Smart and Safe Agriculture in Arid Locations Utilizing 5G, IOT and Machine Learning

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Abstract: Regardless of how people perceive the agricultural process, the truth is that today's agriculture business is more data-driven, accurate, and intelligent than ever. The fast rise of Internet-of-Things (IoT)-based technology changed nearly every industry, including smart agriculture, shifting the industry away from statistical to quantitative techniques. Such dramatic innovations are upsetting established agricultural systems and opening up new chances in the face of a variety of obstacles. This article discusses the possibilities of wireless sensors and IoT in agriculture, as well as the obstacles that will be encountered when this technology is integrated with traditional farming techniques. The Internet of Things devices and communication mechanisms related with wireless sensors used in agriculture applications are thoroughly examined. There is a list of sensors available for specialized agricultural applications such as soil preparation, crop status, irrigation, insect and pest detection. It is detailed how this technology assists producers throughout the agricultural phases, from seeding to harvesting, packaging, and shipping. In this study, we are not only detecting and diagnosing crop illnesses, but also forecasting the quantity of pesticides needed to prevent or manage pests. In this paper, the author claims that he will monitor crops using 5G connections and IOT devices, with IOT devices capturing crop images and then sending those images to a centralized server where machine learning algorithms will predict disease and suggest chemicals to farmers. However, we do not have such IOT sensors, so we are using the PLANT VILLAGE Disease dataset, which contains more than 20 different plant diseases. So, in this project, the dataset will be considered as the data collecting module, and we will then use the CNN machine learning model to forecast disease and prescribe drugs.

Index Terms: Agriculture, IOT, Sensors, CNN Algorithm, Machine Learning

I. INTRODUCTION:

Throughout human history, significant advancements have been developed to increase agricultural productivity with less resources and labor demands. Despite this, the high population growth has never allowed demand and supply to meet. According to projections, the world population will reach 9.8 billion in 2050, representing a 25% increase over the current amount. Almost the whole population increase predicted is expected to occur in emerging countries. On the other hand, the trend of urbanization is expected to intensify, with around 70% of the world's population expected to be urban by 2050. (Currently 49 percent). Furthermore, income levels will be multiples of what they are now, driving up food consumption even further, particularly in emerging nations. As a result, these countries will be increasingly concerned with their nutrition and food quality; as a result, consumer tastes may shift from wheat and cereals to legumes and, eventually, meat. Food production needs quadruple by 2050 to support this bigger, more urban, and wealthier population. In particular, the present annual wheat output of 2.1 billion tons needs grow to nearly 3 billion tons, and yearly meat production should increase by more than 200 million tons to meet the demand of 470 million tons. Crop production is becoming increasingly vital not only for food, but also for industry; fact, crops such as cotton, rubber, and gum play major roles in the economies of many countries. Furthermore, the bioenergy sector based on food crops has lately begun to grow. Prior to a decade, solely ethanol manufacturing used 110 million tons of coarse grains (approximately 10 percent of the world production). Food security is jeopardized when food crops are being used for biofuel production, bioenergy, and other industrial purposes. These expectations are putting further strain on already limited agricultural supplies.

II.SCOPE:

With the application of technology such as those represented in Fig.1, traditional agriculture with manual labor and poor productivity is being turned into sustainable, intelligent, efficient, and eco-friendly agriculture. Long-established old-world agriculture is being replaced by "smart" agriculture. New terms are developing, such as "smart farming," "digital farming," and "precision farming." Smart Agriculture is sometimes known as "Smart Farming." The focus of "Smart Farming" is on accessing data and using that data to optimize a complicated system in order to improve product quality and output while lowering human work.

Fig 1: Application of Technology in Agriculture

III.EXISTING SYSTEM:

With the advent of the Internet of Things and rural digital transformation, these technologies may be used to remotely monitor soil moisture, crop development, and take preventive steps to detect agricultural damages and threats. However, in the past, they dealt with laborious processes. It might result in significant agricultural and production losses.

