Agro based crop and fertilizer recommendation system using machine learning

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Abstract:Over one third of world are employed in agriculture and the quantity is gradually falling because the financial losses of the farmers. One of the causes behind this momentary loss is the shortage for era in agriculture. Continuous cropping and over use of fertilizers cause the decline in soil productiveness and impact the environment as well The paper explains how the amount of soil vitamins and environmental factors followed by the pointers for cropping and special fertilization of the site can be established. 1 The selection of the best crop for the soil and the sowing of it to provide the full yield is one of the key problems in agriculture. The proposed method takes the soil and PH samples as the input and helps to predict the crops that can be recommended suitable for the soil and fertilizer that can be used as the solution in the form of the webpage.So, the soil information is collected through sensors an the data transmitted from the Arduino through Zigbee and WSN (Wireless Sensor Network) to MATLAB and analyzing the soil data and processing is done with help of ANN (Artificial Neural Network) and crop recommendations is done using SVM (Support Vector Machine) .

Keywords: ANN (Artificial Neural Network), SVM , Arduino, Zigbee, MATLAB, WSN

1. Introduction

In India, farming plays a predominant role in economy and employment. The mutual problem. There are Indian farmers who, for their soil needs, choose the right crop. The patterns in agriculture have. Due to globalization, water can be improved using the soil humidity sensor to a large extent, increasing crop yield and the measurement of soil moisture content by field and by field. Where, Data mining plays an important role in agricultural estimation yield analysis of an area. Machine learning helps predict unknown values.

The cost-effective Home kits help in data processing for farmers from diverse demographic dimensions It allows farmers to have access to real time. Weather forecasting, soil scanning, and Internet of Things for data processing. The farmers, therefore, could use the information obtained from the sensors, strategies accurately calculate the Measures to improve fertilizer effectiveness.
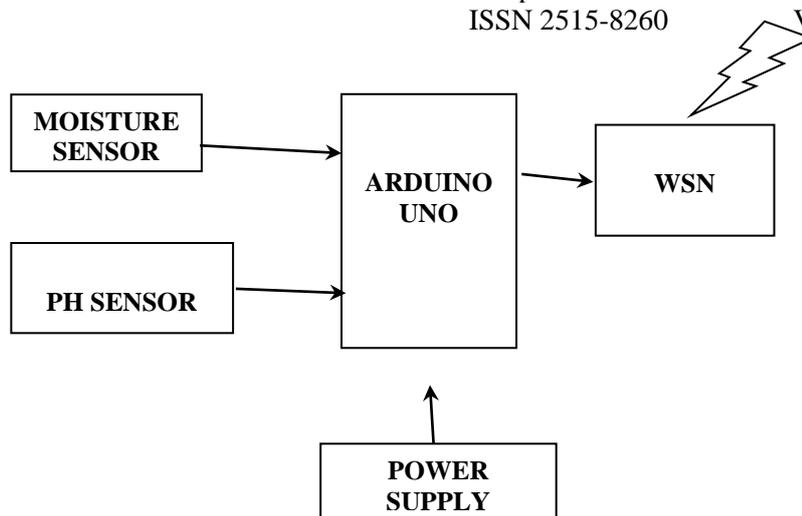
1.1 Block Diagram:

Figure 1: architecture diagram

2. Literature Review:

For decades, the development of agriculture has contributed to the formation of cultures that are climate-friendly for economic growth[1]. Today, agriculture takes place on a massive scale however the agrarian driven increase, poverty reduction, and meals protection are at the stake[2]. The weather exchange could cut crop yields, especially inside the world's maximum meals insecure regions. All plant life requires a balanced supply of micronutrients for its growth Among all of the vitamins for plants increase nitrogen, potassium and phosphorus are the number one macronutrients required by the plants for robust increase[3].Most usually urea used for plant cultivation receives enzymatically hydrolyzed to ammonia by an enzyme know as urease this is found in soil microorganisms. Since the conversion is very fast and exceeds the rate at which the ammonia produced can be used by plant life. Only 40%-50% of urea applied in traditional fertilizers seems to be used by the plant life while the relaxation leaches into the water ,pH is misplaced to the atmosphere by using denitrification. Fertilizers like Ammonia phosphate and Di ammonia phosphate are some assets for phosphorus. The role of potassium is oblique as it is used to activate over 80 enzymes at some point of the plant[4].It allows flora to make robust systems and It will increase plant's capability to withstand excessive weather conditions and make them grow rapidly and combat diseases. It will increase water use efficiency and convert sugar to scratch in the gain filling process. Potassium Chloride-Potash is one of the supplies for Potassium [4]. The acidity of the soil or pH they puck universally. Hence, soil monitoring is the basic process for farming. The unparalleled crop yield because of damaging weather situations and infertile soil led the farmers to face financial trouble inflicting many suicidal cases across the world. Thus, the need for establishment to restrict such a downside and a balanced framework which is beneficial for rugged tendencies of the agriculture field.

