriculture Field Monitoring and Crop Prediction Using Machine Learning

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**ABSTRACT:** Agriculture is demographically the broadest economic sector and plays a significant role in the overall socio-economic fabric of India. Agriculture mainly depends on the soil properties and irrigation water. Due to the change in the weather and climatic conditions, traditional farming systems based on the old beliefs fail to give better result. Proper irrigation has to be done to acquire better Results. Recent development in the technology has a great impact on agriculture. This paper highlights the work done in ML and IOT. In this paper we discuss the Remote monitoring of soil properties using IOT which has an potential to transform agricultural practices. And also a machine learning model to predict the crop based on the soil properties which lead to increase the high yield productivity.

**KEYWORDS:** Agriculture, Soil Monitoring, IOT, Machine Learning, crop prediction.

### I.INTRODUCTION

In a country like India, agriculture is the most prominent sector where the country's major income depends on these fields. About 60% of the land in the country is used for the agriculture and more than 50% of population depends on agriculture. Agricultural Automation especially in developing countries can help on effective yield and reduce human intervention.

Now-a-days Internet of Things (IOT) was being used in various sectors. India being an agricultural country it needs some innovations in the field of agriculture. For Remote Monitoring of the soil properties we need an IOT based system. Internet of things sometimes referred to as the Internet Of Everything(IOE) which consists of all the web enabled devices that collect, send and act on data they acquire from their surrounding environments with embedded sensors, processors and communication hardware.

Various sensors are embedded in the farm to know the soil information. Basically the soil parameters are Soil pH, soil Moisture, Temperature and Humidity. These basic parameters of the soil will help in characterizing the soil and therefore in taking proper decisions.

Machine Learning is an emerging technology which is a subfield of computer science and Artificial Intelligence that focuses on the design of systems that can learn from and make decisions and predictions based on the data. Based on the Machine Learning algorithms the crop has been predicted which gives the better yield. This paper is an attempt to study the various Machine Learning as well as IOT techniques applied to the agriculture sector to predict soil moisture, soil PH, and other factors affecting agriculture.

The structure of the rest of this paper is as follows. It describes the Machine Learning Applied in Agriculture Sector. And also describes the Application of IOT in Agriculture. Finally we did a comparative study on all the above mentioned methods .

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## II. RELATED WORK

### Machine Learning Applied in Agriculture Sector

In the present trend Machine Learning is the emerging technology. Machine Learning is one of the fields in artificial intelligence. It uses the statistical technique to give the computer systems the ability to learn from the given data without being explicitly programmed. "A computer program is said to learn from experience E with respect to some task T and some performance measure P, if its performance on T, as measured by P, improves with experience E." [Tom Mitchell, 1979]. In order to do the predictions machine learning is appropriate. Machine learning tasks are classified into several broad categories. Two main classifications of Machine Learning algorithms are supervised and unsupervised. In supervised learning a pre-defined training data set is provided which helps in predicting the values and gives a new data. Whereas in unsupervised learning there will not be a training data set. It will be provided with lots of data to learn on its own by identifying patterns and relationships.

Several models are present to predict the crop for the farm. Some of the algorithms used in the prediction are support vector machine (SVM), linear regression, Naive Bayes and decision trees.

The traditional farming sometimes may lead to losses due to natural disaster or some other changes in climate. N. Deepa et al.'s proposed a decision making tool for the crop selection [3] which helps in the improvement of crop yield. The input variables were categorized into 6 main variables such as soil, water, season, input, support and infrastructure. In this [3] it uses dominance-based rough approach for determining the priority weights for the variables. To convert sub-variable sequences to main variable sequences a simple additive method is applied to the evaluation scores of the main variables which in turn was calculated by applying the weights of sub variables. Johnson's algorithm is one of the most efficient methods to calculate the minimal subset by calculating discernibility matrix. The evaluation result was applied to Johnson's reduct algorithm and by this the classification rules were generated. The accuracy of classification was calculated using the formula:

$$\text{Accuracy} = \frac{n}{N} * 100$$

Where n is the number of sites correctly classified by the tool and

N is the total number of sites considered for validation.

Rakeshkumar et al.'s have proposed a crop selection method (CSM) to solve the crop selection problems and to increase the crop yield [4]. In this paper comparative analysis of all the Machine Learning algorithms such as Artificial neural networks, Random Forest, Decision Trees, Support Vector Machine, Gradient Boosted Decision Tree (GBDT), Regularized Greedy Forest (RGF).

