# Loss Function Computation using Machine Learning Algorithms based on the effects of Natural Disasters and Plant Diseases on Plant Growth

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A thesis submitted to the Department of Computer Science and Engineering
in partial fulfillment of the requirements for the degree of
B.Sc. in Computer Science

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# Declaration

It is hereby declared that

1. The thesis submitted is my/our own original work while completing degree at Brac University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. We have acknowledged all main sources of help.

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# Approval

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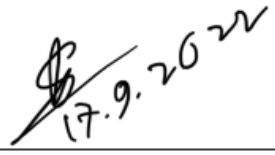


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# Abstract

The perfect place for the human beings to live is the planet named Earth.For this, Earth has to have all the things in the perfect balance for humans or any other living thing to live.Among the things required, plant is the most vital required part.It is the single most important source of oxygen for the living things including humans,animals.On the other hand, Natural Disasters(particular weather factors) are happening frequently and causing varying level of damage to plants.Furthermore, various diseases also harm these plants.For tackling these,here using Machine Learning algorithms, we proposed a "Loss Function" which provides a Loss factor value between (0-1) for determining how certain factors affect plant structure mainly growth and also tell us how much of the Plant is affected/damaged.Many Machine Learning(ML) architectures have been in use for detecting soil structure, plant diseases and other plant related tasks for many years.For the thesis, our group is going to study on how different Natural Disasters (particular weather factors) and Plant Diseases affect plant structure (growth) and get an output of a Loss factor value from the function parameters. Other parameters such as Market demand of plant, economic status of person will also be considered for future work. The Loss function mainly provides a value which is the Loss factor to determine plant growth in a particular condition. Moreover, for the Disease detection we are going to use images with real life backgrounds which will ensure that there are plants in a particular background and we can still detect the disease. Therefore, our main target will be making the "Loss Function" depending on two factors namely Natural Disasters (particular weather factors) and Plant Diseases. By using our "Loss Function" a Loss factor value will be given as output which considers effects of these two parameters on plant growth.



**Keywords:** Loss function; Machine Learning; Loss factor; Natural Disasters; Plant Diseases;

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# Chapter 1

# Introduction

## 1.1 Motivation

Food plays a major importance in people's lives.Most of the food(fruits) comes from plants.However, a large proportion of plants is being affected by pathogenic microorganisms which ultimately leads to food poisoning.Moreover, food security is vulnerable in many underdeveloped countries and a large number of population is going to starvation.These problems are mainly happening due to poor growth of plants due to various Natural Disasters(particular weather factors) and Plant Diseases which ultimately lead to poor food quality and shortage of food. As a result,there is a requirement of a number of detection, identification and treatment strategies of plant growth problems at an early time and this requires new methods for understanding the effects of Natural Disasters(particular weather factors) and Plant Diseases on plants.We also know, Bangladesh as a country is hugely dependent on Agriculture and its Agriculture sector is huge. Most of the farmers are manually handling crop related work such as monitoring.This tells us that if there is a good automatic system for the farmers or people working in agriculture then it will be more efficient and helpful for them.Therefore, by the computation of the "Loss Function", there are going to be some benefits for the plant.Firstly, by creating such function, the Production of plants can be increased, also how much fertilizer is needed for a particular plant can be determined. Moreover, pollution is reduced at a good rate so decreasing extra cost. Due to the method, early detection and prevention can stop spread of crop diseases and initiate use of less drugs to prevent crop diseases so again reducing pollution. Nowadays, precision farming is needed and for that accurate crop details are significant. However, there are some challenges regarding this,for example, effects of Natural disasters(particular weather factors) and Plant Diseases on plants and crop yield have to be taken into consideration. For these challenges, "Machine Learning" algorithms motivate more farm production and reduce impact on the environment. Moreover, we know "Machine Learning" has good computing power so quality and quantity analysis of data in Smart Agriculture can be better processed. Due to Machine Learning, computer simulating learning, knowledge acquiring, improved performance and intelligent self-improvement are possible. Now, effects of particular factors such as Natural disasters(particular weather factors) and Plant Diseases on plant growth are alarming and due to this we are more concerned in finding a smart agriculture method/function for solving this.

## 1.2 Aims and Objectives

This research aims to develop a "Loss Function" which will quickly calculate a value known as "Loss Factor" which will let us know how much of the crop is damaged or affected by the particular parameters which are Natural Disasters(particular weather factors) and Plant Diseases.We will try to analyze different types of crops and test the effects of Natural disasters(particular weather factors) and Plant Diseases on them. The function will show the aggregate effect of these factors on the plant easily. The objectives are:
1. A Computation of a digitized crop suggesting system which includes the "Loss Function" calculation.
2. Determine how Machine Learning algorithms can be used to compute the "Loss Function".
3. Describe Loss factor value (0-1) which will give an idea of how much of the crop is affected.
4. Test on different types of crops and see the effects on them.
5. For authenticity, there will be many discussions with agricultural experts regarding value of the parameters on specific crop.
6. Determine which parameter affects the plants the most.

## 1.3 Benefits of AI

Most of the tasks require looking in tables and documents for performing but AI here can do the tasks, classifications very fast. Moreover,based on training of the machine, it can extract different types of data from documents. Users can easily search things because AI can cause automatic extraction of data and report data very quickly but without AI it would have been very time consuming to search things through documents. Another advantage of AI is that through it anomalies in large data can be found easily. Many companies nowadays want classification tasked performed quickly and this is done by AI's ability to learn and identify data, images from different types of documents. Mainly, AI requires training of machine with data so that it can process same type of data and classify with more accuracy. So, a task which a human would need hours of training to deal with but with AI the machine can process huge complex data quickly. So, looking at the advantages of AI we can figure out that it can play huge role in Agriculture sector. With AI, Agriculture will flourish and will have good results in productivity due to AI's automatic activities. Thus AI is needed for Smart Agriculture.

