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Digital enhancement of agriculture

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ABSTRACT

In India, the field of agriculture is the foundation of India. To make the farming manageable, this framework is proposed. In this framework. Various types of sensors are utilized. This paper presents a completely computerized drip water system framework which is controlled by checking the soil moisture and the requirements of the plants. Another major problem is the pest causing disease detection. The Agri- financial misfortune is fundamentally due to creepy pests and few animals. Subsequently, pesticides are broadly utilized by ranchers to control weeds, creepy pests and plant sicknesses without properly knowing about the disease. Abundance use of pesticides isn't just an unfriendly for the climate yet additionally for human and economy of the nature. In this paper, we proposed plant leaf disease detection, which gives disease name and recommends a pesticide suitable for the particular disease through the approach image processing and Convolutional Neural Network. We proposed another bug control framework What's more, picture handling advancements to control bothers, in this way diminishing the utilization of pesticides. The proposed framework utilizes infrared sensor (IR) to identify the presence of bug by the warmth transmitted by their body. Image-processing is utilized to catch pictures of the bugs to affirm their presence in the field. After affirming the presence of creepy pests by image-processing and PIR sensor, the ultrasonic generator is utilized to create ultrasonic waves which are terrible to bugs and mites, drive them away from the rural field. The proposed framework helps the ranchers to improve the rural creation and the board in an economic and safe way.

Keywords— *Agriculture, Image processing, Sensors, Convolutional Neural Network Algorithm, Ultrasonic frequency*

1. INTRODUCTION

In semiarid and dry zones, proficient water applications and the board are of significant concerns. The nonstop extraction of water from earth is decreasing the water level because of which parcel of land is coming gradually during the zones of un-flooded land. Enormous measure of water goes squander because of inappropriate arranging of water use. The interest for new water saving procedures in water system is expanding quickly right now. The point of rancher is to create "more harvest per drop", henceforth there is need to discover the water system strategies which devours less new water. These methods are useful in the areas where there is a shortage of new water. In the cutting-edge dribble water system frameworks, the main benefit is that water is provided close to the root zone of the plants trickle by trickle because of which an enormous amount of water is saved. At the current period, the ranchers have been utilizing water system method in India through the manual control in which the ranchers flood the land occasionally.

This cycle some of the time devours more water or here and there water comes too late because of which the yields get dried. Water inadequacy can be perilous to plants prior to shriveling gets noticeable. This issue can be completely settled if programmed regulator-based trickle water system framework is utilized in which water system will happen just when there is extreme necessity of water.

Pesticides are a significant issue for Indian farmers contrasted with bugs. There is consistently a touch of toxin in the food we take in. Pesticides are specialists used to annihilate the creepy pests which are negative to people or human concerns and agriculture. Nearly 30,000crores deserving of yields are obliterated by pests and bugs in India consistently, which make farmers to utilize pesticides. For leaves diseases detection, approach is Image preprocessing where we convert image to the Numpy array matrix and we are using deep learning that is convolutional neural network algorithm for classification. Pests affect the quality of the plant and quantity of the production in various ways, they cause various diseases to the plants and some of which eats the plants as well. So, in order to create a better solution to this problem we are making use of the PIR sensor.

2. LITERATURE SURVEY

Dileep Kumar, Tiwari Mamtaz Alam (March 2016), 'Electronic Pest Repellent: They have proposed an electronic bug repellent that is equipped for delivering ultrasonic sound waves to repulse rodents, bugs and irritations. The proposed framework basically means to forestall bug in an eco- cordial

and climate amicable way. The proposed gadget can be utilized in both little and enormous scope. The framework is option in contrast to synthetic pesticides which have an unfavourable impact on human wellbeing.

Ibrahim, A.G., Oyedum, O.D., Awojoyogbe, O.B., Okeke, 'Electronic Pest Control Devices: They examined on the utilization of electronic bug control gadget, different measures, benefits and disadvantages of the gadget. Electronic bug and pest control is an electronic gadget utilized for repulsing bugs. The benefit of this gadget is that, they are modest, eco-accommodating and not unsafe to people. This gadget varies from other gadgets by focusing on the consultation scope of bug and work in view of it. Consequently, this gadget is more effective.

