Smart Farming using IOT and Machine Learning with Image Processing

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***Abstract*—Internet of Things (IoT) plays a crucial role in smart agriculture. Smart farming is an emerging concept, because IOT sensors capable of providing information about their agriculture fields. The project aims making use of evolving technology i.e. IOT and smart agriculture using automation. The proposed framework causes Farmer to enhance quality and amount of their farm yield by detecting surrounding temperature and moistness esteems, soil dampness esteem and water level of the tank from the field with no human intercession. By utilizing the idea of IOT framework can be more effective. In propose work, Farmer capture the disease photo and upload photo, via machine learning farmer can get disease information and solution to disease.**

***Index Terms*—IoT, Machine Learning, Image Processing, Smart Farming, Agriculture, Disease Image.**

I. INTRODUCTION

Agriculture adds to a noteworthy segment of India's Gross domestic product. Considering and foreseeing natural conditions, cultivate efficiency can be expanded. Product quality depends on information gathered from field, for example, soil dampness, surrounding temperature and stickiness and so on. Smart Agriculture is produced utilizing an NodeMCU microcontroller. The Farmer can monitor the controlling actions taken at the farm via android app on farmers mobile phone and details of soil tastings are also available in it. The user can monitor the controlling actions taken at the farm as well as control the irrigation via android app on farmers mobile phone.

Internet of Things (IOT) plays a crucial role in smart agriculture. Smart farming is an emerging concept, because IOT sensors capable of providing information about their agriculture fields. The project aims making use of evolving technology i.e. IOT and smart agriculture using automation. Monitoring environmental factors is the major factor to improve the yield of the efficient crops. The feature of this project includes monitoring temperature and humidity in agricultural field through sensors using CC3200 single chip. Camera is interfaced with CC3200 to capture images and send that pictures through MMS to farmers mobile using Wi-Fi.

With the growing adoption of the Internet of Things (IOT), connected devices have penetrated every aspect of our life, from health and fitness, home automation, automotive and logistics, to smart cities and industrial IOT.

Thus, it is only logical that IOT, connected devices, and automation would find its application in agriculture and, as such, tremendously improve many facets of the farming practice. How could one still rely on horses and plows when self-driving cars and virtual reality are no longer a sci-fi fantasy but an everyday occurrence?. Farming has seen a number of technological transformations in the last decades, becoming more industrialized and technology-driven. By using various smart agriculture gadgets, farmers have gained better control over the process of raising livestock and growing crops, making it more predictable and efficient. In this project, we will explore the IOT use cases in agriculture and examine their benefits. If you are considering investing in smart farming or planning to build an IOT solution for agriculture, dive right in.

There are many ways to refer to modern agriculture. For example, AgriTech refers to the general application of technology to agriculture. Smart agriculture, on the other hand, is mostly used to denote the application of IOT solutions in agriculture.

Although smart agriculture IOT, as well as industrial IOT, arent as popular as consumer connected devices, the market is still very dynamic. The adoption of IOT solutions for agriculture is constantly growing. Namely, BI Intelligence predicts that the number of agriculture IOT device installations will hit 75 million by 2020, growing 20 % annually. At the same time, the global smart agriculture market size is expected to triple by 2025, reaching dollar 15.3 billion (compared to being slightly over dollar 5 billion back in 2016).

Because the market is still developing, there are still ample opportunities for businesses willing to join in. Building IOT products for agriculture within the coming years can set you apart as an early adopter and, as such, help you pave the way to success.

A plant disease is a physiological abnormality. Once a plant suffers from any diseases it shows up certain symptoms. symptoms are the outward changes in the physical appearance that are gradually developed and can be witnessed by naked eyes. Illustrations of symptoms are wilt leaf spots, rots, cankers and many more. The visible effects of disease can broadly categorize in following types: Wilting, Spot, Powdery mildew, Galls, Dryness.

II. Review of Literature

IOT Based Monitoring System in Smart Agriculture, 'Internet of Things' is far and wide castoff in relating devices and gathering statistics. This agriculture monitoring system serves as a reliable and efficient system and corrective action can be taken. Wireless monitoring of field reduces the human power and it also allows user to see accurate changes in crop yield. It is cheaper in cost and consumes less power. The smart agriculture system has been designed and synthesized. The developed system is more efficient and beneficial for farmers. It gives the information about the temperature, humidity of the air in agricultural field through MMS to the farmer, if it fallout from optimal range. The system can be used in green house and temperature dependant plants. The application of such system in the field can definitely help to advance the harvest of the crops and global production. In future this system can be improved by adding several modern techniques like irrigation method, solar power source usage.