IV.PROPOSED SYSTEM:

In this study, we are not only detecting and diagnosing crop illnesses, but we are also forecasting the quantity of pesticides needed to prevent or manage pests. The author of this paper claims that he will monitor crops using 5G connections and IOT devices, with IOT devices capturing crop images and then sending those images to a centralized server where machine learning algorithms will predict disease and suggest chemicals to farmers. However, we do not have such IOT sensors, so we are using the PLANT VILLAGE Disease dataset, which contains more than 20 different plant diseases.

V.SYSTEM ARCHITECTURE

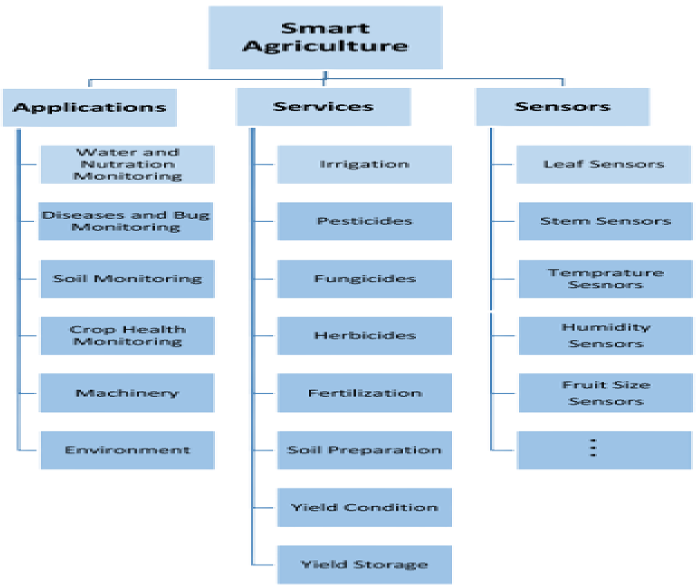

Fig 2: System Architecture

VI.DATA FLOW DIAGRAM:

1. The DFD is a basic graphical formalism for representing a system in terms of input data to the system, various processing performed on this data, and output data created by the system.

2.One of the most essential modelling tools is the data flow diagram (DFD). It's used to simulate the system's components. The system process, the data utilized by the process, an external entity that interacts with the system, and the information flows in the system are the components.

3. DFD depicts how information flows through the system and how it is transformed through a sequence of transformations. It is a graphical representation of information flow and the changes that occur when data goes from input to output.

4. DFD is sometimes referred to as a bubble chart. A DFD may be used to represent any degree of abstraction in a system. DFD can be divided into tiers according to increasing information flow and functional detail., Fig 3.

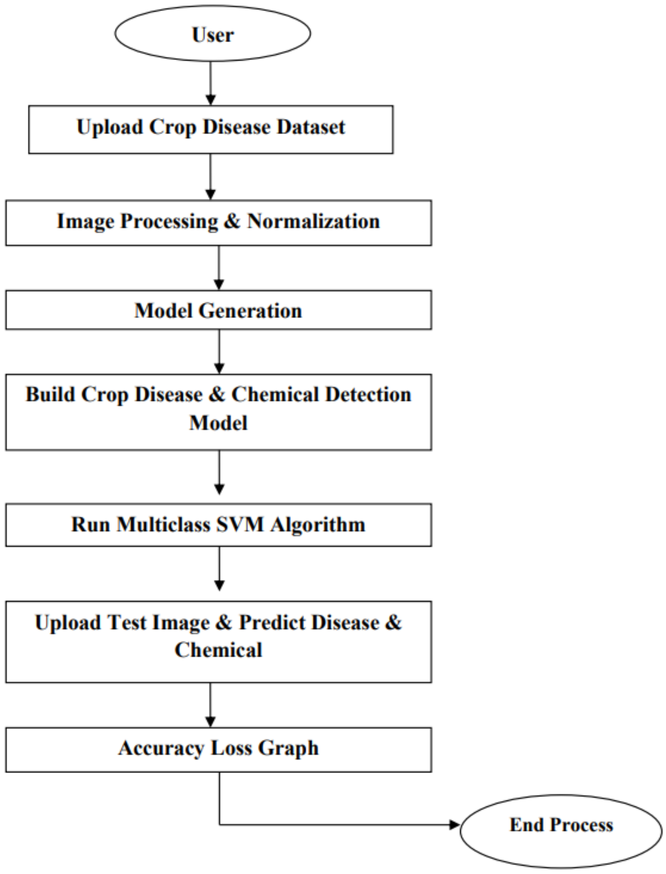

Fig 3: Data Flow Diagram

As the name implies, a Data Flow Diagram depicts the process of applying incoming data and obtaining an output.

