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Monitoring and Controlling Various Factors for Maize Cultivation using IOT and ML

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Abstract- Sensors are global devices that are frequently used to detect and respond to electrical or optical signals. The sensors convert the physical variables. Generally they are to sense all materials, have fast response time, are cost effective and are quite predictable. However there are distance limitations, requires physical contact with target and are quite sensitive to extreme environmental changes. Monitoring and controlling environmental factors is a major factor to improve the yield of maize, which is our area of concern. The system includes monitoring temperature, humidity, water level, pH and the level of chemicals present. A single Raspberry-pi board is programmed to sense and monitor the system. The sensed values of the sensors are viewed on a LCD display. The critical and the desired ranges are fed as a database in excel sheet. Looking on to the results obtained from the sensors, the values in the database, and putting Logistics Regression Algorithm to use, smart predictions are done to display the information required to the farmer for efficient cultivation of the crop. Considerably, by the connections through multi-core processor, the system deliberately connects and improves the network among the sensors, which are connected to the processor to get better data transmission. An increase in product quality and quantity is achieved by following the above mentioned system.

Keywords: smart farming, raspberry pi, IoT, logistic regression.

I. INTRODUCTION

Agriculture is an important source of livelihood because it is the activity of producing food, feed, fiber and many other desired products by the growing of definite plants and the raising of livestock. It goes without saying that the modern agriculture has improved our food economy, increased food supply, ensured food safety and has increased the empirical value of food. However it also leads to environmental issues as it is based on high input-output techniques, using hybrid seeds of high yielding quality, high irrigation water, chemicals. It is observed that the enhancement of agriculture in a decade has notably fallen from 8.71 per-cent in 1960-70 to 2.61 per-cent from 2000-10. The current growth rate will be unable to feed the population of the country by 2025. It was cited that the unbalanced use of fertilizers and pesticides in different regions were blamed for the decreasing soil fertility.

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But the shortfall of awareness among farmers was observed as the reason for this shortcoming. Being at the edge of digital revolution it is high time we anchorage the digital connectivity to help the farmers. Thus it is important to initiate smart farming technologies extensively, starting preferably with progressive states where the acceptance will be easy. IOT complements the smart farming for better prediction, monitoring and automation of the farming system. Various sensors like digital temperature and humidity sensor, piezoelectric sensor and static water level sensor are used to sense the various factors like temperature, humidity, level of pesticides and the water level in the crop field. LCD display is used to display the sensed reading, ML is used for smart prediction. The vision is to enable farmers of different educational and cultural backgrounds and help them improve their crop production. Necessities of IOT in agriculture are:

- **Accurate farming:**

Accurate farming is a process or a practice that makes the farming system more reliable and controlled, for raising farm animals and growing of crops. Accurate agriculture in the recent era has become one of the popular applications of IOT in agricultural areas and a wide number of federations have started using this technique throughout the world. The items and benefits offered by IOT systems include soil moisture probes, VRI (Variable Rate Irrigation) optimization and so on.

- **Agriculture Idlers:**

Agricultural drones are a perfect example of IOT applications. There are two types of idlers i.e. ground-based and aerial-based idlers that are being integrated in agriculture in many ways such as crop health analysis, irrigation, cultivation, and soil and field assessment. Utility of idlers include ease of use, crop health imaging, integrated GIS scheming, time-saving and ability to increase harvest. It involves tactical and plan based real time data collection and processing.

- **Livestock Supervising:**

Monitoring is helpful for the farmers to collect statistics about their location, well-being, and health of the stock.