An Overview of Internet of Things (IoT) and Data Analytics in Agriculture: Benefits and Challenges, An overview of IoT and data analytics in agriculture has been presented in this article. Several areas related to the deployment of IoT in agriculture have been discussed in detail. The survey of literature shows that there are lots of work ongoing in development of IoT technology that can be used to increase operational efficiency and productivity of plant and livestock. The benefits of IoT and data analytics, and open challenges have been identified and discussed in this paper. IoT is expected to offer several benefits to the agriculture sector. However, there are still a number of issues to be addressed to make it affordable for small and medium scale farmers. The key issues are security and cost. It is expected that as competition increases in the agriculture sector and favorable polices are being implemented the adoption rate of IoT in agriculture will increase accordingly. One major area that is likely to draw lot of research attention is the deployment of low power wide area communication technology for agriculture purposes. The NB-IoT is expected to stand out among the LPWA technologies. This is because of the 3GPP open standard and adoption by the telco companies.

IOT Based Smart Agriculture System , IOT based smart agriculture system can prove to be very helpful for farmers since over as well as less irrigation is not good for agriculture. Threshold values for climatic conditions like humidity, temperature, moisture can be fixed based on the environmental conditions of that particular region. The system also senses the invasion of animals which is a primary reason for reduction in crops. This system generates irrigation schedule based on the sensed real time data from field and data from the weather repository. This system can recommend farmer whether or not, is there a need for irrigation. Continuous internet connectivity is required. This can be overcome by extending the system to send suggestion via SMS to the farmer directly on his mobile using GSM module instead of mobile app.

Smart Farming Using IOT, Even today, different developing countries are also using traditional methods and backward techniques in agriculture sector. Little or very less technological advancement is found here that has increased the production efficiency significantly. To increase the productivity, a novel design approach is presented in this paper. Smart farming with the help of Internet of Things (IOT) has been designed. A remote controlled vehicle operates on both automatic and manual modes, for various agriculture operations like spraying, cutting, weeding etc. The controller keeps monitoring the temperature, humidity, soil condition and accordingly supplies water to the field. Based on using the green energy and smart technology the agriculture sector will find better productivity

A Model for Smart Agriculture Using IoT, The paper proposes a wise agricultural model in integration with ICT. ICT have always mattered in Agriculture domain. Village farmers may have planted the "same" crop for centuries, but over period, weather patterns and soil conditions and epidemics of pests and diseases changed. By using the proposed approach, received updated information allows the farmers to cope with and even benefit from these changes. It is really challenging task that needs to provide such knowledge because of highly localized nature of agriculture information specifically distinct conditions. The complete real-time and historical environment information is expected to help to achieve efficient management and utilization of resources.

III. Proposed System

Our System motivation is the loss of crops and its quality by use of wrong watering techniques and attacks of animals in agriculture. So we are modifying advanced automatic system which will improve crop quality and avoid crop damage with the use of wireless technique with IOT and android App. The Farmer can monitor the controlling actions taken at the farm via android app on farmers mobile phone and details of soil tastings are also available in it. In propose system farmer upload image of disease plant via android application, and recieves disease information , solution to particular disease.

IV. System Architecture

V. Algorithm

A. Polling

– procedure polling controller
– begin:
– sensorValue readSensor();
– sendMsgToServer(sensorV alue);
– loop:
– if resultAvailable() then
– result readResult();
– applyValue(result);
– goto begin;