However, when applying the input data, we require classification methods to categorize and detect crop disease from the dataset. Machine learning gives two algorithms for this purpose. They are as follows:

1. CNN Algorithm
2. SVM Algorithm

1. CNN Algorithm:

Convolution Neural Networks (CVV) are mathematical models used to tackle optimization problems. They are built up of neurons, which are the basic computational units of neural networks. A neuron receives an input (say x), does some calculation on it (say, multiplying it by w and adding another variable b), and produces a result (say, z= wx+b). This value is transferred to a non-linear function called activation function (f) to generate the neuron's final output (activation). There are several types of activation functions. Sigmoid is a prominent activation function. The neuron that employs the sigmoid function as an activation function is known as a sigmoid neuron. Neurons are called based on their activation functions, and there are many different types of them, such as RELU and TanH. A layer is the next building component of neural networks and is formed by stacking neurons in a single line. Layered image is shown below in Fig: 4.

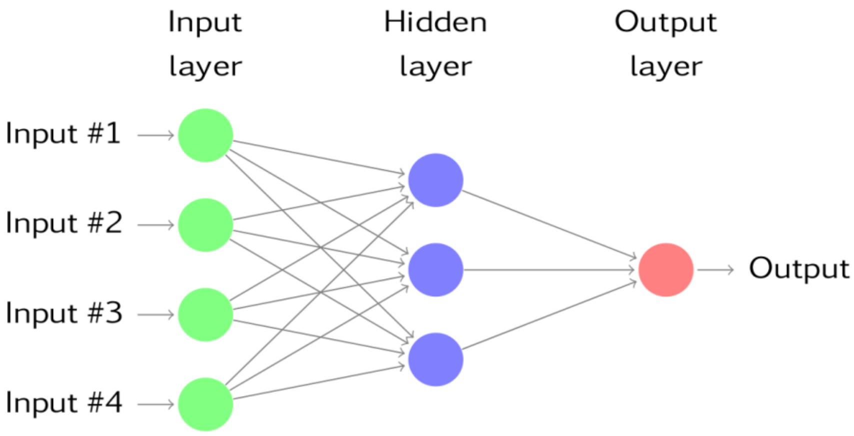

Fig 4: Convolutional Neural Networks

To forecast picture class, numerous layers act on each other to find the best match layer, and this process is repeated until no more improvement is possible. 26 To show how to construct a convolutional neural network-based image classifier, we will construct a 6-layer neural network that will detect and distinguish one picture from another. This network that we will construct is quite modest and can be run on a CPU as well. Traditional neural networks that excel in picture classification have many more parameters and take a long time to train on a standard CPU. However, our goal is to demonstrate how to use TENSORFLOW to construct a real-world convolution neural network.

2.Support Vector Regression Algorithm:

Support Vector Regression (SVR) is not like other Regression models. To forecast a continuous variable, it employs the Support Vector Machine (SVM, a classification technique). Support Vector Regression attempts to fit the best line within a predetermined or threshold error value, whereas other linear regression models attempt to minimize the error between the predicted and actual value. In this sense, SVR attempts to categorize all prediction lines into two types: those that cross over the error boundary (space split by two parallel lines) and those that do not. Lines that do not cross the error border are ignored because the difference between the anticipated and actual values exceeds the error threshold. The lines that pass are evaluated as a potential support vector for predicting the value of an unknown or missing value, Fig: 5.