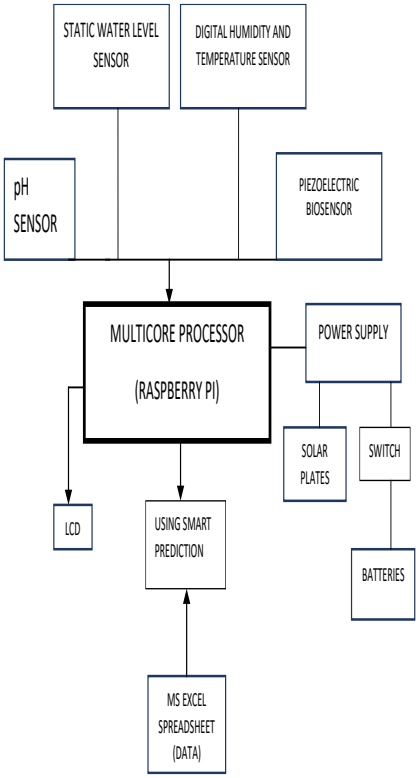
This data helps them in recognizing the state of their farm animals, such as separating the sick animals from the herd, forbidding the spread of the disease to the entire stock.
The likelihood of stock breeders to locate their stock with the help of IoT based sensors thus downsizing labor costs by a substantial amount.

- **Smart Greenhouses:**

Greenhouse farming is a method that improves the production of crops. Greenhouses monitor environmental aspects in two ways- either through manual intervention or a proportional control system.
However human intervention has flaws such as production loss, energy loss and labor cost. Various sensors that weighs the environmental aspects according to the crop requirements are used for guiding the environment in a smart greenhouse. Then a cloud server is created for distantly accessing the system when it connects using IoT.

II. PROPOSED SYSTEM

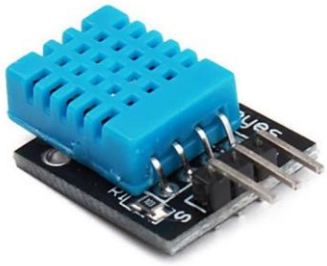
System Architecture:



The proposed architecture is a pragmatic and promising solution to increase the productivity of maize using IOT with cost effective methods. The proposed system is a combination of IOT and ML. There are 4 sensors con nected to the multi-core processor. The power supply to the system is provided by solar plates and alternatively batteries can be used which can be turned on by a switch. The readings are displayed using an LCD monitor and using the data set provided, the LR algorithm compares it with current readings and performs predictive analysis to suggest actions to take for optimal outcomes.

1. SENSORS

DHT11:



DHT11 is low-cost digital temperature and humidity sensor. It works best between the temperature range 0 to 50 degree Celsius, and the humidity ranges from 20% to 30%. It has excellent fast response quality and high performance, sampling rate of 1Hz that is one reading per second. Its sampling time will also depend on its body size, smaller size will give the sampling rate of 1Hz and the bigger size will give 0.5 Hz i.e. one reading in every 2 seconds. It is convenient to use and is handy is size. DHT11 is a low power consumption device whose operating power supply voltage ranges between 3 to5 volt. It has a 2.5 MA maximum current durationDHT11 consists of a humidity sensing component and a temperature sensing component. It consists of a NTC temperature sensor or thermistor, and an icon behind the sensor. For evaluating humidity, the prior is used, which has two electrodes with moisture holding substance between them. So as the humidity varies, the conductivity of the substrate or the resistance between these electrodes varies. This switch in resistance is quantified and processed by the IC which makes it ready to be read by the controller. For calculating temperature, this sensor uses a NTC temperature sensor or a thermistor. A thermistor is a volatile resistor that changes its resistance with the change in temperature of the surrounding. This sensor is made by forging of semi-conductive materials in order to cater larger changes in the resistance with just small change in temperature. The term NTC means “Negative Temperature Coefficient”, i.e. the temperature is inversely proportional to the resistance.