## 1.4 Negative impacts of Natural Disasters on plants

There are two types of damage on plants which are caused by natural disasters those are direct and indirect damage. Damage that comes from physically attacking plants is direct damage. Damage can be of short time occuring at a particular stage of the plant. Direct damage can be fatal because within seconds natural hazards produce damage to crops sector that can be total or partial damage mainly done to agriculture farms, workshops, storage, agriculture area, processes consisting of

irrigation, water dams and harvested ready plants. Another type is the indirect effect that causes potential problem of production because of disturbance to activity flow of things and processes and expensive production. Damages which are indirect mainly occur due to low income, decrease in production, environmental problems. In pre-20th century many famines were affected by natural disasters such as drought, extreme weather which all damaged crops and livestock. According to a Report of 2003, precisely 246 million people faced damage due to natural disasters every single year, between the year 1993 and 2002. During 1993 and 2002 natural disasters caused destruction of about 42 billion dollars every 12 months. An estimate of the destruction on single year based varied from 67.7 billion dollars-18.1 billion dollars between the year 1995-2001. If we rank different types of natural disasters by amount of damaged caused then the ranking would be: firstly flood, windstorms, drought, forest fires, extreme fires, extreme weather, landslides and more. On an estimate calculation, Asia (49percent) was damaged highly, then to America (30percent), after that Europe (20percent), then came Oceania (3percent) and lastly Africa (2percent).Income generation depends on the loss of perennial plants like banana plants or trees, forest area and these have huge effects on the income. The income that is coming from agriculture based loss may be of short or long duration.

## 1.5 Negative impacts of Plant Diseases on plants

Plant diseases are a major problem to plants. Plant Diseases affect Agriculture, Population growth and huge part of the Economy. To know precisely the effects on Plant Health, we should know Plant Disease management, rate of Plant Loss due to Plant Diseases and obtain more precise results . This encourages a demand for detection, identification of Plant Diseases and understanding of Plant Diseases reasons as well as the finding of new ways of disease identification are required for the Plant Diseases to be detected early.However, Non-Expert farmers sometimes are not aware of non-native diseases for which they need to talk to other people for advice/information regarding abnormal characteristics or symptoms on plants. In some developing areas, farmers may need to travel long distances to talk to experts, which can cost huge money and is time-consuming. These problems have to be dealt with and require research to start automatic process of diagnosing Plant Diseases.
Since, we are talking about Plant Diseases, Insect can be a major source in spreading various Plant Diseases.The impacts of insects in agriculture are huge. Firstly, insects can directly harm the growth of plants. Furthermore, the land area quantity is getting lower everyday due to over population,the demand for nutrients and also for non-renewable energy is getting higher.Besides, insects have a high amount of feed conversion rate that is why they are targeting crops. It is observed that insects emit less green and consume more crops like rice, jute etc. For example, a group of ants can consume food approximately 38 to 60 grams per day. Insects can easily cause harmful impacts on agricultural sector, market access, the environment and people's lifestyle. Lastly, Insects can cause problems by damaging crops through eating the juice of the crop and food production gets affected which ultimately parasitizes livestock or creates a health problem for humans. Therefore, these insects are causing more Plant Diseases which affects the overall growth of plants.

# Chapter 2

# Literature Review

## 2.1 Natural Disasters effect on Plant Growth

### 2.1.1 Flood

According to [1]–[3], it is know that salinity level increase is caused sometimes by storms and floods which can make the agriculture purpose area very rough and unsuitable which can be a problem. In [4], it is talked about two types of damages cause by floods which are direct flood damage and indirect flood damage, direct effects mostly happen at the time of less growth type season and indirect effects happen at the time of more growth season. Some of the noticeable damages at the time of less growth season are disappearing of nutrients in the soil area, loss of the top part of soil, soil compaction, erosion of soil, perennial crops being damaged, permanent stop to farming in floodplains. Some of the damages at the time of more growth time include plants being waterlogged, plant lodging, availability of less nutrients in soil, no more pasture use, erosion of soil, more attacked by diseases and pests, interruptions occuring to farm systems, perennial crops being damaged.

**Less growth season-**
•Less availability of nutrients in soil and no top part of soil.
• Compactation of plant area.
•Erosion of soil.
•Undesirable materials being deposited.
•Perennial crops being permanently damaged.
•Anaerobic processes occuring frequently.
•Plains covered in flood causing less farming.
•Rivers and other water areas getting separated.
**More growth season-**
• Plants getting water logged.
•Good plants being logged, Less available soil nutrients.
•No more use of pasture.
•Soil having too much erosion.
•More attacked by other creatures and plant diseases.
•Disturbance happening on plant growing decisions.
•Plants getting permanently damaged, also trees.
•Temperature of soil getting reduced, need of expensive drainage systems.

•Habitat loss.
•Transportation problems.

### 2.1.2 Drought

Droughts lead to long-term land degradation which can cause serious effects. Such as [5] droughts on plant growth are devastating. Agricultural Gdp having fall of 50 percent means that a Gdp is affected by 10 percent decrease in which in early drought time total of 20 percent was covered by agriculture. Moreover, [6] said that during the year 1971, 1982 and 1994, North region of Brazil faced severe drought, causing the agricultural Gdp to alter between 17.5percent to 29.7percent, the area's Gdp's fluctuations were explained almost by too much drought.

### 2.1.3 Cyclone

Typhoons are another disaster that have severe impacts on planting area, such as, at south part of hainan region during October 2nd of 1999, around 26 million timber trees had destruction on them [7]. Storm which attacked Thailand during 1989 November wiped around 150 thousand amount of rubber trees, coconut trees and oil planting area [8]. Coastal area seas cause huge wind, mostly pour salt on coastal type land that makes it very hard plant trees which are affected of too much salt. Here there are regular destruction and non-regular destruction. The regular destructions contain:
• Plants,vegetable type plants being destroyed.
• Soil fertility is hugely reduced since salines are deposited on land and seas cause flood over them.
• Transportation system being disturbed.
• Standing crops are being destroyed which are damaging for the future plantings.

### 2.1.4 Rainfall

According to [8], a good balance of rain and proper watering can help to grow fast. Hence, plant growth process has an important part which is germination. Therefore, heavy rainfall can kill the seeds and can harm the germination process, also heavy rain can cause flood. Thus, the flood can kill the crops or harm the crops. Similarly, the heavy rain fall can make a harmful effect on soil such as changing soil moisture, soil erosion, temperature of soil decreasing etc.

### 2.1.5 Volcano

From [9],volcanic eruption is another harmful effect to plants. Moreover, volcanic ashes have harmful and toxic elements such as Sulphur. Besides, these types of toxic acids can cause burning effect to plants and can cause harmful effect on leaves also can reduce the weight of the plants.

### 2.1.6 Wind

In [10],wind has its own direction and velocity which is called wind turbulence. Furthermore, wind can directly make an impact on photosynthesis and gas exchange

at leaf scale. Moreover , at the time of strong wind can make the trees or plants to re-orientate themselves can destroy crops , can make soil erosion and so on.