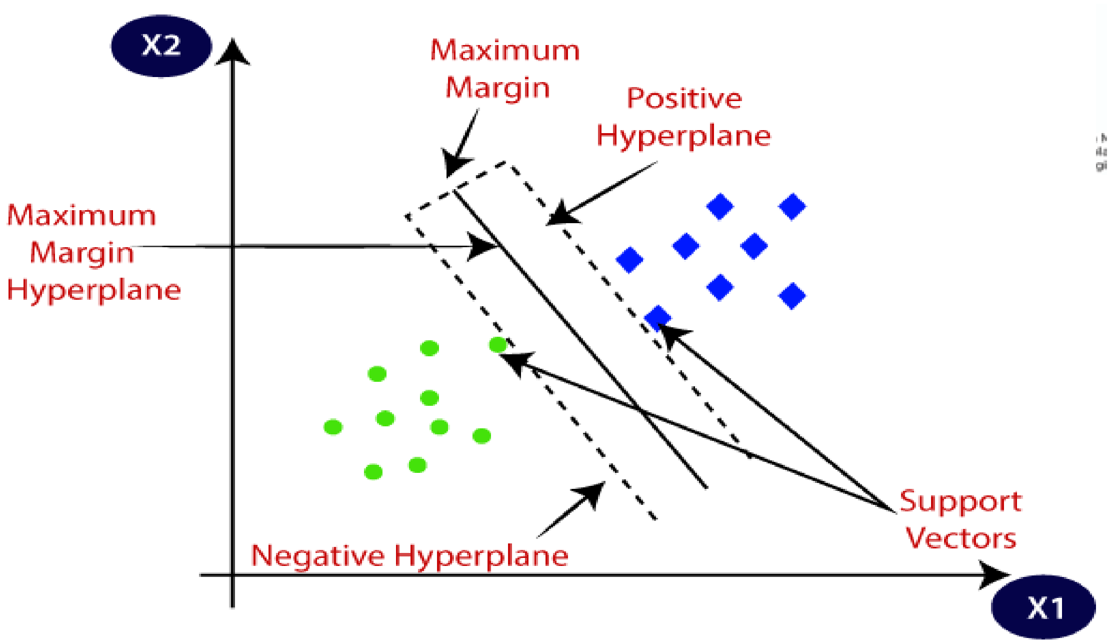

Fig 5: Support Vector Machine Algorithm

VII. IMPLEMENTATION

Users will provide their physical information to the system upon request, and after analyzing the data, the system (ML model) will prescribe the pesticide for crop disease on the user information. As shown in Fig: 6.