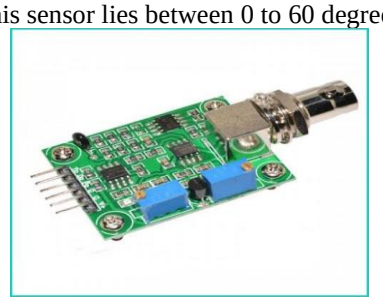
Static Water Level Sensor:

Level sensors are used to detect the level of fluid substances. The static water has a volumetric water content ranging between 0 to 45%. It has a typical accuracy of 4% that has a resolution of 0.1% .This is a low power consumption device which has an operating power supply of 3 MA, temperature ranges between -40 to 60 degree Celsius, small in size having a dimension of 8.9 x 1.8 x 0.7 cm.

Capacitance is used in this sensor to evaluate dielectric permittivity of the local medium. In soil, dielectric permittivity is a basis of water content. The sensor consists of a set of parallel wires. One set is connected to the positive power source, such as battery while the other is connected with a negative source. The set of wires do not touch each other, so no current flows between them. Current will flow from the positive to negative wires when the sensor gets wet. The sensor builds a voltage proportional to the dielectric permittivity of the soil content. There is a 2cm zone of impact with respect to the flat surface of the sensor, however at the extreme edge, it has little or no sensitivity.

pH sensor:

pH measurement performs a vital role in many industrial approaches. It provides a control point for neutralizing acids and bases. pH is the mathematical depiction of gram equivalent per litre of hydrogen ion concentration in any compound. The pH sensor has a measuring range of 0.00-14.00pH. Solutions having pH value between 0 to 7 is acidic solution with high concentrations of hydrogen concentrations whereas pH values ranging from 8 to 14 are basic solutions with small hydrogen concentration. This sensor helps to examine the pH level of soil for ideal growth of crops according to the requirements. It has a zero-point ranging 7+-0.5 pH. It has an internal resistance of 250m, and a response time of one-minute. The operating temperature range for this sensor lies between 0 to 60 degree Celsius.



This sensor is an electrode consisting of 4 components i.e. a measuring electrode, a reference electrode, a preamplifier, and an analyzer or a transmitter. The pH meter calculates the potential difference and corrections across the glass membrane. The potential difference is attained between two marks; one is the electrode in contact with the internal solution, and the second is achieved by linking to a reference electrode ,that is buried in the solution to be studied. Often, this reference electrode is construct in a glass electrode, in a concentric double barrel body of the device.

The potential difference between the two electrodes provides a direct examination of the hydrogen ion concentration or pH of the system and is first pre-amplified to intensify it and then given to the voltmeter.

Piezoelectric bio-sensor :

Pesticides play a vital role in the high yielding accomplished in agriculture through the control of plants or animals life that are inspected as pests. Despite having benefits, some also have drawbacks, such as budding toxicity to humans and other desired classes. Unmasking of the general population to pesticide most frequently arises through utilization of treated food sources. Unabating chemicals can be multiplied through the food chain and have been recognized in various products. Biosensors are logical devices which contain an amalgamation of biological spotting elements like sensor system, and a transducer.

The real time use of these biosensors mainly carries checking ecological pollution control, in agriculture field as well as food industries. Piezoelectric biosensors are a group of logical devices working on a principle of affinity interaction recording. Among all transducers, piezoelectric systems have transpired as the most striking due to their homogeneity, low instrumentation costs, possibility for real-time and label-free detection, easier field-testing and generally high sensitivity. As families, organophosphate and carbamate compounds constitute of a huge number of pesticides and insecticides because of their low endurance and high potency.

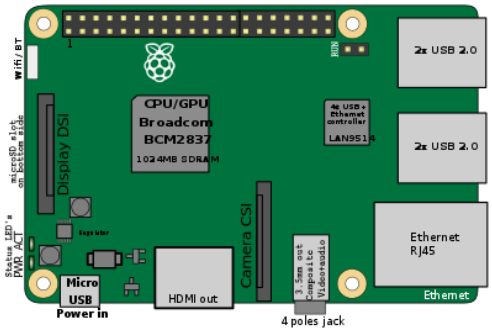
As many pesticides are devised to curb different enzymes within insects and other pests, applying these enzymes for testing purposes seemed a convincing route. Enzymes such as acetylcholinesterase, butyryl cholinesterase and others were used in the biosensor to investigate, for their ability to detect pesticides in environment.