3.Hardware Overview:

3.1 Arduino:

Arduino is a software and hardware company which is freely available for the user community.It manufactures and designs Single-board microcontroller kits .It can construct digital devices and interactive gadgets which can feel and control items inside the physical world. There is an Arduino uno that is installed on a microcontroller board known as the atmega328 datasheet, a free and open - source electronics platform focused entirely on user friendly hardware and applications. There are 14 digital output / input pins, 6 digital output pins, A USB link and ICSP header, a crystal oscillator at 16 MHz and a push button.

3.2 Arduino UNO:

Arduino is a microcontroller-based kits available as an open source for constructing interactive objects and digital devices that can monitor and feel physical devices. it's a microcontroller board Built by several suppliers using microcontrollers. A collection of digital and analogue input / output pins will communicate with different latest infrastructure and circuits. This enables the loading of programmed from USB (Universal Serial Bus) personal computers that act as a serial communication interface. Arduino's project offers development environment support Processing using self-supported languages like C and C++.
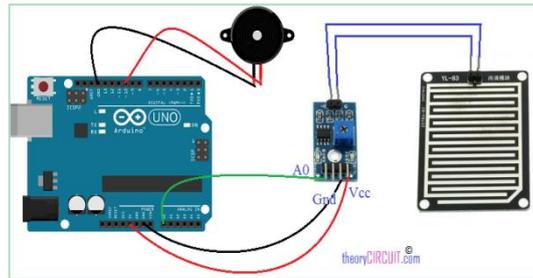

Figure 2: Arduino UNO

3.3 MoistureSensor :

Soil moisture sensors,Electrical resistance, for example, dielectric steady or neutron interaction, use different properties of the soil to serve as one of the proxies for measuring the moisture content in the material. Soil moisture sensors diploma the volumetric water content in material that uncontrived gravimetric measurement of self-ruling soil moisture calls for casting off, drying, and weighting of a sample.

3.4 Soil Moisture Sensor Interfacewith Controller:

The relation between the measured belongings and soil moisture need tobe calibrated and willvary counting onenvironmental elements according tosoil kind, temperature, or electric powered conductivity meditated microwave radiation is unauthentic by means of the soil moisture and is usedfor much off sensing in hydrology and agriculture. The transportable probe instruments could even beemployed by farmers or gardeners.
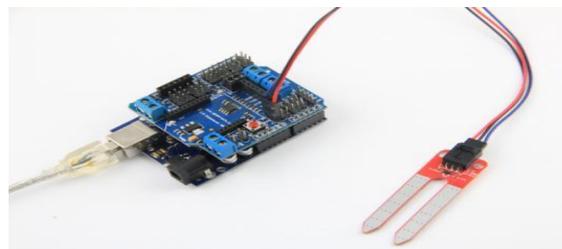capabilities

Figure 3: Soil Moisture sensor

3.5pH Sensor :

A   pH Meter is a logical device that quantifies the Hydrogen particle motion in water based total arrangements, demonstrating its sharpness or alkalinity communicated as ph. It electrical potential

identifies with the   acidity or   pH of the arrangement. Run of   the   mill exercises using   our   pH sensor   incorporate; Corrosive wiring titrations, Investigations of circle of relatives unit acids and bases.
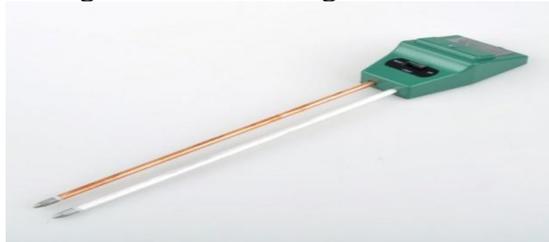

Figure 4: pH Sensor

3.6pH Sensor Interface with Arduino:

A pH sensor Is a system that quantifies the   hydrogen   particle   focus   (pH) in an   answer , displaying   its corrosiveness or alkalinity. Notwithstanding estimating the PH of fluids, it is able to likewise gauge the wateriness and mild level. The pH sensor has an inbuilt   meter   to quantify the light power. The pH of a wordplay shows how acidic or essential (soluble) it is. The pH expression deciphers the estimations of the hydrogen particle fixation which typically extends between truly 1 and   10 x – 14 gram   equivalents consistent   with litre into numbers somewhere inside the variety of 0 and 14.
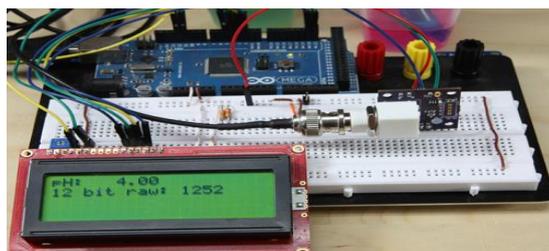

Fig 5: sensors with Arduino interface

3.7Zigbee:

The ZigBee in an Arduino board allows communication wirelessly .It's miles based on the Xbee module from MaxStream. The module can speak up to one hundred feet indoors or 300 toe s exterior. It could be used as a serial/USBalternative ,can be positioned into a command mode and configure it for a diffusion of broadcast networking alternatives. The shields break out every pin to a through- hollow solder pad. It also provides pin headers and analogue inputs for the use of optical pins 2 to 7. It was created in collaboration with Libelium, who designed it (used for increasing sensor networks) to be used for their Squid Bee motes.
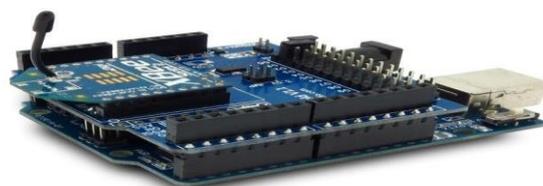

Figure 6: Zigbee

4.SoftwareOverview:

4.1 Embedded CProgramming :

Embedded C is programming language extension for C that writes issues for various embedded systems between C extensions. It supports features such as arithmetic calculation of fixed points, separate multiple memory banks and basic operations of input / output(I / O). A built-in framework is a system for embedding is a computerized system with a safe purpose inside a larger electrical and mechanical system, often with computational restrictions in real time and the general-purpose counterparts are small size, low power with restricted processing resources, usage, however, robust operating levels and low cost per system take full advantage of existing sensors and the network of embedded units on top of hardware intelligence mechanisms. Most modern embedded systems have CPUs with peripheral interfaces or integrated memory.

4.2 MATLAB:

MATLAB is matrix laboratory which uses the proprietary programming language of math works that functions as a numerical computing method multi paradigm. MATLAB can perform plotting the matrix manipulations of data and function , implementing algorithms, user interfaces development and programs interfacing with them .It has an MuPA which is an optional toolbar symbolic engine that enables access to symbolic programming skills and can incorporate graphical design based on multi domain simulation model for complex and embedded systems. It involves the development of math and computer algorithm modelling exploration and visualization of science and engineering graphics through simulation ,development and testing of data analysis technology development including graphical interface construction

4.3 Arduino IDE:

The Arduino IDE offers a development environment that is an application that is cross platform it provides a wiring project software library that offers several procedures for popular input and output. By using special code structuring rules, C and C++ languages are also supported. Programs can be uploaded and written to compatible Arduino boards**.**

5.Methodology:

5.1 Datasets:

It can be accumulated in two ways: one is to obtain records from a valuable online resource and the other is the reverse. Data from the sensor nodes. Online datasets are conveniently accessible in the form of a matrix of records or unmarried Table Database. There could be more details in the datasets that are organized or unstructured formats. Because certain datasets are explicitly protected, certain preliminary registration and authentication as a way to gain entry. The other source of proof is sensor datasets, which are by organization / surroundings in particular. There is a sensor node infrastructure in the organization / environment where the data is collected according to their a structure for programming and stored within the backend.

