ADVANCED AGRICULTURE SYSTEM USING PREDICTIVE ANALYSIS AND INTERNET OF THINGS

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Abstract- The main objective of the proposed work is to provide client about the Status of the Agriculture crops planted by analyzing the data gathered from sensors installed in fields and to provide notifications via email under any abnormal conditions arises by implementing Real time crop monitoring System using Internet of Things and Data Analysis Predictive Models.

Index words- Predictive Models, crop monitoring, Agriculture data set, Agriculture Automation, Internet of Things, MQTT protocol, Raspberry pi 3 ,Node MCU ESP8266, Rain sensor, , soil sensor, DHT-11 sensor, moisture level sensor.

I. INTRODUCTION

The rapid advancement in the field of the Internet of Things can be extended to Modernize the Agricultural practices and can improves the productivity of the crops by applying the right scientifically recommended techniques and can assist the farmers in monitoring the crop yield, and helps him to take decisions regarding the types of crops to be planted, estimates the soil nutrients, fertilizers level required. IOT helps in collecting information about conditions like field weather, soil moisture, temperature etc. This enables detection of weed, level of water, pest detection, animal intrusion into the field, crop growth, agriculture. IOT helps farmers to get connected to his field anytime.In this paper we propose a novel architecture that integrates concept of Internet of Things with better agricultural practices by performing the data analytics on that acquired dataset. This is the best solution supporting agriculture sector clients to directly monitor and estimate the crop productivity, notifies the client when any abnormal changes occurs in the crop fields and helps them to take decisions in order to meet the Market demand for that crop.The proposed architecture has the further advantage of eliminating the extensive usage of the fertilizers, seeding of non-productive crops which limit the crop productivity and provides best solutions by using concepts of Data Analytics. The efficiency of the proposed architecture is evaluated through extensive experimental results based on prototype implementation of the model for different types of crops, soils, climatic conditions and found to be good.

II. LITERATURE REVIEW

Liu Dan [1], Joseph Haule, Kisangiri Michael [2] and Wang Weihong, Cao Shuntian [38] conducted experiments on intelligent agriculture greenhouse monitoring system based on ZigBee technology. Min yuan,Deyi Tai,Xia Oweixu, Xiang Zhan, Yuanyuan Zhang [13] studied the work of rural farming community that replaces some of the traditional techniques. The sensor nodes have several external sensors such as soil moisture sensor, soil pH, atmospheric pressure sensors attached to it. Based on the soil moisture sensor the mote triggers the water sprinkling during the period of water scarcity and switches off after adequate water is sprinkled. This results in water conservation and soil pH is sent to the base station and in turn base station intimates the client about soil pH via SMS using GSM model. It helps the farmers to reduce quantity of fertilizers used. A development of rice crop monitoring using WSN is proposed to provide a real time monitoring and increasing the production. The automated control of water sprinkling and Analysis of data is implemented using wireless sensor network.Fu Bing [11],V.Sandeep, K. LalithGopal, S. Naveen, A.Amudhan, L.S.Kumar [23] have proposed the transition from precision agriculture to modern agriculture in China. The agriculture intelligent system was based on IOT which is introduced for organic melons and fruits production and quality. Many of the technologies were used in the system, such as RFID, sensors etc.,. The system contains three platforms to monitor agriculture and fruits. The intelligent agricultural system based on internet has been applied to the melon and fruit production. It plays a role which is not onlythat the farmers have lesser working hours, but also to improve the ability to save costs, improve the quality of fruits. P. Tirelli, N.A. Borghese [2] found that monitoring pest insect population is currently a issue in protection of crops. The system here is currently based on a distributed imaging device operated via a wireless sensor network that is able to automatically capture and transmit images of trapped areas to a remote station. The station validates the density of insect evolution at different farm locations and produces an alarm when insect density goes over threshold. The client nodes are spread in the fields, which act as monitoring stations. The master node coordinates the network and retrieves captured images from the client nodes. During a monitoring period of four weeks the network operating regularly, predicts a pest insects' population curve correlated to daily evaluation obtained by visual observations of the trap and hence the feasibility is determined.Jinhu Liao [30], Chen XianYi, Jin Zhi Gang, Yang Xiong [37], WeiminQiu, Linxi Dong, Haixia Yan, Fei Wang [38] have proposed a remote monitoring system, which can monitor agricultural land in real time and makes good decisions. The system collects data from a farm by using Zig Bee modules, which makes data fused by using high performance controller ARM micro controller and transfers the data to a remote computer by using GPRS modules to take an informed management decisions by using computer. This is not only a solution to improve the level of agricultural production, but also to reduce human the costs very effectively.Nelson Sales [31] experimented with interconnection of smart devices embedded with sensors that enabled them to interact with the environment and among themselves, forming a Wireless Sensor Network (WSN). These network nodes perform acquisition, collection and analysis of data, such as temperature and soil moisture. This type of data can be applied to automate the irrigation process in agriculture for decreasing the water consumption, which would result in monetary and environmental benefit and use of cloud computing which has the high storage and processing capabilities, the rapid elasticity and pay-per-use characteristics makes an attractive solution to the provided might help researchers to highlight issues in the agriculture domain Related Problem. The main motivation behind this is to provide day-to-day report on the crop status by constantly monitoring the changes in the data that has been gathered from the rain sensor, soil moisture sensor, pH level sensor, gas sensor, temperature sensor and abnormal changes in the weather and to predict their effect of these changes on the crop productivity in order to notify the client which helps him to automate the recovering procedures to that forecasted damage.

III.ARCHITECTURE

In order to achieve this objectives we are using the proactive I.O.T network of the sensors and devices which communicates over the network using the MQTT protocol.