RASPBERRY PI:

Raspberry pi is a low cost, small chipped computer that plugs into television or computer monitor. Being a single board computer it is powerful and useful, and are familiar to any Linux head. Few of the essential hardware specifications of it are US keyboard, monitor, power supply and video cables. For machine learning applications, it is used with different resources. In February 2016, raspberry pi 3 model-B was released with a 1.2Ghz, 64 bit quad-core processor. 11n Wi-Fi, Bluetooth and USB booth are few of the capabilities of raspberry pi 3 model-B.

It provides an additional group of 40 GPIO (General Purpose Input Output) pins that enables one to manage electronic parts to explore the internet of things (IOT) and physical computing. These input output pins receive commands and perform according to the programming of the device. It has 1100 MHz ARM (Advanced RISC Machines), where RAM memory ranges from 256 to 1GB. The CPU speed appears to be 1200 MHz in the system information, when idling speed lowers to 600 MHz using USB like flash drive, pi 3 can be rebooted. Another advanced chip integrated in the board is the GPU that carries out functions of image calculations. It also includes an Ethernet port that sets a path-way for communicating with other devices. To maintain internet connections, the ether port is connected to the router. The board contains 4 USB ports that is used for communication

and for storing the operating system, SD card that is added to it.



The Raspberry pi board uses XBee socket for wireless communication purposes. The power source connector is a small switch whose main purpose is to enable an external power source and is placed on the side of the shield. UART or Universal Asynchronous Receiver or Transmitter is a serial input and output port which is used to transfer the serial data in the form of text and is useful for converting the debugging code. With the help of low cost adaptor and HDMI male cable, many LCD and HD television monitors can be connected to the raspberry pi board. The various applications of raspberry pi are like internet radio, home automation. controlling robots ,tablet computer, streamer, arcade machines and much more.

LCD DISPLAY:

Liquid crystal display(LCD) is a flat panel display that uses the property of liquid crystal like light modulating. It uses black light or reflector to produce images in colour or monochrome as it does not emit light directly. Small LCD screens are consumer portable devices such as camera. It is connected to the multi-core processor and is used to display the sensor readings.

Logistics Regression Algorithm:

Logistics Regression is a significant regressive study to run when the dependent variable is dichotomous (binary). Like all regression analyses, this is a prognostic analysis. Logistic regression is used to relate data and describe the co-relation between one dependent binary variant, multiple nominal, ordinal, interval or ratio-level unrestrained variables. Logistics Regression is an estimating modeling algorithm that is used when the Y variable is binary categorical. That is, it can take only two values like 1 and 0. The aim is to find a numerical equation that can be used to predict the probability of event 1. Once the equation is acknowledged, it can be used to estimate the Y when only the X's are known. The general workflow includes getting a dataset, training a classifier and making a prediction using such classifier.

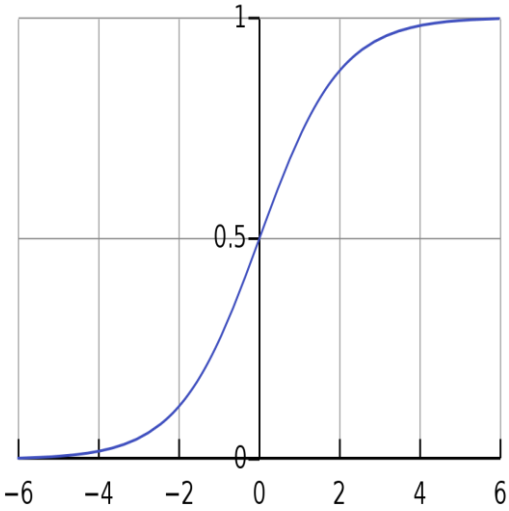
$$z = \theta_0 + \theta_1 \cdot x_1 + \theta \cdot x_2 + \cdots$$

$$g(x) = \frac{1}{1 + e^{-x}}$$

$$h = g(z) = \frac{1}{1 + e^{-z}}$$

(Squashed output-h)