### 2.1.7 Air moisture

In [10],moisture in the air try to keep plants healthy and boost properly. In addition, if the air humidity increases then the growth of various types of pests will increase such as bacteria, mold, fungus . Again, these pests cause different plant diseases such as crown rot. Lastly, dry air moisture can create fire in jungle.

### 2.1.8 High temperatures

According to [10],High temperature has an impact on photosynthesis and plant transport system. Again, high temperature reduces the amount of tubers of the plants and increases respiration loss during night. Moreover , high temperature will reduce the growth of the certain plant and it will dry up the soil. Lastly plant will die by the lack of food reserves.

### 2.1.9 Low temperatures

In [10]During low temperature the water which is situated inside the plant cell will freeze up and the plant will die easily from inside part. Despite this, the low temperature will make a vital impact on some most essential processes such as flowering, photosynthesis, respiration and germination thus it will reduce the plant growth because of the lack of food. Furthermore, the toxic matters of metabolism stores inside the plant tissue as the plant is not growing properly so that the other plant process also will not work properly .Additionally, low temperature can freeze the soil so in this case plant is unable to get proper nutrients.

### 2.1.10 High cloudiness

More causes of diseases and poor growth structure of plant [10].

### 2.1.11 Hail

In [10],hail occurrence depends on the weather. For example , in spring season the maximum leaves fall out and new tender leaves will start growing thus it will reduce the amount of crops or fruits. For this reason, hail damage makes the plant weak and unhealthy .Later,the low hail can allow the high growth rate of pests and plant diseases.

### 2.1.12 Lightning

Lightning can damage a healthy tree and also cause forest fire [10].

### 2.1.13 Snow

From [10],due to heavy snowfall woody plants are mostly affected. Furthermore, surprising occurrences can particularly affect reproductive organs of the plants or crops.

### 2.1.14 Snow Avalanches and Huge Earthquakes

As seen in [10],these two things can almost make a permanent loss in crop farming ,farmland etc. Furthermore , releases of the harmful CO2 and dangerous greenhouse gases such as hydrogen sulfide (H2S) is harmful for plants,human and also for animals.

### 2.1.15 Environmental pollution

According to [10],air pollution directly affects living tissues of trees and reduces the ability of photosynthesis and respiration process. Equally, air pollution will affect the metabolic function of the leaves. Moreover, during air pollution the soil and the water seems acidic and thus it is harmful for the growth of a plant. In water pollution, the acid rain will mix up with water later into soil and will damage the trees .Furthermore, plants need fresh water not acidic water so this can make the plant unhealthy .Lastly, sometimes irrigation water pollution may occur.

## 2.2 Plant Diseases effect on Plant Growth

According to [11], we can express disease degree either by amount or number of times. Amount here means the calculation related to the percentage of affected type of plants or affected plant part area, independent of each damage level. Symptom degree is amount of the affected part or plant organ being shed by signs of the plant disease type. Damage occurs due to the amount and area of symptom area. In [12], Disease degree occurs due to high amount of rusts, on powdery mildews, on leaf spots areas. However, we are concerned more about diseases which affect entire plant structure. In [12], it is said that Disease occuring is examined by counting of affected versus good examining areas which is less eronous compared to examining the disease degree. Examining areas can be called affected only if affected amount is above a specific value (such as plant damage minimum) and this is said as damage occurings rate. Also [12] says that a specific symbol of damage because of plant disease is covering diseased plant parts which increases difficulty level for disease identification and it is also not surely specific of why plant parts are covered. Organ covering can affect the real affection amount over a tree. In [13], to achieve an estimate of disease then normal amount of examining area of trees or like tree part, full tree structure or plots, fields, farms, regions, countries should be considered. Diseased plant areas or affected areas can be widespread or found together, can also be normal type or system related by looking at structure of soil or type of disease. Whether infection areas are randomly distributed or not can be determined by taking a large sample area for disease degree rather than for diseases occurings [14].

Research projects include getting data of number of affected areas and size determination. If affected area is normal, affected rate per leaf is counted and their diameter is measured also total calculated region of affected area is calculated. Affected part has a relation with the leaf area which is said as disease amount in percentage number. However, if affected areas have different sizes then they can be assigned to different sizes classes and calculated. By using these methods we can study how quantitatively host changes by pathogen attack. These techniques have been used to give more details into the explanation mechanisms for affected area sign progress.

In addition, there are some photo ways which can detect electromagnetic type of waves which are outside of range of visible light to give disease signs a value which is impossible to detect from humans perspective. By having more number of signs, symptoms can be detected more early. According to [14], [15], genome and transcriptome works has helped to know about the differences in genetic variations which are in both plants and disease causing organisms. Photo phenotype has the potential to significantly attain the power to identify tree disease phenotypes quickly. In [16], it is said that the use of automatic, digital photo in plant disease experiments causes data to be collected at different time ranges which gives photos through which numeric phenotype information is achieved also improves happenings of more experimental processes. Image data can be used for phenotypic calculations. For information regarding plant structure and growth rating, these types of calculations consider of plant tallness or biomass amount. To know more about plant disease symptoms especially on plant leaves then photos are used.

In [17], many disease symptoms show unique spectral reflecting structures which make hyperspectral photos identify signs and individual symptoms accurately. According to [17], with proper high resolution, specific reflecting structures in the visual ranges were enough for good sugar beets plants to be differentiated from plants like mildew and Cercospora leaves and in order to know differences between mildew infection vs Cercospora infection. In [18], [19] it is stated that hyperspectral photos need light waves and reflecting waves so environment's pattern changes must be considered on the time of photo details steps. In [20], disease causing organisms which cause closure related to stomata in trees or plants are the causes to low transpiration rate and higher plant part temperature. There is different types of relation between stage of symptoms and range of temperature. Cubensis causes an infection where surface temperature is first decreased because of contraction of stomata area in the beginning of infection. After some time when there are necrosis areas due to disease causing organisms, infected leaf starts to have temperatures which compared to uninfected areas are much higher and this is due to no cooling which ultimately leads to tissues being destroyed.