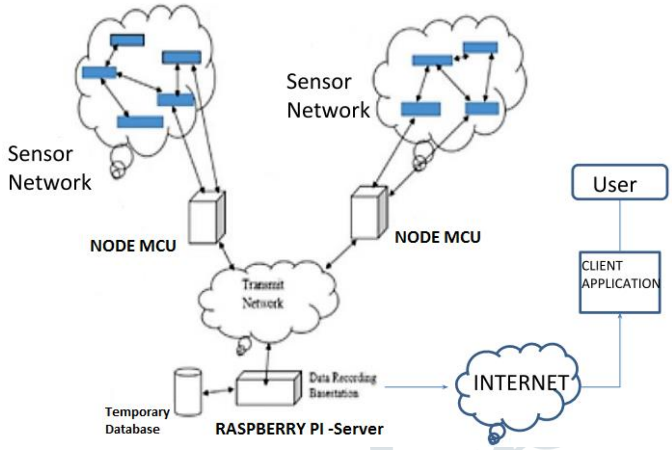

Fig 3.1 Architecture of the agriculture I.O.T SmartNet

The above fig 3.1 shows the architecture of the Internet of Things network which we are currently using in this research work. The devices used in this experiment includes Raspberry pi3,NodeMcu Esp8266, Rain sensor, pH sensor, Dht13 sensor, Soil moisture sensor and LDR sensor.

Raspberry pi-server Sensor data acquisition : The sensor data acquisition phase constantly acquires the sensor data from the sensors in cycle of 3 seconds. In this phase IoT devices gathers the data and stores the datasets which is acquired from the sensors in a temporary storage of the Raspberry pi microcontroller

Data pre-processing: The server performs the data preprocessing operations .It converts the data acquired from the sensors and deletes the unnecessary data which is incomplete and performs the data cleaning on it. After performing the pre-processing the data is stored in the temporary server database.

Data classification and outlier reduction: The data classification phase acquires the samples of test datasets from the server and performs the k-means clustering. The k-means clustering algorithm creates k groups from a set of objects so that the members of a group are more similar. The test datasets acquired from the sensors is clustered and centroid of the k clusters are evaluated. The k-means clustering is designed to operate on the continuous data than that of other classification techniques.

Data selection and evaluation: The data selection phase selects the datasets which are slightly beyond the outliers and performs the grouping of the acquired samples which have similar range and performs linear regression to select the best dataset and eliminates the outliers from the given sets. The predictive model which is generated is going to be evaluated by testing the model using the test data sets acquired from the server storage.

Knowledge presentation: The knowledge presentation phase presents the report on humidity, temperature, moisture levels, rain prediction and forecasts the climate changes. It also presents the fertilize level and notifies the user where abnormal conditions arises. This phase is the most crucial phase which presents the end report to the user. Typically this report is embedded in the client application .

IV. EXPERIMENTS AND RESULTS

For our experiments, we used popular online tools such as Thingspeak, SPSS modeler a widely used data analysis tool for real time data monitoring that supports data visualization in the form of the statistical graphs. When such a tool is integrated with the sensors the real time data monitoring is shown where the outliers can be detected and filtered out manually. SPSS modeler is another popular data mining software with unique graphical user interface and high prediction accuracy is widely used after the sensor data is fetched and stored in the database.. In all experiments, 10-fold cross-validation was used to evaluate the classification accuracy. The Nearest Neighbor classifier was used to get a baseline accuracy, which simply predicts the majority class.

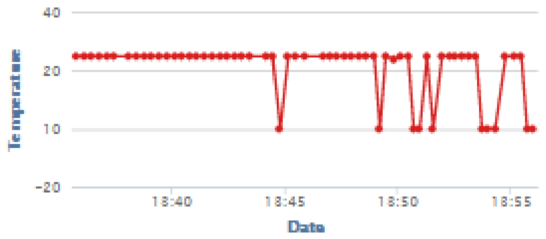

Fig 5.1 statistical graph for Field Temperature using Thingspeak

In the fig 5.1, temperature is taken on the X-axis and Date is taken on y-axis

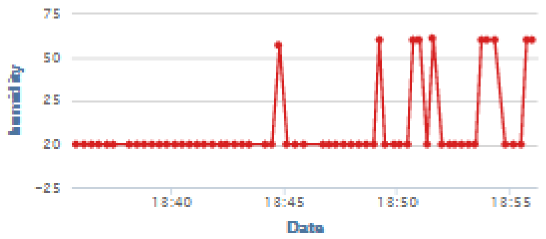

Fig 5.2 statistical graph for Soil Humidity levels using Thingspeak

In the fig 5.2,humidity is taken on the X-axis and Date is taken on y-axis.

As shown in fig 5.1and 5.2.thingspeak tool provides the real -time visualization of the sensor data which helps us to view the rapid changes in the humidity levels, temperature conditions. This facilitates the end-User to take the reactive procedures when sudden changes occurs in these values.

V. CONCLUSION

In this paper we proposed a system that integrates the Data analysis techniques with the IoT automation which is applied on the Agriculture system. IoT based smart farming system can prove to be very helpful for farmers since over as well as less irrigation is not good for farming. Threshold values for climatic conditions like humidity, temperature, moisture can be fixed based on the environmental conditions of that particular region. This system generates irrigation schedule based on the sensed real time data from field and data from the weather repository. In our future work, we are trying to eliminate one of the limitations of this system that, continuous internet connectivity is required at user end which might prove to be costly for farmers. 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. Weather data from the meteorological department can be used along with the sensed data to predict more information about the future which can help farmer plan accordingly and improve his livelihood

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