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NOVEL APPROACH OF AUTOMATION IN AGRICULTURE USING IOT AND DIFFERENT MACHINE LEARNING ALGORITHMS

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Abstract: Agriculture automation is an recent trend is emerging need as the population of world is growing rapidly. To fulfil the need of food for increasing population, it becomes mandatory to make smart work and enhancements in agricultural practice. Automation techniques such as Internet of Things, big data and machine learning techniques proving helpful for farmers to make precise decisions regarding crops quality and obtain maximum or highest profit. In this research work discusses about different machine learning algorithms to deal with the major challenge presented by IoT is how to analyse the large amount of collected data. This paper also discuss about sensors like soil, humidity to collect crop related data with the help of Raspberry pi. Combination of IoT and machine learning can lead a excellent and great future for agriculture farming.

Keywords: Internet of Things, Machine learning, Agriculture, farming, Sensors, Raspberry pi., data analytics, etc.

Introduction : IoT has really exploded over the past years, demonstrating its potential in applications ranging from wearable and automated cars to smart homes and smart cities, creating an impact everywhere[1]. According to recent research by Gartner, there are around 16 billion devices connected to the IoT now and this is expected to rise to 25-30 billion by 2021. All such connected devices generate a massive amount of information that needs to be monitored and analysed, so that they learn continuously from the available sets of data and improve themselves without any manual intervention [2]. That‘s how IoT devices are becoming smarter. There are different ML algorithms and techniques that are implemented to easily analyse massive amounts of data in a short span of time, increasing the efficiency of the IoT.Different ML techniques such as decision trees, clustering, neural and Bayesian networks, help the devices to identify patterns in different types of data sets coming from diverse sources, and take appropriate decisions on the basis of their analysis [3].The IoT using machine learning is set to push the future of farming to the next level. Smart agriculture is already becoming more commonplace among farmers, and high tech farming is quickly becoming the standard thanks to agricultural drones and sensors. In countries such as China and Japan, wide-scale deployments of smartphones and internet of things (IoT) systems have led to a rapid adoption of precision agriculture solutions [4].

Literature Review: To enhance the efficiency and safety of production and management of modern agriculture in China, as well as Israel based on the new generation of information technology (IT), an integrated framework system platform incorporating the Internet of Things (IoT), cloud computing, data mining, and other many more technologies is investigated. The design of combining Internet of Things, block chian technology(BCT),

cloud computing, big data and modern agriculture is proposed. In addition, a hybrid data storage scheme based on NoSql database DynamoDB, relational database Oracle, and _le object storage Amazon S3 is designed. Using open source hardware raspberry pie, a low-cost, a stable and highly scalable intelligent gateway for IoT [1].To manage heterogeneous information and data coming from real datasets that collect physical, biological, and sensory values,the three different data sources, with a special eye for the IoT sensors dataset, have been exploited using machine learning techniques and the more standard statistical ones [2]. In the cloud, machine learning based real-time analytics is performed to predict the future condition of the crops based on its past data. Limitations of the system are capturing correct data from large data set and security [3].The research deployed a sensing network to gather the field data of some crops (Potatoes, Tomatoes, etc.), then fed these data to a machine learning algorithm to get a warning message finally displaying both the data and the warning message through a Graphical User Interface (GUI) [4]. The few technologies like machine learning, deep learning, IoT, cloud computing in some developed countries and developing countries were discussed and also mentioned the differences between them [5]. The field data collected from the deployed sensors (air temperature, air humidity, soil moisture, soil temperature, radiation) and the weather forecast data from the Internet are used for predicting the future soil moisture. Multiple ML techniques are analysed for predicting future soil moisture and the results obtained using GBRT are quiet encouraging. The proposedtechniques could be a crucial research front for optimizing the water usage in irrigation[6]. The R. Kamath et al [7]. described the implementation of a wireless visual sensor network for precision agriculture to monitor paddy crop for weeds using Raspberry Pi.Bluetooth 4.0 was used by visual sensor nodes to sendthe datato the basestation. Base station forwarded the data to the remote station using IEEE 802.11 a/b/g/n standard. The solar cell battery was used to power up the sensor nodes and the base station. At the remote station, images were preprocessed to remove soil background and different shape features were extracted. Random forest and support vector machine classifiers were used to classify the paddy crop and weed based on the shape features. Using NodeMCU and several sensors connected to it; temperature, humidity and soil moisture level is monitored. Also, a notification in the form of SMS will be sent to farmer's phone using Wi-Fi about environmental condition of the field [8]. The robotic arm helps in unwanted plant elimination. The heart of system is microcontroller which controls the entire operation. The K. S. Santhosh et al [9]. prototype model has been implemented so that it can be scaled up for development of the larger systems.O. Elijah et al [10] proposed work on Cloud platform, sensors and cameras; communication technology can be beneficial to increase productivity of crop yield.

Proposed Work: In this paper, data collection through IoT and data analytics using machine learning different techniques for automatic agriculture is proposed.

3.1 Data collection using IoT sensors: Farmers can monitor various conditions like soil moisture, water level, light, humidity, obstacles, and motion from anywhere by combining sensors, motion detectors, button camera, and wearable devices. The IoT-based smart farming automates the irrigation system and is highly efficient as compared to the

conventional operations [11]. This concept can help farmers to do farming in ultramodern way in era of manpower scarcity & very busy lifestyle. It is easy to follow the trends in organic farming, family farming, group farming etc.