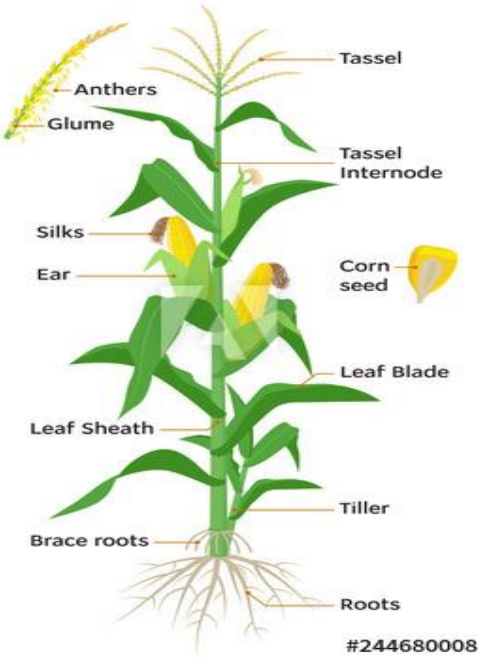
We take the outcome(z) of the linear equation and provide to the function g(x) which returns a squashed value h, the value h will lie in the range of 0 to 1. To perceive how sigmoid function squashes the values within the range, the graph of the sigmoid function is given.



Sigmoid Function graph

It can be seen from the graph, the sigmoid function changes into asymptote to y=1 for positive values of x and converts asymptote to y=0 for negative values of x.

Data are unrefined fact, value, text, sound or pictures that are not explicated and analyzed. **Data** is the most influential part of all Data Analytics, Machine Learning, Artificial Intelligence. A **dataset** is a compilation of **data**. Most frequently a **data set** is analogous to the details of a single database table, or a single statistical data matrix, where each column of the table depicts a specific variable, and each row corresponds to a given member of the **data set** in the question. The operation of **coaching** an ML **model** embraces, presenting an ML algorithm (that is, the **learning** algorithm) with **training** data to learn from. Predictive analytics use historical **data** to **predict** future events and make decisions. Generally, historical **data** is used to build a mathematical model that captures important necessities. That predictive model is then used on current **data** to **predict** the next event, or to suggest actions to take for optimal outcomes.



III. MATH

$$z = \theta_0 + \theta_1 \cdot x_1 + \theta \cdot x_2 + \cdots$$

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A. Figures and Tables

Soil Type	pH range	Soil moisture	Temperature	Humidity
Clay soil	5.5 – 7.0	3.0 – 4.0 inches	14 – 25 degree	45 – 60 %
Loam soil	6.3 – 6.8	4.0 – 4.5 inches	18 – 27 degree	50 – 60 %
Sandy soil	6.0 – 6.5	5.0 – 6.0 inches	17 – 28 degree	60 – 75 %
Silty soil	5.5 – 6.5		10 – 28 degree	55 – 70 %

B. RELATED WORKS

[1]Here, a smart farming system is implemented consisting of a sensor system and a control system. While the prior consists of all the sensors, the letter includes controlling methods like a lower, watering system and a roofing system. All the sensed data are provided to the farmer to help him make proper decisions for controlling the system. [2] It focuses on smart irrigation system consisting of different sensors, using relay the motor is switched on, that is connected to the solar panel and sprinklers start sprinkling water to the plants .To fill the tank a pumping motor is used. Through WSN the updated information is sent to the server. [7] The GPS based mobile robot is programmed to control various sensors. The warehouse contains a motion detector that detects the motion when security mode is on, and the alert message is sent using Raspberry pi. The fan is switched on or off automatically, maintaining the temperature and humidity. A pump is used for irrigation that remotely controls through mobile or computer and the data is transmitted to the user. [11]It focuses on developing smart agriculture using IOT. The system is divided into two section i.e. the field section and control section. Field section comprises of the sensors deployed in the field while control section verifies the received data with the threshold values. Any change is notified by LED and an alarm as a message is sent using GSM module.