According to research, Insects are major cause of Plant Diseases on plants. Flying insects like butterflies, bumblebees and hoverflies can cause effects like destroying the growth of the plant and interior or edge location of the plant in the land [21]. Furthermore, using recent survey we can say that the terrestrial insect population rate is around 10.6% per decade[22]. Moreover,the water population rate is around 12.2% per decade at the countryside level. Besides,because of global warming, in localized area the biomass of flying insects is almost greater than 75% around 27

years in nature safeguarding area like Germany as shown in survey [23]. Therefore, the effect of climate change is hampering the biodiversity of the plant [24].Since, the photosynthesis pathway (C3 and C4) both are changing their path for this reason the amount of CO2 is increasing and thus it affecting the weather as well as harmful for plants .As, the CO2 is increasing so the biodiversity and food habit of insects is changing rapidly. Similarly, insects are another reason of plant or crop disease. Furthermore, due to global warming the biodiversity and the food habit of harmful insects is changing and their growth rate is also increasing [25]. Again, pests and diseases can make a great loss to production of the crops [26] such as, photosynthetic rate reducers (bacteria, fungi viruses), light stealers (weeds, pathogens) etc. In addition, pests can easily reduce the quality of the crops as they eat the leaves and thus imbalance the photosynthesis cycle. For example, these types of pests can make a lot around 50% in wheat production, around 80% in cotton production , around 26% for soybeans production etc. Lastly, weed production has the highest potential loss due to pests.

# Chapter 3

# Proposed Materials and Methodology

## 3.1 Proposed System Architecture

Here, we are trying to compute the "Loss Function" which consists of the process of taking in some parameters for obtaining a value known as the "Loss factor". The Parameters of this function are concerned with the effects of Natural Disasters(particular weather factors) and Plant Diseases on Plant Growth. This "Loss factor" is a value in the range of (0-1) which will indicate whether the crop is fit or not for planting. Firstly, a set of different crops is acquired and based on the two parameters we are using, we will do testing on those particular crops and figure out how different factors are affecting the plants and producing a "Loss factor" value. In next step, we will consider those two factors/parameters for our "Loss Function" calculation which are Natural Disasters(particular weather factors) and Plant Diseases. In third step, we will acquire information from the existing knowledge and opinion of experts which will tell us how much severe or dangerous each plant disease is and weather condition values for the plant growth so that we can use these particular values of the particular parameters for a specific crop and calculate "Loss factor". Then, we will consider two Approaches for the "Loss factor" calculation and they are i) using Mathematical function and ii) using Machine Learning. If we choose Mathematical function approach, then for calculating the "Loss factor" for a specific crop we will take input the particular values of the parameters and put in the "Loss Function" for getting a value between (0-1). On the other hand, in the Machine Learning approach, the "Loss factor" calculation for a particular plant will depend on "Training" using a dataset. After training using the dataset, testing will be performed as well as validation. Therefore, when the input values are given, "Loss factor" value is easily computed. During the Machine Learning approach, we will consider many known architectures while doing testing and training for the datasets and try to find which algorithm is best suited for this calculation. We will do training and testing separately for each parameter Natural disasters(particular weather factors) and Plant Diseases. The output achieved from each testing can be used to form an aggregate value by using the "Loss Function".In most of our training process of each parameter we considered Deep Learning algorithms and are hoping to get a "Loss Function" using that algorithm.