J. Mahalakshmi, G. Shanthakumari (March 2017), 'Automated Crop Inspection and Pest Control Using Image Processing': They have proposed a picture preparing calculation for crop review and bug control. This work mostly centers on recognition of paddy plant infections. Utilizing this method different paddy infections are recognized

Smart drip irrigation system for sustainable agriculture G Kavianand; V M Nivas; R Kiruthika; S Lalitha: Agriculture is the foundation of India. To make the practical agribusiness, this framework is proposed. In this framework ARM 9 processor is utilized to control and screen the water system framework. Various types of sensors are utilized. This paper presents a completely mechanized dribble water system framework which is controlled and checked by utilizing ARM9 processor. PH content and the nitrogen substance of the dirt are every now and again observed. To screen and controlling, GSM module is executed. The framework advises client about any unusual conditions like less dampness substance and temperature rise, even centralization of CO2 by means of SMS through the GSM module.

An application of image processing techniques for detection of disease on Brinjal leaves using K-means clustering method (2016): Disease are more affecting India agriculture especially on brinjal, in the way of finding solution they developed an approach to detect the brinjal leaf. Disease by using image processing and one of the AI algorithms called K-means clustering. Here they were detecting the brinjal diseases like Bacteria wilt, Cercospera leaf spot, tobacco mosaic virus, and collar rot. The leaf spot is considered and it is possible to identify the disease using k-means clustering algorithm and ANN (Artificial Neural network).

Detection of Leaf Diseases and Classification using Digital Image Processing (2017): In India Agriculture and farmer is the backbone of Indian economy in order to make them strong they proposed a system which was detecting the leaves diseases by using Image processing, and segmentation of leaves using K-means clustering, and feature extraction and classification of diseases using GSLM (Gray-level Co-occurrence Matrix) and SVM (Support Vector Machine) respectively.

3. SENSORS

3.1 Capacitive Soil Moisture Sensor

A capacitive soil sensor works by estimating the adjustment of capacitance caused by change in dielectric. In basic terms, capacitance estimates the measure of electrical charge that can be put away across an electrical potential. A capacitive soil sensor consists of a positive and negative plate, which are isolated by a dielectric medium in the center. the soil serves as the dielectric medium and its capacitance changes with dampness content. By blending the sensor with a clock circuit, we acquire a simple analogue voltage that can be perused with an Arduino. This voltage thusly has a direct relationship with the soil dampness content. The capacitive soil moisture sensor can read the soil moisture values in more frequent intervals. And has longer maintenance.

Fig 1. Capacitive soil sensor

3.2 PIR Sensor

PIR sensor, also known as passive infrared detector is an associate degree electronic sensor that measures infrared (IR) light divergent from objects in its field of read. PIR sensor is a type of proximity sensor which is used to detect the motion of the object. These sensors detect movement in general but do not reveal the information of as to who moved or what has moved. These sensors do not emit any energy for the purpose of detection they only work by sensing infrared radiation (radiant heat) that is emitted or reflected by objects.

PIR sensors detect motion and are virtually always used to determine whether a living thing (mostly human) has entered or exited the sensor's range. The working of the PIR sensor in simple terms:

We know that all the living organisms to some extent produce some amount of thermal energy or it can also be referred to as infrared radiations, whereas the non-living creatures such as inanimate objects do not produce any heat or thermal energy of their own, so if a living organism be it animals, human or insects passes by the PIR sensor within the scope or range of the sensor (here 6 meters), the sensor will detect it. Whereas if a non-living creature pass by the PIR sensor if will fail to detect since the non-living object does not emit any sort of thermal energy.