An ANN is an interconnection of weighted processing unit. A processing unit takes input from previous processing unit or from outer unit and transfer output to other processing unit. An artificial neural network is used when number of input attribute n. The advantage of support vector regression is to avoid difficulties of using linear function in large input samples space and optimization of a complex problems transformed into simple linear function optimization is lesser. Support vector machine used for crop yield prediction is called support vector regression. Random Forest is a bagging technique which is based on tree ensemble machine learning method. Random Forest can be used in high dimension input predictor a globally optimized decision tree is created in RGF whereas locally optimized decision tree is created in GBDT. RGF takes advantage of tree structure as it works on fully corrective regularized steps whereas GBDT does not take advantage of tree structure as it works on partially regularized steps. RGF works faster and more accurate than GBDT for regression problem. In this the author proposed a method named Crop Selection Method (CSM) to achieve net yield rate of crops over season.

Crop can be classified as:

1. Seasonal crops— crops can be planted during a season. eg. wheat, cotton.
2. Whole year crops— crops can be planted during entire year. eg. vegetable, paddy
3. Short-time plantation crops— crops that take short time for growing. eg. potato, vegetables,
4. Long-time plantation crops— crops take long time for growing. eg. sugarcane, canda.

Performance and accuracy of CSM method depends on predicted value of influenced parameters, so there is a need to adopt a prediction method with more accuracy and high performance.

**R.Nagini et al.** explains an Explorative data analysis and discusses about designing of various predictive model [5]. A sample data set is taken and various regression techniques are applied in order to identify and analyse the properties of

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each. Various regression techniques discussed are Linear, Multiple Linear, non-Linear, Logistic, Polynomial and Ridge regression. Using this paper, comparative study of various data analytics algorithm is obtained. This helps us to judge which algorithm best suits our proposed system.

## Application of IOT in Agriculture

Internet of Things (IOT) refers to the use of intelligently connected devices and systems to leverage data gathered by embedded sensor actuators in machines and other physical objects. Internet of Things is a concept which enables interaction among the objects that are present in environment. Now-a-days IOT is being used in the agriculture. Several sensors are provided to know the values of soil pH, soil moisture, temperature and humidity.

Prathibha SR et al., proposed work on IOT based monitoring system in smart agriculture [6]. The aim of the paper is to make use of emerging technology i.e. IOT and smart agriculture using automation. To improve the yield of the crop all the environmental factors plays a significant role. In this paper it provides the temperature monitoring and humidity in the field through the sensors. In the proposed system CC3200 is the main block which consists of micro controller, network processor and Wi-Fi unit on the same line. To sense the temperature value in the farm it uses the Temperature infrared thermopile sensor- TMP007, which is used to sense the real time temperature values. This sensor has a built in digital control and math engine. To know the moisture of air with in the farm it uses the humidity sensor –HDC1010. Camera is interfaced with CC3200 to capture images and send that pictures through MMS to farmers mobile using Wi-Fi. For this it uses the camera booster pack via PCB using MT9D111 camera sensor. This paper gives the environmental details in the farm to farmer by the MMS. This reduces the human intervention and help in taking appropriate decisions for increase in the crop yield.

RajaLakshmi et al.'s developed a IOT based system using sensors to monitor the crop field[7]. The author uses the different sensors like soil moisture, light, temperature and humidity. It undergoes in 3 phases.

1. Data collection phase
2. Storing in database
3. Data processing.

The data collected from the sensors is sent to the micro controller, here it uses the arduino board and the data is stored in the database through the wireless transmission. The data will be processed in the last phase and the decision will be taken. If the values are below the expected level a message will be sent to the farmer.

R.N Rao et al.'s main aim is to provide the required water to the farm at correct time[8]. In this the author uses the soil moisture sensor, humidity sensor, temperature sensors and also calculates the duration of sunshine per day. Based on this calculations required amount of water will be supplied to the farm. A Raspberry Pi and a cloud based IOT system is used to monitor the real time data of the crop field.

## III. CONCLUSION

Agriculture is the predominant sector where major enhancements have to be done. In this paper we have analysed some of the crop prediction methods based on their accuracy using Machine Learning algorithms and the real time monitoring of soil properties using the IOT. The algorithms are used for the better crop prediction based on the soil properties will ensure in good quality and quantity of the crop.

There is a need to further enhance IOT with machine learning techniques to improve real time use of sensors in agriculture. IOT applications must be easy to use so that the farmers can take the advantage of it. We need to develop applications to analyse data captured by sensors in real time using Machine learning algorithms

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