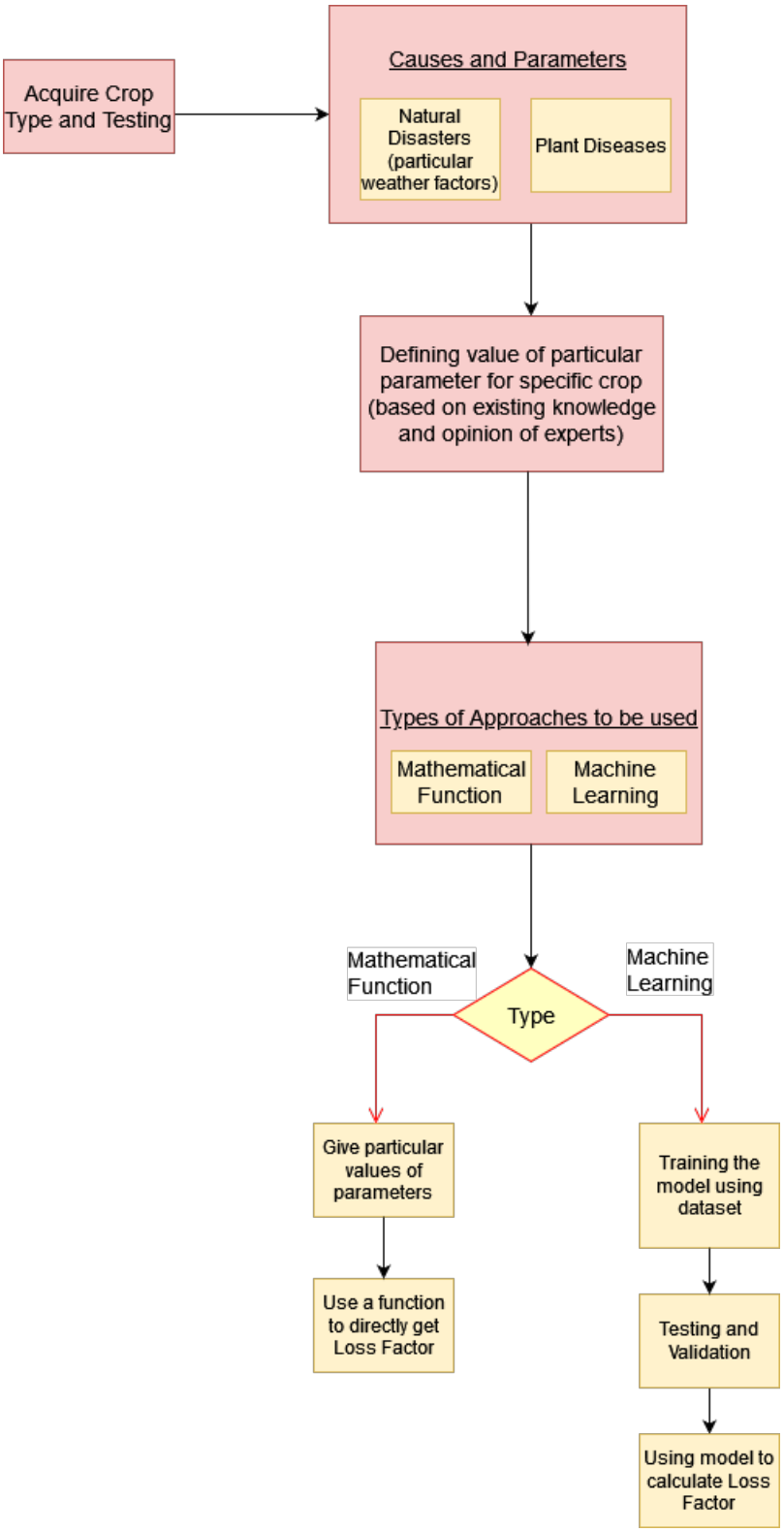


Figure 3.1: Flowchart of System Architecture

## 3.2 Used Algorithms for Plant disease detection

### 3.2.1 Using Classification Problem

A good use of ML(Machine Learning) has been Classification problem solving because of its increased use in many areas.The basic definition of the process can be said as the task of finding the output class which is "y" of an input vector(x) having "K" dimensions.This action can be done by making a function of Classification type or a rule of Classification type, these will be capable of finding signs of new output.It is to be noted the variable "Q" is same as the quantity of different output classes.For two possible outputs of the labels,it is known to be binary classification.When there is more than two then it is Multiclass classification. Here, for Plant disease detection, Multiclass classification is being used which tells if a plant is affected by disease or not and also tells the disease type.

### 3.2.2 Sequential Model

The model is very easy to use. It consists of methods all in a linear stack and also groups the layers inside a stack(linear).The primary task happens to be that sequential order is maintained for arranging the layers of keras.While using the model,transfer of data occurs from layer to layer.Continuous data flow occurs until final layer has the required data.It is found that many ANN's try to put this Model which is of sequential API type in use.

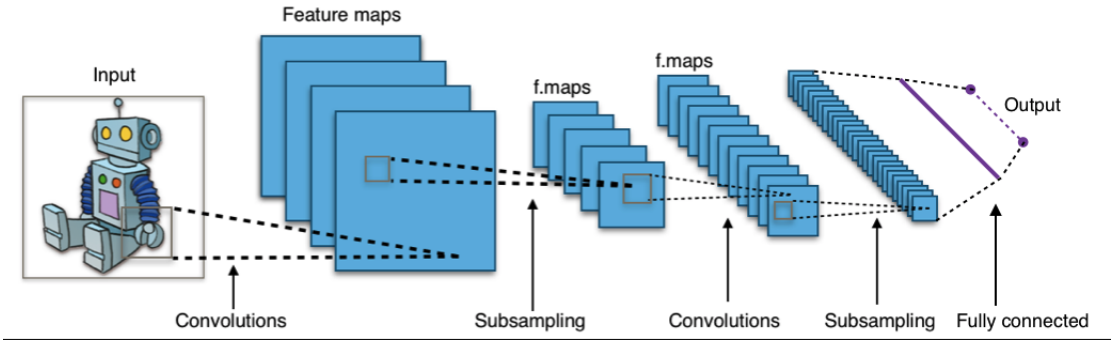


Figure 3.2: A Sequential Type Model Architecture

### 3.2.3 Convolutional(CNN) type of network

Convolution type of network is considered a part of Deep learning type architecture and is also considered a deep learning type of network class,mainly implemented in places of analyzing visual images.Here,a special technique is used called Convolution.The main task of "ConvolutionNet" happens to be compressing images into the right form that is easy to handle and work on,keeping in mind that important details which will be helpful in predicting correctly are not removed.Convolution neural networks have multiple layers consisting of neurons which are artificial.During the input of an image,each layer provides many functions mainly of activation type which get transfered from one layer to the next layer.By seeing a particular map known as "Activation Map" which is in the last convolution neural network layer,the layer for

Classification purpose gives a bundle of rightly predicted outputs that indicates how confident the image is of a "certain class".

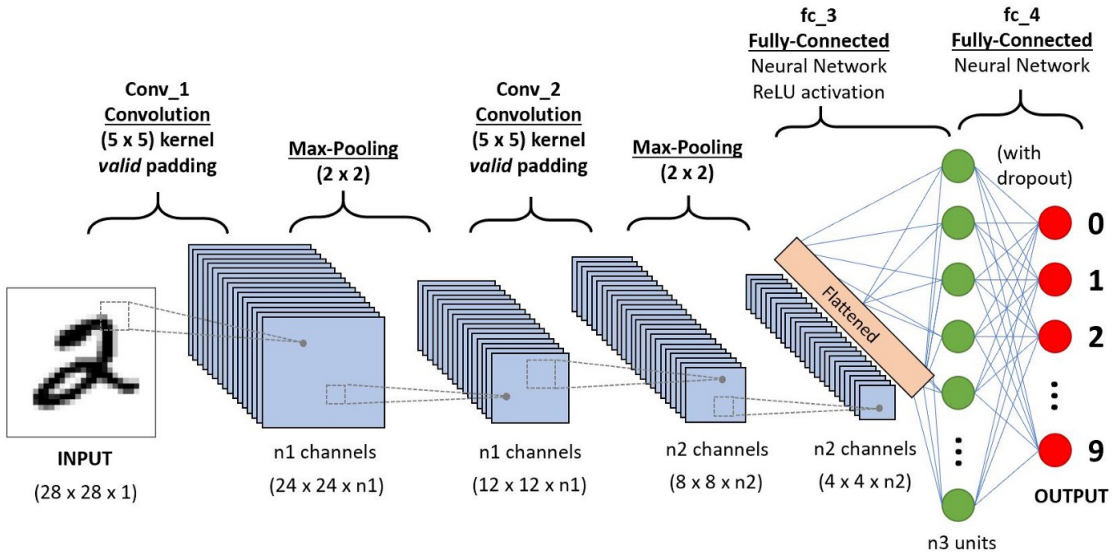


Figure 3.3: CNN Architecture

### Max Pooling Process

This layer is mainly in need for compressing spatial area of the convolving type feature.In addition, decreases computing capability which is needed for processing the data by lowering dimensions.In this process,observing image's single part which is surrounded by the Kernel gives the highest value of a particular pixel.Many denoising activities along with dimensionality reduction occurs here.

### Batch Normalization Process

Between different layers of the Neural Network, a type of Normalization process is happening instead of happening in raw data type.Full dataset is not being used much rather this is done in small batches.Furthermore,Training speed increases very much.Not only the Neural Network is becoming more stable by adding many layers in the network but the network is also getting faster.Two operations occur which are Stardardization and Normalization by the new layer that affects the layer which is an input from the previous layer.Moreover,it is seen that the normalization process happens as a collection/batches rather than a single type of input.