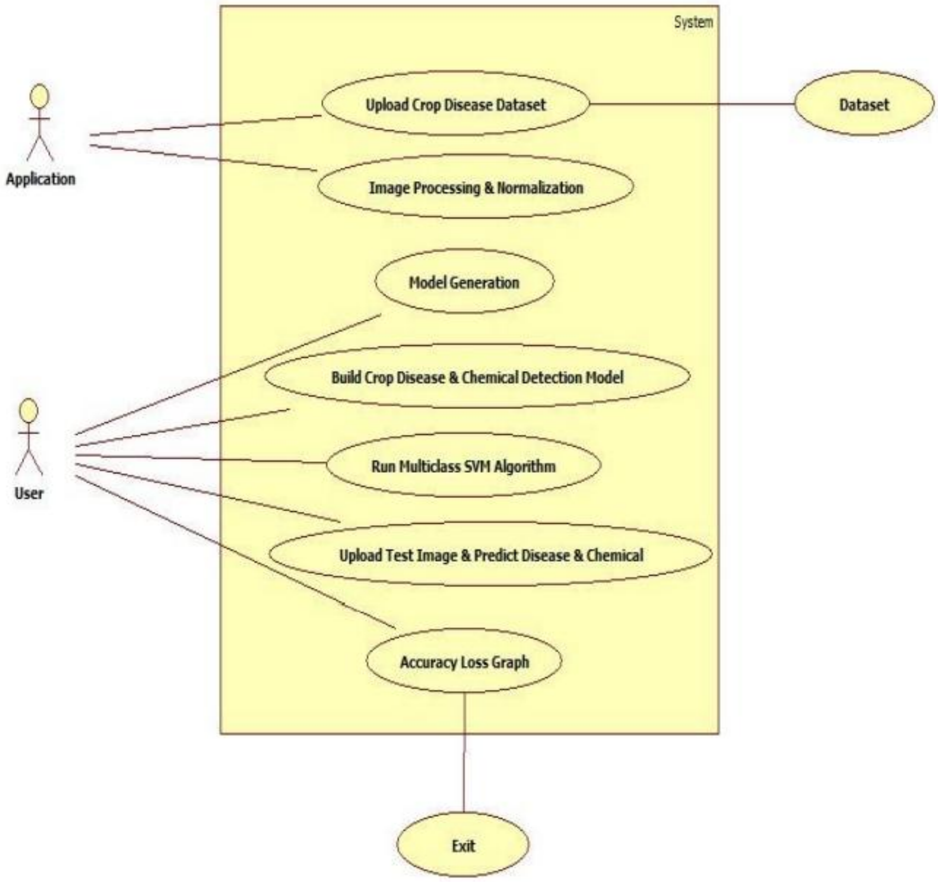

Fig 6: User Flow Diagram

VII.RESULTS

As soon as the project is begun, a dialogue box prompts the user to enter information such as upload crop disease dataset, Image Processing and Normalization, and so on. Build Crop Disease and Chemical Crop Detection Model, Run Multiclass SVM Algorithm, Upload Test Image and Predict Disease & Chemical, Accuracy & Loss Graph, and Exit.

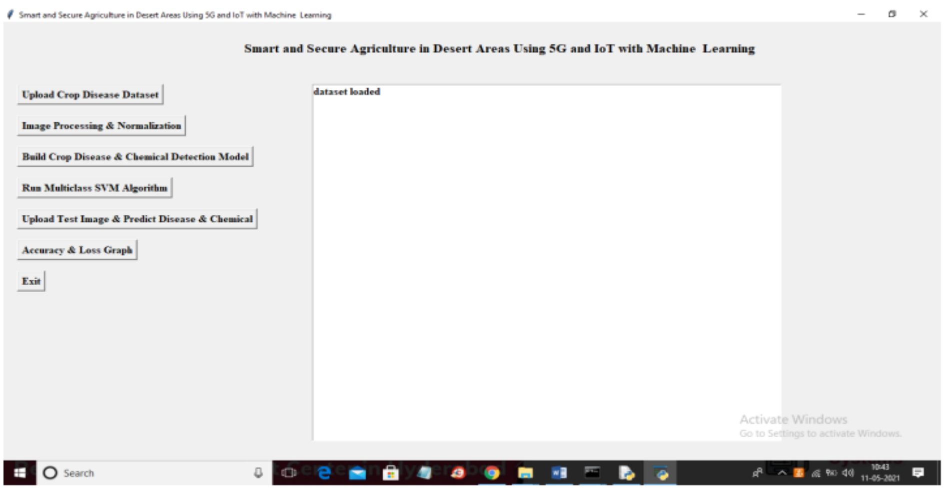

Fig 7: Output Dialogue Box

After the crop dataset is uploaded, our system processes the photographs of various crops using a multiclass SVM algorithm and reports on the images discovered in the dataset, the number of classes categorized, and the number of test and training multiclass in the dataset.

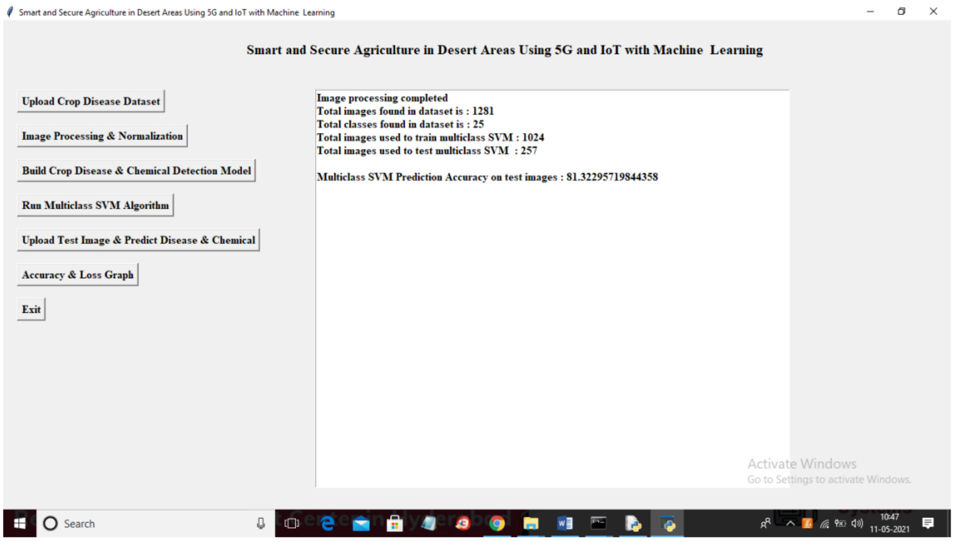

Fig 8: Multiclass SVM Prediction on Test Images

Now, one image is uploaded from the dataset, and the 'Open' button is clicked to obtain the output shown below.