5.2 Crop Prediction Using ArtificialNeural Networks:

The method of crop yield prediction is used to predict the exact crop by sensing various soil and soil profile. Additionally, atmosphere-associated parameters. Criteria like pH, nitrogen , potassium, phosphate, Depth, Temperature, Precipitation. ANN are learning algorithms which can designed after brain. That is, similar to how the neurons in our nervous machine are able to study from the past records, similarly, the ANN is capable of studying from the information and offering responses in the shape of predictions or classifications. In our model the ANN is particularly used for the normalization reason in order that the cost acquired from the sensors can be precise and the prediction may be accurate. ANN is particularly used for the normalization reason in order that the cost acquired from the sensors can be precise and the prediction may be accurate.
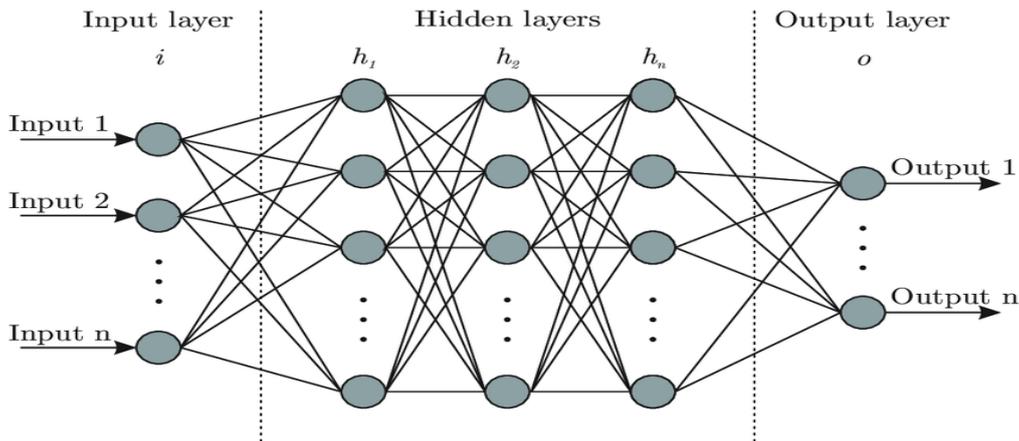

Figure 7: Neural Networks

5.3 Support Vector Machines:

The SVM finds its region in the Suggestion gadget with schooling set in this painting for education. Yeah, in our Model SVM is used to distinguish the two values of one kind, namely the pH fee and the moisture value of the dataset. And do the subsequent sorting. Support Vector Machines are a form of supervised machine to learn about. Algorithm that offers analysis of class and regression evaluation data. While they can be used for regression, For schools, SVM is widely used. Within n-dimensional space, we perform plotting. The meaning of each feature is The price of the basic coordination is still the same. A proper hyperplane is found between the 2 groups. Such an instruction guide. Vectors are the organized embodiments of observation by man or woman. It is a border strategy to segregate Each of those schools. Create a hyperplane that divides the dataset into classes. Now let initiate with a problem with a sample. Assume that you have to distinguish purple triangles from blue circles for a given dataset.
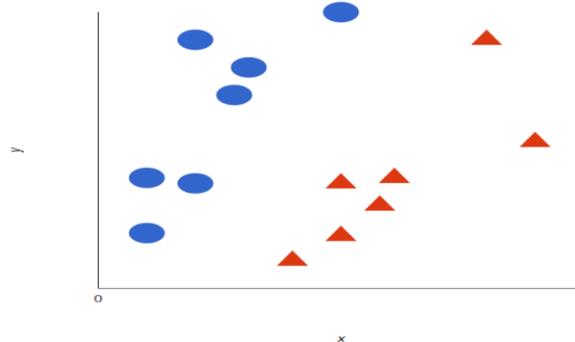

Figure 8: Support Vector Machine(SVM) before hypothesis

Your aim is to build a line that separates the documents into two groups, making a distinction between pink triangles and blue circles .It's easy to picture a straight line dividing the two training courses. There is not, therefore, a single line, You can agree on which role you should perform. Let us imagine a number of the lines that would have been able to Distinguish:
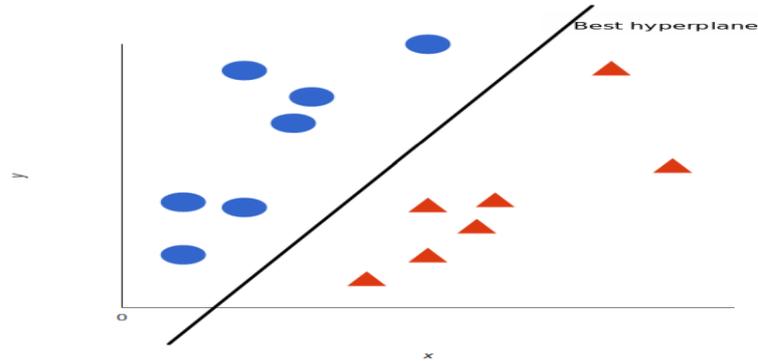