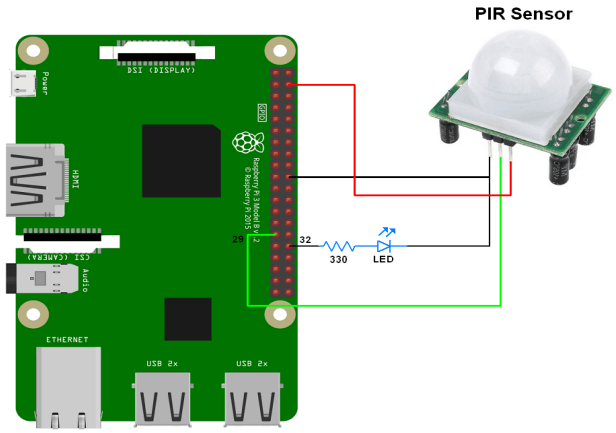

Fig 2. PIR sensor

3.3 Leaf disease detection

Detecting leaf disease is very helpful for formers and in increasing their economy. Here we have taken Potato, Pepper, and Tomato plants for experimenting disease detection system. The dataset consists of Pepper bell bacterial, and healthy pepper images, and similarly for Tomato, Tomato Early blight, late

blight, bacteria spot, leaf mold, septoria leaf spot, spider mites and two spotted spider images, and for Potato, potato healthy, late blight, and early blight, these data is been used for training the two types of model CNN model and RESNET model and by inputting new diseased leaf image, the model will predict the disease of the respective leaf.

3.4 Architecture

The architecture has two parts, model training and image processing. Images are converted to matrix and that Image matrix dataset undergoes with image processing and 80 % of data is used for training and 20% data is used for testing purpose which understand the pattern in the images layer by layer so, the model will be called as sequential model.

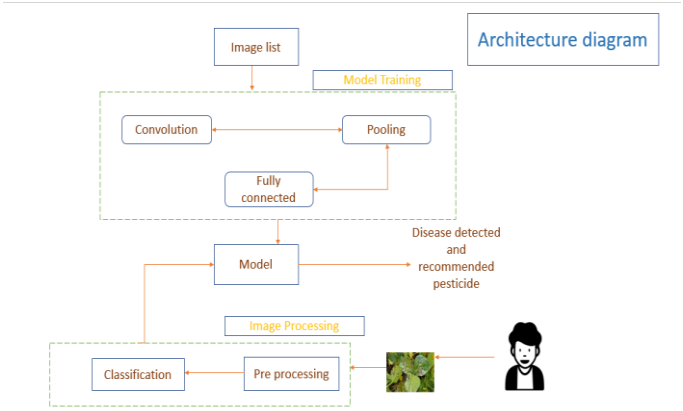

Fig. 3. Sequential CNN Architecture diagram

When user browse the leaf image will get converted and by calling model.predict(image matrix) it return the pattern detected and it will get converted to the name of the disease from dictionary.

The fig [3] shows the architecture of Sequential CNN model the leaf disease detection system.

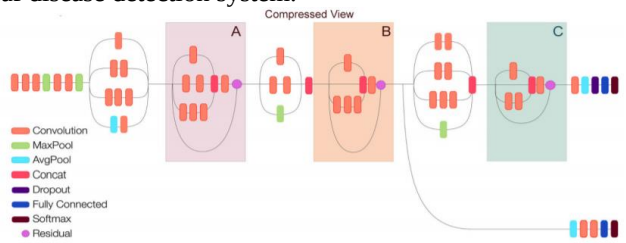

Fig. 4. RESNET Inception V2 architecture

A resnet inception is a CNN model which involves 2 concepts Resnet has 164 layers

One layer of resnet consist of convolution wherein you would be removing the blurring issues the padding issues of the image and then next you would do an activation over the model and bring in all the values into a certain mathematical form it can be sigmoid, Sigma relu etc Then you would bring The mean and variance of all the values to a standardized form from zero to one by batch normalization And then you would do a Max pooling that is you would be choosing the best probability in that particular filter and move on That consists of one restaurant layer now when you are moving on to the next layer you know that the model is generally divided into layers When you fit set the output of the previous layer as a residue to due to the next layer then it becomes a residual model In an inception model we would be choosing and mixing up different kernel Sizes And then send it out for the next activity the resent inception model is a combination of the above 2 activities mentioned.