Soil Sensors : The use of soil sensors can help farmers to manage seasonal water application, applying less early and late in the season. If sensors are deployed in several areas of the field, they can direct differential irrigation rates, creating uniform soil moisture, reducing water use, and improving overall yield.

The soil sensors [9], which are at uniform distances across the farmland, can alert farmer to any irregular conditions like high acidity or low moisture. The farmers can get an accurate soil data either by the dashboard or a customized mobile application.

Temperature and humidity sensor: DHT22 is a low cost digital sensor that uses a thermistor to measure the air in the surrounding and also a capacitive humidity sensor to measure humidity. A capacitive humidity sensor measures relative humidity with the placement of a thin strip of metal oxide between two electrodes [11-12].

Ultrasonic Ranging sensors: Sensors of this category are considered a good choice being low cost, potential to operate in a variety of applications, and ease of use and adjustability, such as the sampling rate. Common uses are tank monitoring, spray distance. When combined with a camera, these sensors can then be used for the weed detection [12], where the heights of plants are identified using the ultrasonic sensors and the camera determines the weed and crop coverage.

Data analytics using Machine learning algorithms: Machine learning is a type of AI that gives machines the ability to learn from experience. Its algorithms use computational methods to learn directly from datasets without depending on predetermined equations as a model. The algorithms progressively adapt to enhance their performance as the available number of training samples increases [13]. The ultimate view point of ML is to automate the data analysis process with the help of algorithms that are enabled with continuous learning skill. Hence ML refers to the set of techniques meant to deal with huge data in the most intelligent way in order to derive actionable insights. The ML algorithms can be classified into three categories; supervised, unsupervised, and reinforcement learning algorithms [14] .

Supervised Learning: Supervised learning is performed when specific targets are defined to reach from certain set of input. For this type of learning, the data is first labelled followed by training with labelled data (**having** inputs and desired outputs). It tries to identify automatically rules from available datasets and define various classes, and finally predict the belonging of elements (objects, individuals, and criteria) to a given class [15].

Unsupervised Learning: In unsupervised learning, the environment only provides inputs without desired targets. It does not require labelled data and can investigate similarity among unlabelled data and classify the data into different groups [14].

Reinforcement Learning: In Reinforcement Learning (RL), no specific outcomes are defined, and the agent learns from feedback after interacting with the environment. It performs some actions and makes decisions on the basis of the reward obtained. It is greatly inspired by learning behaviours of humans and animals. Such behaviours make it an

attractive approach in highly dynamic applications of robotics in which the system learns to accomplish certain tasks without explicit programming [14].

Current methods in machine learning:

Decision tree (DT):- This method is also known as classification and regression trees (CART), which can be applied to both categorical and continuous input and output variables. It works by splitting the data into two or more homogeneous sets or regions based on the most significant splitter among the independent variables. DT works by following the decisions in the tree from the root down to a leaf node [14].

Regression:- Regression is supervised ML techniques that predict continuous responses such as stock prices, fluctuations in electricity demand, and time-series sensor data. Mainly, there are two types of regression algorithms: linear and nonlinear. Linear models rely on the assumption of a linear relationship between independent and dependent variables [16].

Bayesian models:- Bayesian models (BM) are a group of probabilistic graphical models in which the analysis is initiated within the context of Bayesian inference. Following equation represents the Bayes‘ Theorem that forms the basis for BM. This equation is used to calculate the posterior probability using the prior probability and the information from the data collected. P(A|B) is the posterior probability that we wish to calculate. P(A) is the known prior probability. P(B|A) is known as the likelihood of the observation B[17].

$$P(A|B) = P(B/A)\frac{P(B)}{p(A)}$$

Support vector machine (SVM):- Similar to SVM classification, SVM regression algorithms are modified to predict a continuous response.49 Instead of finding a hyperplane that separates data, SVM regression algorithms find a model that deviates from the measured data by value no greater than a small amount with parameter values that minimizes sensitivity to error.40 It is suitable for high-dimensional data where a large number of predictor variables exist. Potential applications of SVM in WSNs supported PA are as a regression for yield and sensor data forecasting [18].

Artificial neural network (ANN):-ANN is an information processing system that has certain performance similar to the biological neural networks. This learning algorithm could be constructed by cascading chains of decision units such as perceptron or radial basis functions, used to recognize non-linear and complex functions [18-19]. A neural network is characterized by 1) its pattern of connections between the neurons called its architecture, 2) its method of determining the weights on the connections called algorithm, and 3) its activation function. The general architecture of the ANN algorithm consists of input units, single or multi-layer hidden units, and output. ANN can be used for regression and classification problems. Commonly implemented ANN learning algorithms include the radial basis function, perception algorithms, back-propagation, and feed forward Propagation.

Conclusion: It is proposed to monitor some system parameters like soil moisture, soil pH, soil temperature, water level, growth of crops using machine learning different techniques and algorithms. To accomplish this work on the implementation level the first requirement is to review and implementation of existing methods and techniques of machine learning. The

research aims making use of evolving technology i.e. IOT and smart agriculture automation using machine learning techniques. The proposed research causes farmer to enhance quality and amount of their farm yield by detecting surrounding temperature and moistness esteems, soil dampness esteems 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 techniques, farmer can get disease information and solution to different types of diseases.

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