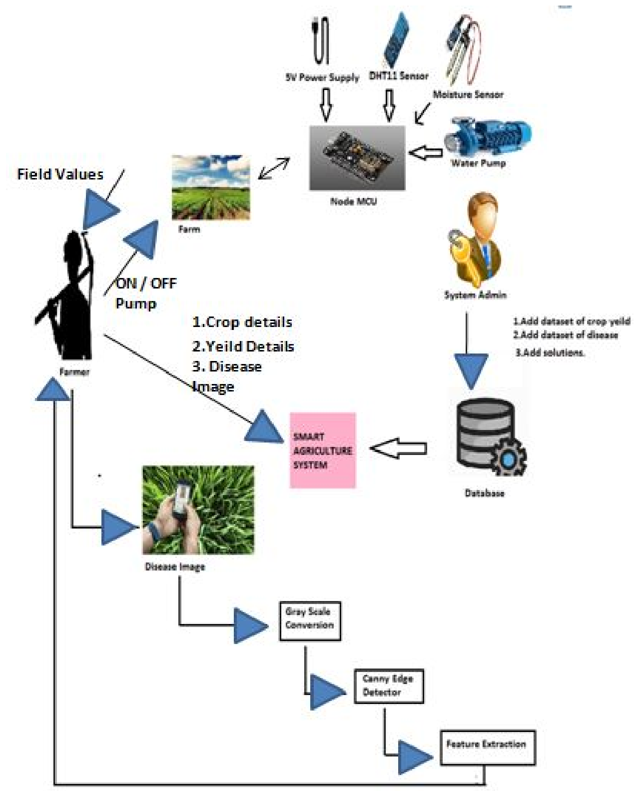

Fig. 1. System Architecture

– goto loop;

B. SVM

Input: Input: D dataset, on-demand features, aggregation-based features,
Input: Output: Classification of Application

1) for each application image_id in D do
2) Get on-demand features and stored on vector x for image_id
3) x.add (Get_Features(image_id));
4) end for
5) for each application in x vector do
6) Fetch first feature and stored in b, and other features in w.
7) $hw, b(x) = g(z)$ here $z = (wTx + b)$
8) if (z =0)
9) assign g(z)=1;
10) else g(z)=-1;
11) end if
12) end for

C. Decision Tree

Decision tree induction is the simple learning method of decision trees from class training tuples.
Steps:

1) Check if algorithm satisfies termination criteria.
2) Computer information-theoretic criteria for all attributes.
3) Choose best attribute according to the information-theoretic criteria for construction of tree.
4) Create a first node i.e decision node based on the best attribute in step 3.
5) Split the dataset based on newly created decision node in step 4 as per decision node.
6) For all sub-dataset in step 5, call C4.5 algorithm to get a sub-tree (recursive call).
7) Attach the tree obtained in step 6 to the decision node in step 4 for tree construction.
8) Return tree.

D. Naive Bayes

Naive Bayes model is easy to build and particularly useful for very large data sets. Along with simplicity, Naive Bayes is known to outperform even highly sophisticated classification methods.

Bayes theorem provides a way of calculating posterior probability P(c|x) from P(c), P(x) and P(x|c). Look at the equation below:
$P(c|X) = P(x|c)\ P(c) / P(x)$
$P(c|X) = P(x1|c) \times P(x1|c) \times \ldots \times P(xn|c) \times P(c)$

VI. MATHEMATICAL MODEL

Let S be the whole system,
S = { I, P, O}
Where,
I = Input,
P =Process,
O = Output
I = { I1, I2, I3, I4, I5}
Where, I1 = Soil Moisture
I2 = Temperature/Humidity
I3 = Crop details
I4 = Yield details
I5 = Disease image
P = {P1, P2, P3}
Where, P1 = Check if moisture is greater or lower than threshold
P2 = Find temperature and humidity at real time
P3 = Feature Extraction
P4 = Feature selection
P5 = Comparing disease image with disease image dataset
O = {O1, O2, O3, O4, O5, O6}
Where, O1 = Water pump on and off respectively
O2 = Moisture temperature and humidity value
O3 = Crop prediction
O4 = Yield prediction
O5 = Disease information
O6 = Solution to disease

VII. SYSTEM REQUIREMENTS

A. Software Requirement

1) Technology Used : Python 3.7

2) IDE: Python IDLE
3) Operating System : Windows 7 or above

B. Hardware Requirement

1) Hard Disk : 80 GB
2) RAM: 2 GB OR ABOVE
3) Processor : Intel Pentium 4 and above

VIII. EXPERIMENTAL ANALYSIS

To evaluate the system, major indicators of performances are chosen.

1	Accuracy

Accuracy is simply define as the ratio of prediction into total number of sam-ples in a input dataset.

These are good measures of performances since they mea-sure what percentageof crop and yield the system is able to predict and how many incorrect classificationsit makes in the process. The following sections give the details of evaluation schemeand the results obtained.