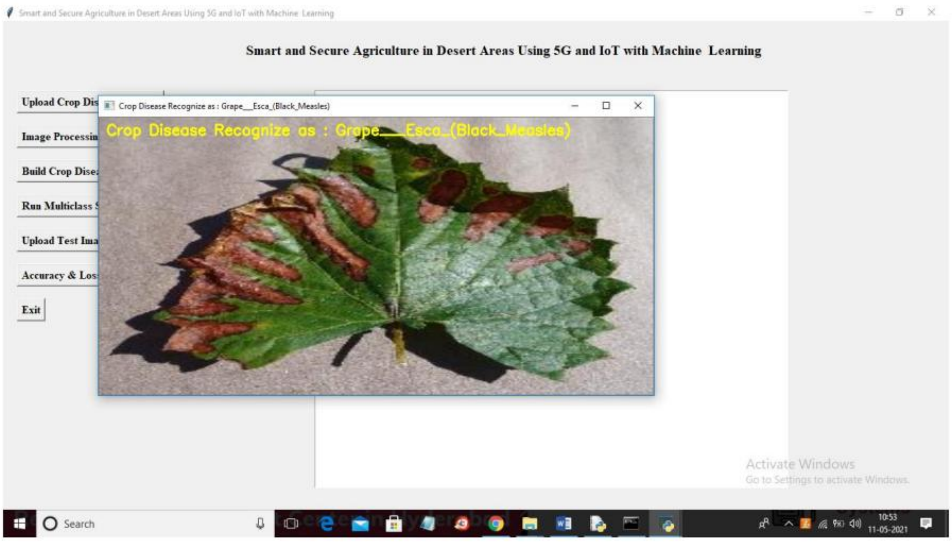

Fig 9: Crop Disease Prediction Using CNN

You may notice illness forecast as 'GrapeEsco Black Measles' in the picture title or yellow color text above and now close above image to receive below fertilizer or chemical data.

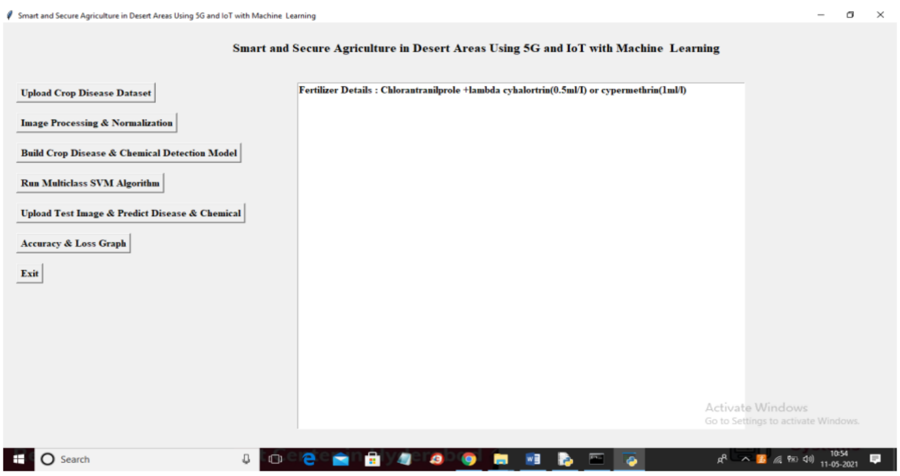

Fig 10: Predicting Chemical for Crop Disease

In the text box of the above screen, you can see the chemical details used to prevent that disease, and similarly, you may submit a test or other photos, and then click on the 'Accuracy Loss Graph' button to receive the graph shown below.