4. METHODOLOGY

4.1 The soil moisture module

We will dip the capacitive soil sensor In the various water soil levels and in this place we will be using an Arduino and a Raspberry Pi We will connect the capacitive sensor to the Arduino because the capacitive sensor gives you an analog output an Arduino has got analog pins but on the other hand Raspberry Pi does not have analog pins Then from the Arduino we will be sending the data to the rasp Berry π In the Raspberry Pi system we would take an input of a plant name and then we will have an inbuilt Python hash table that will be consisting of the plans and the respective soil moisture now taking up the input value as the plant and comparing it in the dictionary we will obtain the soil moisture content of the plant and then compare it with the sensor values if the values are sufficient and they are almost equal then we would print out a statement say saying that 'it is sufficient' else if the water content from the sensor level is greater than the actual needed level then we would say 'it is drowning' else we will say that 'I am dry' .

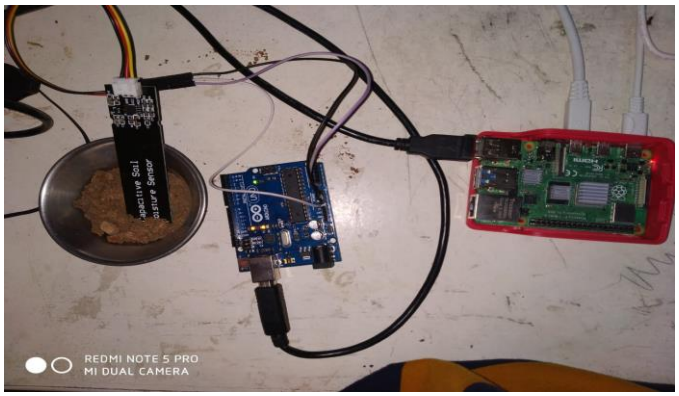

Fig 5. Soil moisture hard ware connection

In the python code which is reading the sensor There is already a dictionary that has been set with the plant name and its required moisture value We take the input as the plant name and then we will traverse over the dictionary to match the key And the input value once matched It will take the value of the key that is matched here the value is the required moisture level and then it will compare it with the sense or value and then suggest 3 actions

1. Turn on the motor to water the plants In case of deficiency
2. Switch off the motor as the plant has been watered sufficiently
3. Switch off the motor as the water level in the plant is more than the required amount

The required action will be suggested to the farmer over a email so that the farmer can access the email and then perform the required action

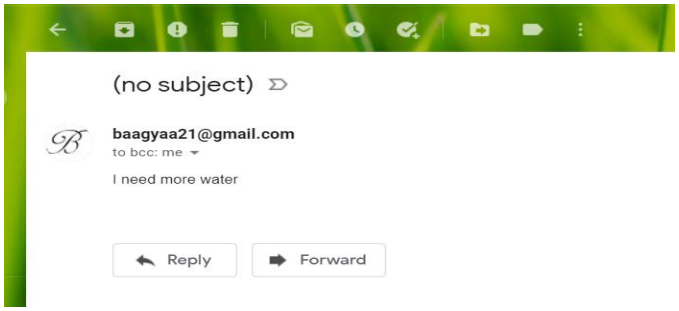

Fig 6. Trigger to the mail

4.2 Pest Module

We know that all the living organisms to some extent produce some amount of thermal energy or it can also be referred to as

infrared radiations, whereas the non-living creatures such as inanimate objects do not produce any heat or thermal energy of their own, so if a living organism be it animals, human or insects passes by the PIR sensor within the scope or range of the sensor(here 6 meters), the sensor will detect it. Whereas if a non-living creature pass by the PIR sensor if will fail to detect since the non-living object does not emit any sort of thermal energy. Since the PIR sensor can only detect the living object but cannot provide any corresponding data regarding the detected object, we use the Ultrasonic sound module integrated with it.

Sometimes, even when we take various precautions on pest control yet there are chances for the pests to reach the field, so here is a mechanism that is used to scare away these pests, that is nothing but the ultrasonic sound, Ultrasonic waves emits short wavelength, high-frequency sound waves that are too high for humans to hear. The average teenagers can hear sounds ranging from 20 to 20,000 Hz, whereas people in their adulthood only hears up to 12-14,000 Hz. Insects, pests and animals can hear sounds in a much higher range. On average, ultrasonic devices sound wave of about 65,000 Hz chases the pests away.

So in this system we have developed the program in such a way that when the motion is detected by up IR sensor it will automatically start playing an ultrasonic sound which has got 60,000 Hz and above that would help in driving the pest away.