### ReLU Function

ReLU mainly ( R=Rectified linear type unit) is not a simple or straight activation method but it is more of a non-linear type which functions on multiple-layered neural network architecture.On this layer,each and every negative value from the filtered image is identified and replaced with zero value.This function activates when the input in the node is found to be more than a specific number. The output equals to zero when there is input value less than the zero value.However,if the value(input)

is greater than a certain value which is mainly a threshold value then there is a relationship which is completely linear between it and dependent variable. This says that the speed of training process is increased hugely for Deep Neural Network Architectures and it is proven to be more faster than different Activation functions.Mainly,a ReLU layer i) works on element-wise operations. ii) gives a rectified feature map output.

### Dropout Technique

It is a regularization technique for Neural network model.During the training process,this technique ignores many chosen neurons which are random in nature.A "dropped-out" process happens randomly which specifies that the work being done by them for activating actions of downward type neurons are gone during upward passing,also the data about updated weights are not summed for downward passing neuron.When learning process of the Neural Network Architecture occurs, the neuron weights are kept into the network.Neuron weights are chosen is such a way so that they can be used for attaining right features mainly showing some Specialization process.Neurons which are not far get more dependent during this specialization process which if happens too much then the fragile model can get too much specialized type towards training set.Therefore,depending too much on the context mainly towards a neuron at the time of Training is called as complex co-adaptations.

### Softmax Process

Softmax is a type of mathematical function which transforms a vector of many numbers into a single vector containing probabilities and there is proportionality between the probability of each value with the relative scale of each vector value.For a good Activation function type this is used in a Neural network architecture.Moreover,it is used for normalizing the outputs by transforming them from weighted added values into different probabilities that adds to one.Every output value of Softmax function is known as the probability of membership of each of the class.

### Adam Optimizer

This is known as the mixture of RMSprop together with Stochastic Gradient Descent which includes momentum. Squared gradients are used for scaling the learning rate (mainly RMSprop).The main aim of the momentum process is to take different varying gradient average in place of taking stable gradient(mainly SGD).Moreover, by using this Optimizer the Learning Rate is done in an adaptive method, meaning that a calculation of single rate of learning occurs against each of the varying variables.In addition, estimations are used of the gradient's first and second moments for adapting the learning rate of individual weight of Neural network.

## 3.3 Used Algorithms for predicting suitable Plant in particular Weather factors

Here, we are considering some weather factors like Air temperature, Humidity, Soil pH and Rainfall values of an area as an equivalence to Natural Disasters effect on plant growth. By observing these weather factors, a suitable crop is predicted.

### 3.3.1 Decision Tree and Architecture

It's type belongs to supervision type Learning.Comparing to other learning methods,this algorithm is very good for solving problems containing Regression and classification solving problems.The aim for this algorithm directs to making a methodolgy which depends on train of data and letting different classses or required output from the desired variable to be told by studying the rules of decision contained in training data. In these Trees,the root of the tree is used as the starting point for predicting the output class of a record.Then a comparison happens between the starting attribute and the target's attribute.By observing the differences,the part of tree indicating that targeted value is chosen and the route to another node is taken.

#### Different Types of this Algorithm(Decision Tree)

i)A tree which has categorized variable as target.
ii)A tree which has continuous variable as the target.

#### Certain Terms to consider for this type of Tree

i)**Node of Start:** Represents full tree or every branch which forms division of more than two homogeneous type of sets.
ii)**Dividing type of Node:** When there is formation of many nodes from a particular main node.
iii)**Node which provides the Decision:** When the branch nodes gets splitted into more branch nodes.
iv)**Node at the end:** There is no possibility of division of node.
v)**Process of pruning:** Many branch nodes of a decisive node are gone or pushed aside.
vi)**A small tree:** A little part from main tree.
vii)**Main type and Branch type Nodes:** When a node is splitted into many nodes then that node is the main type node of those splitted nodes and the splitted node are considered branch type nodes of the main type node.

#### The mechanism of Decicion Tree

Decision trees start classification starting from the start node and towards a particular ending node which ultimately gives the Classification problem type solution.There are many test case type of nodes for several attributes and a route/edge descending from node shows indication to available answer to scenario of test.The process occurs recurrently, always happens for each and any sub-tree which is rooted at the new node.

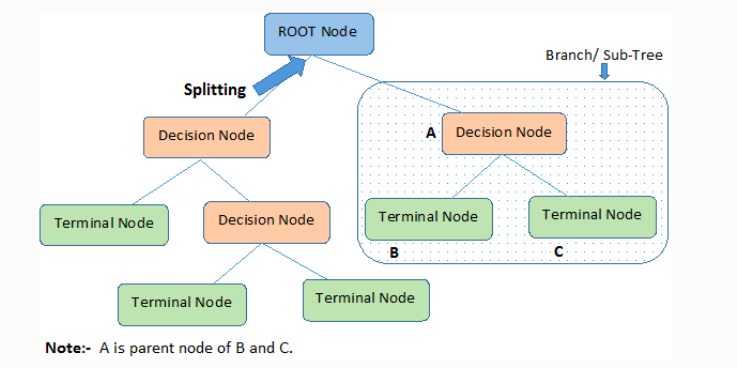


Figure 3.4: Decision Tree

### Some Assumptions to take when forming the Tree

•For the root, the set used for training is considered at the beginning.
•Values providing the features are mainly categorized.However,in case of continuous values then they are discretized before making the model.
•By looking at the attribute values records are spread out recursively.
•Some statistical ways are considered so that different attributes can be root or any internal type node.

Furthermore, Decision Trees follow of SOP representation which is sumofproducts and another name is Form of Normal Disjuction.In case of a single class,each extension from starting of the tree to a sub node having same type of class is values getting product,extensions which are not same and finishing in that same type forms sum.

Main task would be the consideration of what attributes would be the starting node.This choosing is known as Attributes Choosing process.Many Varying attributes choosing methods are there to know which attribute can best be the starting node for a level.

### How Decision Tree Algorithm actually works

Due to the decision of strategically splitting, the tree's precision gets affected.Solution types differ for classification type and regression type of trees.

Trees of Decision use many methods for determining if a main node is needed to be splitted into branch type nodes or not.By making different branch type nodes the homogeneity level of producing branch type nodes increases.So,it can be said that the node purity is greater when compared with required output.There is division of nodes by considering every possible values and finally uses best homogeneous branch type node division.

Algorithm selection process is mainly based on form of required variable.Some algorithms are stated here:
i) Id3 type(mainly d3's extension).
ii) C4.5 type(Id3's next form).
iii) Cart type(used in Classification type and Regression type of trees).

iv) Chaid type (Different level type of splits are done when considering classification type of trees).
v) Mars type(multiple variant type).