Figure 9: SVM after hypothesis

We should discover the variables that lie nearest to each of the groups, according to SVM. These points are related to here. To as vectors of assistance. We discover the closeness between our dividing plane and the aid vectors in the following step. The width between the points and the dividing line is known as the margin. The aim of a collection of rules for an SVM is to Maximize this margin very well. The hyperplane becomes the most attractive once the margin reaches its limit.
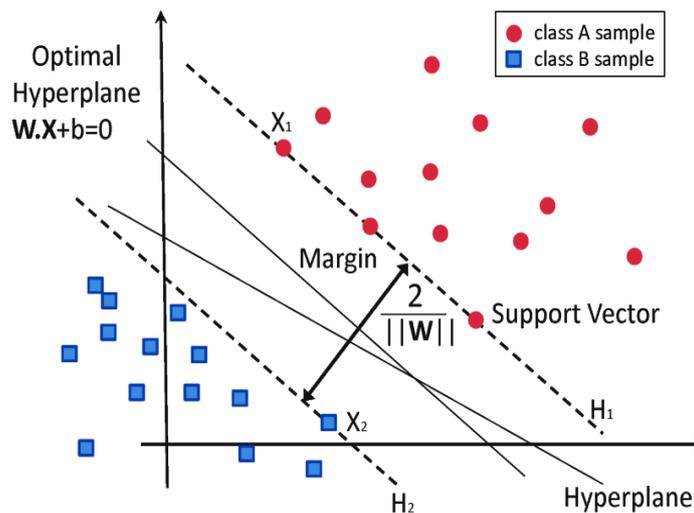

Figure 10: SVM Classifier

6.Fertilizer   Recommendation (Natural Language Processing):

6.1 Componentsof Natural Language Processing:

There are two components of NLP as given in debatable   situations: the proposed device has an added benefit of suggesting fertilizer for the farmer primarily based on the crop predicted. Here the Nitrogen Phosphate and Potassium are the 3 simples' crucial minerals for crop growth   and consequently fertilizer recommendation is primarily based on these three values. If there may be the most desirable availability of those primary nutrients in the soil, then no fertilizers are required. When there takes place the deficiency of nutrients then the fertilizers are suggested.

Natural Language Processing, or NLP for short, is typically known as the electronic manipulation of natural language by software, also including speech and text. Natural Language Processing (NLP) is perhaps the most machine-learning approach to engaging with complex agents to just use a natural speech, including certain English. Recognition is required, you want a clever device including certain robotics to function according to your directions, when you need to hear selection from a clinical expert system based on dialogue.

In order to conclude successfully with the herbal languages often used by individuals, the NLP discussion includes the introduction of computer systems. An NLP system 's output and input could be-

1.Voice.
2.Text Authored

Natural Language Understanding (NLU)

- Mapping the information properly into supportive representations in natural language.
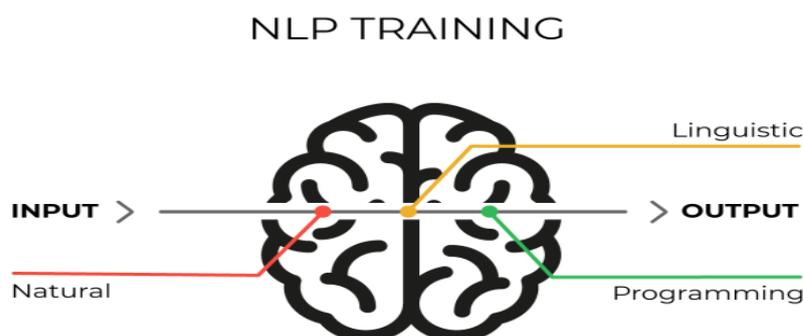- Processing facility aspects of the language

Figure 11: NLP

7. Future work:

1. Building this particular application   in   the local Language, so that it would be more comfortable for farmers.

2. Crop sicknesses detection and prevention

3. A generalized prediction version for numerous crops by thinking about different parameters like humidity and sun radiations can be developed.

4. Giving information about micro nutrients.

5. The data processing from the weather can be qualified enough to support these data. Mainly if any complex comparative of the data is required the similarity of the weather can be indulged in the data processing sector to control the computation time.

8. Conclusion:

Big data has turned agriculture into an intellectual world that offers more comprehensive data. In Big Data Analytics, decision-making is done through a range of techniques. India is a nation in which agriculture plays a primary role. The important element of our nation is the prosperity of farmers. Thus our work helps farmers in cultivating the best seed based on soil requirements so productivity increases and acquire profit with the support of big data analytics. Thus, improved crop prediction, opportunity to forward - and the help of weather forecasts to improve production at field and income rates. This is excessive time to decrease manufacturing and environmental risks and need to boost feasible economic advantages for the forming network to alleviate social consequences of unforeseen weather extremes. Thus, the farmers can plant the proper crop increasing yield rate and also growing the general productiveness of the nation.

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