So as soon as a living object is detected, immediately the ultrasonic sound is played by the system, which in turn chases the pests away.

Fig 7. Pest Detection hardware connection

4.3 Plant disease Detection

Sometimes when we fail to detect the best it spoils the plant or the plant leaves and also certain times it emits some kind of disease or infection to the plants when this disease or infection is recognised at an early state then we can save the plant from further hazard is infections or effects So for the plant disease detection we are going to do image recognition by using 2 modules and we have done that in Python.

The 2 models that we had performed for the image recognition word CNN sequential model and inception resnet v2 let me give a small comparison between the models and then talk about the model which has got the higher Accuracy.

We had initially worked on the CNN sequential model in which we had taken the sample image size as just 200 and then using a 3 layer rest net a basic convolution model we got an test accuracy percentage of about 82% Then we had to remove the limit of 200 images and then use the entire data set which consists of about 20,000 images and then we couldn't try this over the Google colab because it give us a time out as the number of images were to high for it to load and run the program so later we run it in the laptop which has got about 12 GB ram and we got and accuracy of around 69% And then in order to take up the full load of 20,000 images we not only had to enhance the GB ram of the laptop we also had to choose a different algorithm so for enhancing the ram of the laptop we took the local disk C&D as we took the storage space and then virtualize it and then also made that as the ram we could finally expand the ram to around 30 GB so as to run this algorithm.

The inception restlet algorithm consists of 164 layers with multiple convolution filters in order to learn the model much deeply not only that the speciality of this model is the residual part that means resnet here in each layer it will feed residual output of the previous layer as an input to the next layer so that the model can learn much better by tuning the hyper parameters, epoch, batch size accordingly we could yield a accuracy of around 91% for the entire 20,000 images

4.4 Convolution Neural Network

CNN is of the deep learning algorithm widely used for image processing and pattern matching. CNN can take an input image and assign importance, like weights, and biases to various objects in the image and it will be able to differentiate from one another.

There are different layers in the algorithm, convolution, Relu, pooling, and fully connected layer as show in below fig [8].

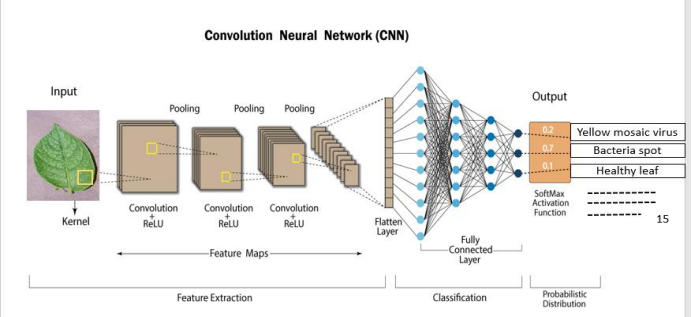

Fig 8. CNN

4.5 Resnet

One layer of resnet consist of convolution wherein you would be removing the blurring issues the padding issues of the image and then next you would do an activation over the model and bring in all the values into a certain mathematical form it can be sigmoid, Sigma relu etc Then you would bring The mean and variance of all the values to a standardized form from zero to one by batch normalization And then you would do a Max pooling that is you would be choosing the best probability in that particular filter and move on That consists of one restaurant layer now when you are moving on to the next layer you know that the model is generally divided into layers When you fit see the output of the previous layer as a residue to due to the next layer then it becomes a residual model

In an inception model we would be choosing and mixing up different kernel Sizes And then send it out for the next activity the resnet inception model is a combination of the above 2 activities mentioned In the Figure below

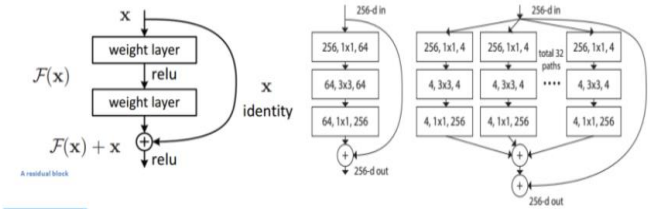

Fig 9: RESNET architecture

4.5.1 Kernel
It's a matrix moves over the images to extract the features from the image it acts like filter.

4.5.2 Convolution layer
It's the building block of CNN and it has input images represented as vectors and filters such as weights and biases which are generated randomly and output vectors or the feature maps which are generated by input vectors with the use of filters.