## 3.4 Datasets Description

### 3.4.1 Plant Disease

Here, there was analyzing of 54,306 plant leaf images which have 38 class labels types for each of them.Every class indication is a diseased type crop pairing and this is done by only analyzing the different plant leaf pictures.For different approaches,the images were first resized pixels of "$256 \times 256$" and model was optimized and predicting work was achieved by observing these low- quality pictures.
For every experiment approaches,3 different picture types of "PlantVillage" pictures were used.First,the images of "PlantVillage" were in fully coloring form(normal form),secondly grey scaled type pictures of the "PlantVillage" images were considered then finally there was a type of the "PlantVillage" images mainly concerned with plant leaf being cut out from whole image meaning getting rid of the extra background image and information because it might cause forming of few inherent bias information in the images because of using regularization way of finding of data for the "PlantVillage" pictures.Segmenting process was done because of a script which was used to perform good for the particular dataset.A technique was used due to some masks created due to the observation of the coloring,brightness and saturation quality components of multiple regions of the pictures in different coloring spaces (mainly Lab type and hsb type).There was a process which allowed a good fix of colour casting that proved to be too high in many parts of the dataset images, which leads to getting rid of another possible bias situation.


Figure 3.5: Pictures of PlantVillage's plants, which show every diseased plants

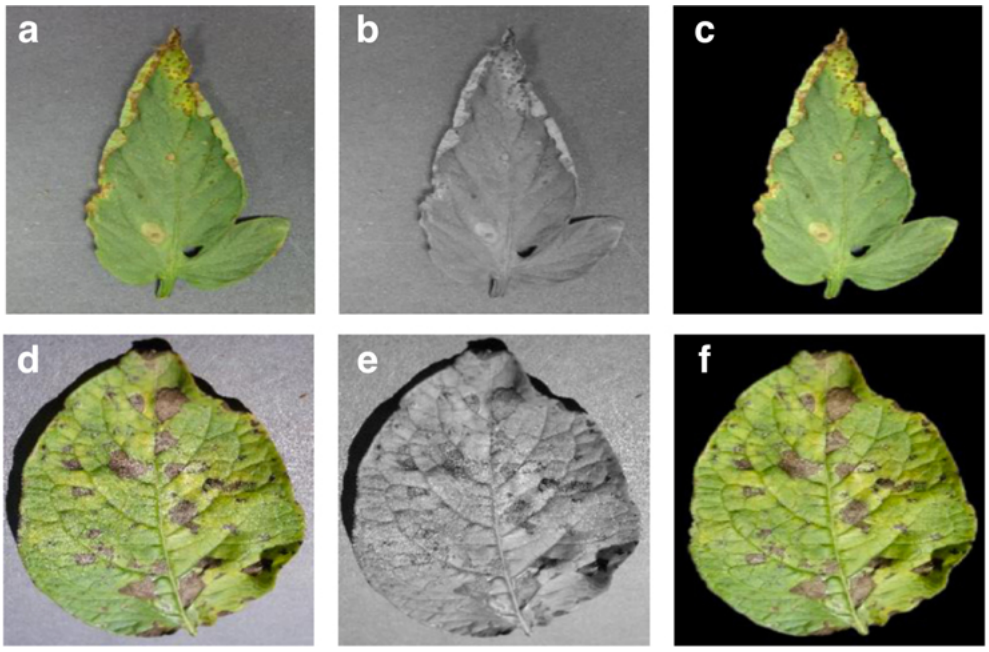


Figure 3.6: Images showing 3 different image types of PlantVillage images which are done using different experimental conditions. (a) First image coloured type, (b) First image gray-scaled type, (c) First image segmented type, (d) Second image colored type, (e) Second image gray-scaled type, (f) second image segmented type

The dataset was under controlled environmental conditions. The plant images mainly consists of these 14 types:
Apple type, Blueberry type, Cherry type, Corn type, Grape type, Orange type, Peach type, Bell Pepper type, Potato type, Raspberry type, Soybean type, Squash type, Strawberry type, and Tomato type.
The Image collection has mainly 38 different variation of plant diseases which are shown below:
1.Scabbed disease Apple-images

2.Black rotted Apple-images

3.Cedar containing Apple-images

4.Normal Apple-images

5.Normal Blueberry-images

6.Normal Cherry-images

7.Powdery mildewed diseased Cherry-images

8.Gray leaf spotted Corn-images

9.Common rusted Corn-images

10.Normal Corn-images

11.Northern Leaf Blighted Corn disease-images

12.Black rotted Grape-images

13.Black measles containing Grape-images

14.Leaf blighted Grape-images

15.Normal Grape-images

16.Huang-longbing diseased Orange-images

17.Bacterial spotted Peach-images

18.Normal Peach-images

19.Bacterial spotted Bell-pepper-images

20.Normal Bell pepper-images

21.Early blighted Potato-images

22.Normal Potato-images

23.Late blighted Potato-images

24.Normal Raspberry-images

25.Normal Soybean-images

26.Powdery mildewed Squash-images

27.Normal Strawberry-images

28.Leaf scorched Strawberry-images

29.Bacterial spotted Tomato-images

30.Early blighted Tomato-images

31.Late blighted Tomato-images

32.Leaf molded Tomato-images

33.Septoria leaf spotted Tomato-images

34.Two spot spider mite type of Tomato-images

35.Target spotted Tomato-images

36.Mosaic virus containing Tomato-images

37.Yellow leaf curl virus containing Tomato-images

38.Normal Tomato-images

### 3.4.2 Natural Disasters(particular weather factors)

According to the Air temperature, Humidity, Soil pH and Rainfall values, a suitable crop is predicted. Here, this dataset contains data of about 3100. The Crop predicted include Rice,Wheat,MungBean,Tea,Millet,Maize,Lentil,Jute,Coffee, Cotton, GroundNut,Peas, Rubber,Sugarcane,Tobacco, Kidney Beans, Moth Beans, Coconut, Black gram,Adzuki Beans,Pigeon Peas, Chickpea,Banana, Grapes,Apple, Mango, Muskmelon, Orange, Papaya, Pomegranate,Watermelon.

| temperature | humidity | pH | rainfall | Label |
|---|---|---|---|---|
| 20.87974371 | 82.00274423 | 6.502985292 | 202.9355362 | Rice |
| 28.97274022 | 60.50275586 | 4.800908436 | 186.5498269 | Tea |
| .... | ..... | .... | ... | ... |

Table 3.1: Dataset for crop prediction in particular weather factors

## 3.5 Data Preprocessing

### 3.5.1 Plant Disease

The dataset's raw images were first resized to the DEFAULT Image Size= 256x256 for matching the insert figure of first layer of neural network architecture. Every destination of the plant disease images folder has dissimilar quantity of pictures.However,everything were not chosen but we chose the first 100 pictures from each folder path so that the model can be trained efficiently.Then The loaded images were in the process of getting mapped from every type or output of each plant disease type to a special value to complete the training procedures. Furthermore, guessing an output or the type of the disease from the result of the classifying model is also found out.Lastly, the images which are loaded is divided into 2 different sets,one is training of data and another is testing of data having 2/10 dividing ratio between them.Training images was used for the classifying model to get trained while the testing images were used for verification of the used model at the time of testing.