TABLE I
STANDARD METRICS FOR PREDICTION

Standard metrics	**Predicted Crop**	**Predicted Crop**
	Crop	Not-Crop
Crop	True Negative (TN)	False Positive (FP)
Not-Crop	False Negative (FN)	True Positive (TP)

The accuracy score is measure the performance of overall system.

TABLE II
RESULT TABLE

Approaches	**Accuracy**
SVM	0.92
Decision Tree	0.70
Linear Regression	0.83

In this experiment the accuracy of crop prediction is increased by using theSVM classifier. Linear Regression is used to classify crop yield Table II shows the result table of crop yield prediction system , Result is mentioned in the form ofaccuracy.

As the system is about Predicting crop yield so the true positive predictionplays an important role which gradually increase the accuracy of whole system,where as false positive results into decrease.

The figure 2 shows the performance evaluation of the Crop prediction system where as comparison of the one classifica-tion methods such as SVM and Deci-sion tree . is shown with respect to accuracy.

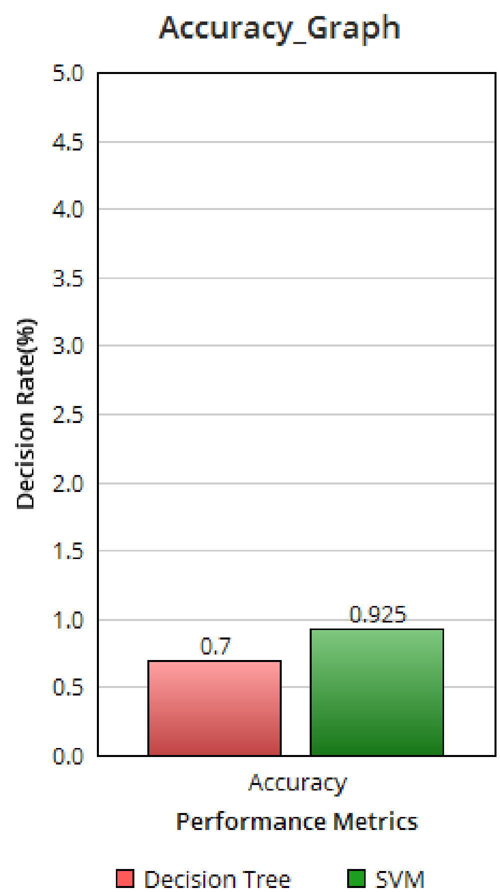

Fig. 2. Performance Evaluation

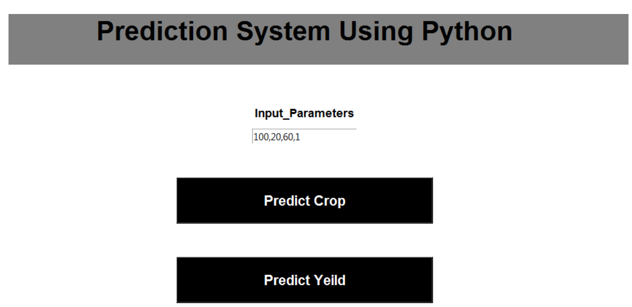

Fig. 3. Input for Crop cultivation

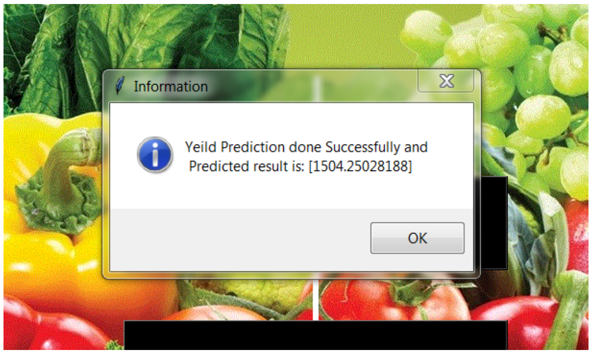

Fig. 4. Crop predicted

IX. CONCLUSION

System will avoids over irrigation, under irrigation, top soil erosion and reduce the wastage of water. The main advantage is that the systems action will be change according to the situation (crops, weather conditions, soil etc.). Propose system will detcet disease of plant and provide solution through android application. By implementing this system, agricultural, horticultural lands, parks, gardens, golf courses will be irrigated. Thus, this system is cheaper and efficient when compared to other type of automation system.

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