4.5.3 Relu (Rectified Linear Unit)
This layer is computed after the convolution layer and it is activation function that allows the neural network to account for non-linear relationships. So, it sets the all negative values to zero.

4.5.4 Pooling layer
It reduces the resolution of the feature map by reducing height and width of the output vector but keeps the features required for the classification and it also controls the over fitting of the curve. In this project we have used max pooling.

4.5.5 Flatten layer
In each convolution the model learns the information from generic to specific and after the final convolution layer, Relu ,Pooling , the feature map will be converted in to a vector that is single dimension array which is termed as flatten layer.

4.5.6 Fully Connected layer
The output from flatten layer is fed to this layer. The feature vector from this layer is further used to classify images between different categories after the training and here all inputs from this layer are connected to every activation unit of the next layer.

4.5.7 Soft-max layer
It is a classifier which distinguish the output and probability distribution and non-normalised output and that interpreted as probability.

The model accuracy is plotted as shown in the fig [8].

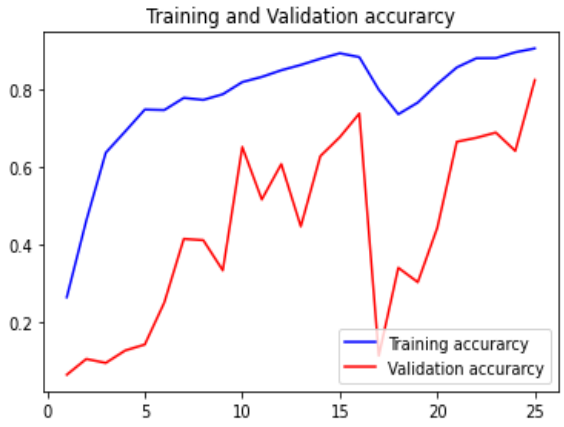

Fig 10. Training and Validation accuracy

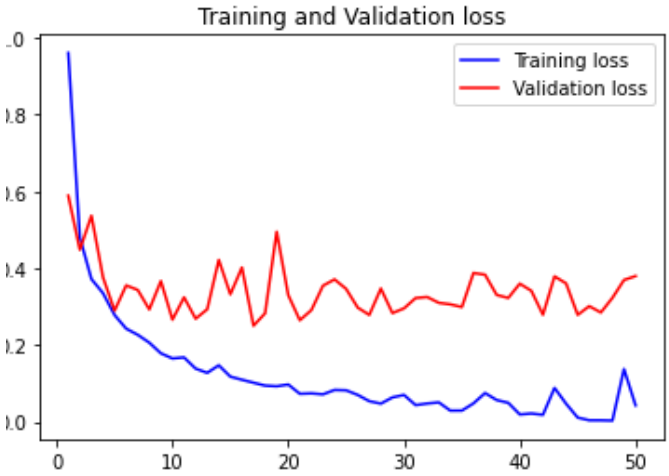

Fig 11. Training and Validation Loss

5. FUTURE WORK
- Uh we would like to implement this on a larger scale in actual fields so that it would help the farmers
- We would also like to create a mobile application where the entire set of activities can be tracked by the farmer then and there in the place of him not having to do anything

6. CONCLUSION
In this particular paper we aim to solve some of the issues faced in agriculture by digitalizing it. Drip irrigation is not effectively achieved by a conventional farming or manual farming hence we have tried to digitalise it by the help of hardware and sensors. Pests even though being very small have attacked and destroyed yields the farmers have taken a lot of energy to grow so we have found a effective method of detecting the pest and trying to prevent it by using ultrasonic wave frequency as beyond a certain way frequency the insect cannot bear the ultrasonic waves and tend to run away from the field. Plant disease detection is also another important aspect of agriculture so when the best sometimes are not detected it ends up spreading different kinds of diseases to the plants so detecting them in early stage we can take some measures to mitigate the diseases so we are using an optimal model in order to detect different diseases on mainly four plants tomato bell pepper potato.

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