IV. RESULT AND DISCUSSION

With the use of sensors the environmental factors affecting the growth rate of maize crops like temperature, humidity, soil moisture and the chemical level present in soil are monitored and displayed using LCD screens. Also using machine learning algorithm of Logistics Regression, the system is made smart which by using its prognostic analysis suggests farmers to take appropriate decisions accordingly, suiting the growth of crops and thereby increasing its productivity.

V. CONCLUSION

The proposed system is made to implement a mechanism to improve and increase the yield of healthy maize crops using different modules.

The modules we used here are to process the input taken from the sensors and processes it such that the farmer is well aware of the current situation and takes actions necessarily.

This paper presents the improved techniques for increasing the yield of maize crops in a cost effective way thus playing a critical role in anchoring smart farming technologies in rural areas and for choosing different techniques for future technology to improve.

The concluded aim of designed process model is to improve the yield quality of maize crops thus encouraging the initiation of smart farming technologies everywhere.

REFERENCES

1. M K Anushree, R Krishna 'A smart farming system using Arduino based technology' https://www.ijariit.com/manuscripts/v4i4/V4I4-1483.pdf
2. Nikesh Gondchawar 'IoT based Smart Agriculture' https://pdfs.semanticscholar.org/c77d/1965f44f2aa55eef4220251841e9551ed1b2.pdf
3. Erastus Ogunti 'IoT Based Crop Field Monitoring and Irrigation Automation System' http://ijiset.com/vol6/v6s3/IJISET_V6_I3_17.pdf
4. Anusha BM, Nandisha K.N, Shreeraksha J.K, Tejas Gowda K 'Smart Agriculture'http://www.ijaerd.com/papers/final%20ieee%20paper.doc
5. M.Saroja Sankari , D.Shunmugapriya and S.P.Uma Maheswari 'IoT Based Smart Agricultural Monitoring System' http://ajast.net/data/uploads/4067.pdf
6. TANMAY BARANWAL, NITIKA, PUSHPENDRA KUMAR PATERIYA 'DEVELOPMENT OF IOT BASED SMART SECURITY AND MONITORING DEVICES FOR AGRICULTURE' HTTPS://IEEEXPLORE.IEEE.ORG/DOCUMENT/7508189/

7. Kajal N. Dhawale, Dr. Narendra Bawane 'IoT Based Smart Agriculture System' http://iosrjen.org/Papers/vol9_issue5/Series-8/2.%2004-09.pdf
8. M.Sankaramahalingam, Divya Bharathy M S, Aksha R 'Remote Temperature Monitoring and Control using IoT' https://mail.google.com/mail/u/3/#inbox?projector=1
9. Sachin Athreya D , Rashmi H C , Sowmya N , Shashidhar K P'An Automatic Irrigation System using WIFI in Wireless Sensor Network 'https://www.ijireeice.com/upload/2017/june-17/IJIREEICE%2014.pdf
10. Y. Zhu, J. Song, and F. Dong, "Applications of wireless sensor network in the agriculture environment monitoring," Procedia Eng., vol. 16, pp. 608–614, Nov. 2011.https://core.ac.uk/download/pdf/81147055.pdf
11. Sandra Rhea Samson, S. Sanranya, G. Shanmugapriya, R.Subhashri 'IoT Based Smart Agriculture Monitoring System' https://pdfs.semanticscholar.org/278f/384d0db82009073cde01d3588ac77e45986a.pdf

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