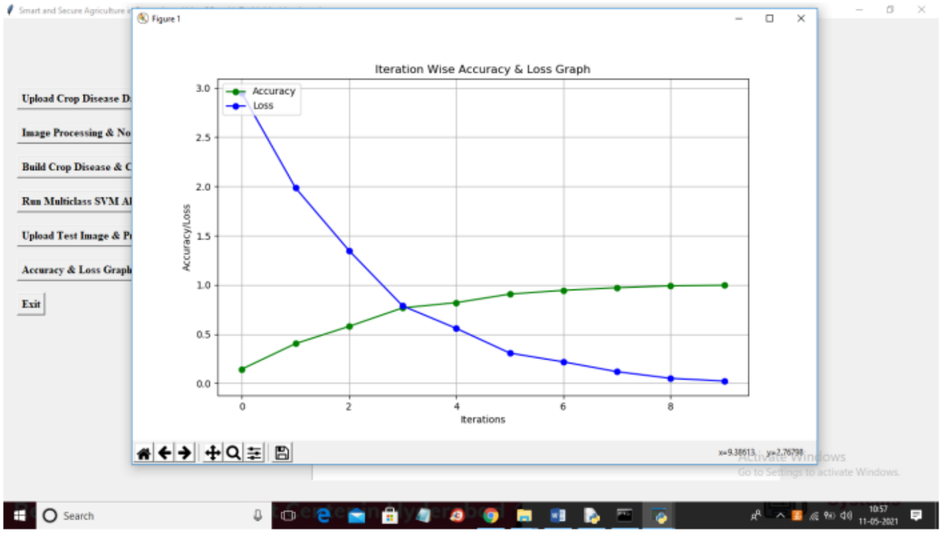

Fig 11: Accuracy and Loss Graph

In the above graph, the x-axis represents iterations/epoch and the y-axis represents accuracy and loss values, and we can see that with each increasing epoch, accuracy increases and loss decreases, indicating that an accurate prediction model is generated. In the above graph, the green line represents accuracy and the blue line represents loss.

VIII.CONCLUSION

In this research, we discussed not only detecting and diagnosing crop illnesses, but also forecasting the amount of pesticides needed to prevent or manage pests. The author of this paper claims that he will monitor crops using 5G connections and IOT devices, with IOT devices capturing crop images and then sending those images to a centralized server where machine learning algorithms will predict disease and suggest chemicals to farmers. However, we do not have such IOT sensors, so we are using the PLANT VILLAGE Disease dataset, which contains more than 20 different plant diseases.

REFERENCES

[1]Accessed:Apr.18,2019.[Online].Available:https://www.un.org/development/desa/en/news/population/world-population-prospects-2017.html
[2] Accessed: Apr. 15, 2019. [Online]. World agriculture: towards 2015/2030 by FAO, Available at www.fao.org/3/a-y4252e.pdf
[3] Abhishek D. et al., "Estimates for World Population and Global Food Availability for Global Health", Book chapter, The Role of Functional Food Security in Global Health, 2019, Pages 3-24
[4] Elder M., Hayashi S., "A Regional Perspective on Biofuels in Asia", in Biofuels and Sustainability, Science for Sustainable Societies, Springer, 2018
[5] hi, X.; An, X.; Zhao, Q.; Liu, H.; Xia, L.; Sun, X.; Guo, Y., "State-of-the-Art Internet of Things in Protected Agriculture", Sensors 2019, 19, 1833.
[6] J. Lin, W. Yu, N. Zhang, X. Yang, H. Zhang and W. Zhao, "A Survey on Internet of Things: Architecture, Enabling Technologies, Security and Privacy, and Applications," in IEEE Internet of Things Journal, vol. 4, no. 5, pp. 1125-1142, Oct. 2017
[7] S. Navulur, A.S.C.S. Sastry, M. N. Giri Prasad, "Agricultural Management through Wireless Sensors and Internet of Things" International Journal of Electrical and Computer Engineering (IJECE), 2017; 7(6) :3492-3499. 56
[8] Zhang, L., Dabipi, I. K. and Brown, W. L, "Internet of Things Applications for Agriculture". In, Internet of Things A to Z: Technologies and Applications, Q. Hassan (Ed.), 2018