#### Data Augmentation

For increasing the number of images of the dataset significantly,this Data Augmentation technique is used.Various operations were done such as shifting, rotation-type, zooming and flipping of the pictures which helped for getting a better and diversed dataset.

By giving processed pictures inside the used model, there is efficient knowing of the details from various parts of the particular picture and allowing it to show good on unknown picture information.

#### Model

Here,the hyperparameters used for our plant disease classification model are defined:

Epochs-number=25.

Steps-number=100.

Lr value=1e-3.

Batch-size-number=32.

Width-value=256.

Height-value=256.

Depth-value=3.

Now,a sequential architecture model is created for the classifying objective. While using the model,there is both creation of “channel last” method and there is also the creation of a switch for back-end which has “channel first”.

For the model,a two dimensional Conv(convolution) layer is created with a kernel of 3 by 3 containing filter size=32 and a Rectified Linear Unit activation is used here too .After that we started performing batch normalization process to make neural network faster, max pooling operation to calculate maximum value, and 25 percent or 0.25 dropout type regularization operation in the next layers.

Later on,2 divisions of two dimensional Convolutional type layer having filter size=64 is made and Rectified Linear Unit activation ensured by the pooling process and dropout processing layer.This job is done for the very end set of Fully Connected type layer which has filter=128 in the Conv two dimensional layer which creates the only difference between other layers.

#### Training

Firstly, we initialized the local optimizer along with learning rate before starting the training process.The Adam optimization method is picked as it nearly executes so fast and gives superior universal minimum convergent value as differed with many more optimization techniques.

#### Testing

At the time of testing the picture data, we select pictures from data sets unsystematically.After selecting those pictures, we try to figure out the particular disease or class of that picture.

### 3.5.2 Natural Disasters(particular weather factors)

#### Data Collection

Data about Humidity, Air temperature, Soil pH and GPS module are placed with the NodeMCU platform inside a portable kit. Soil data is collected by installing the kit in the farm. This collected data is stored and transferred to a database for further processing. Moreover, the atmospheric humidity,temperature,soil pH,soil moisture information are transferred to the database also.The GPS module sends the latitude and longitude which is retrieved in the form of belonging state.This is used to collect the rainfall data of that place during previous year.

### 3.5.3 Using Common Plant types for Analyzing

For our ”Loss function” computation, we are going to use plants which are common both in Natural Disasters and Plant Diseases datasets such as apple,grapes,soybean, tomato and more.This will give a more accurate and good result.

# Chapter 4

# Results and Analysis

The “Loss Function” which provides us with the “Loss factor” value mainly consists of Two parameters which are i)Natural Disasters(particular weather factors) and ii)Plant Diseases.If the Weather factors are suitable but the plant has a particular disease with a Loss Function value,then the closer the value is towards value ”1” the more severe and affected the plant is by the disease and if the value is close to ”0” then the plant is less severely affected or damaged.

## 4.1 Weather factor Analysis

According to the dataset, it is checked whether the required plant is suitable for planting in the available area weather factor conditions ( Air-Temperature, Humidity, pH and Rainfall) or not. If the area conditions are suitable then the plant can be planted there for good growth and it is suggested. For this analysis, we are considering a variable “WeatherVal” which is needed as an input for the Loss Function. This suggestion makes the value of “WeatherVal” equals to “1” and then the plant is checked further for Plant Disease analysis. However, if the area weather conditions are not suitable then it is suggested that the “AREA DOES NOT CONTAIN FAVOURABLE WEATHER CONDITIONS” and “WeatherVal” equals to “0”. It is to be noted that ”WeatherVal=0” here means Area is not suitable for planting the required plant.If Weather Value is “0” then there is no further checking for presence of any plant disease since the area is already not suitable for planting.The following table shows the results from weather related analysis:

| Required | Conditions | Suitable | Output | WeatherVal |
|---|---|---|---|---|
| Apple | AirTemp=22.75088787<br>Humidity=90.69489172<br>pH=5.521466996<br>Rainfall=110.4317855 | Apple | apple | 1 |
| Watermelon | AirTemp=22.75088787<br>Humidity=90.69489172<br>pH=5.521466996<br>Rainfall=110.4317855 | Apple | Area does not contain Favourable weather conditions | 0 |
| Grape | AirTemp=29.99677<br>Humidity=81.54157<br>pH=6.112306<br>Rainfall=67.12534 | Grape | grape | 1 |
| Watermelon | AirTemp=29.99677<br>Humidity=81.54157<br>pH=6.112306<br>Rainfall=67.12534 | Grape | Area does not contain Favourable weather conditions | 0 |

Table 4.1: Weather factor Analysis

## 4.2 Plant Disease Analysis

After the analysis of the plant in particular weather factors and getting the value of "WeatherVal" equals to 1 we move ahead in determining if the plant has any particular disease or not. Firstly, we need to know how much Severe a particular disease is for a plant. To know it numerically, we talked to several Experts related to plants and got values we need for constructing a formula.The formula is called the "SEVERITYINDEX($S_i$)".

$$SeverityIndex(S_i) = Damaged\ caused\ to\ plant\ by\ the\ particular\ disease \div Total\ production\ of\ the\ plant \quad (1)$$

Using the Expert's knowledge and the above formula, the "SeverityIndex($S_i$)" of each disease is calculated.Once this is done, if the plant is seen to be affected by a particular disease,the Plant Disease analysis provides the probability of the plant being affected by that disease. From the Plant Disease analysis, a particular "SeverityRating" value which is between 0-1 is given as output.This value tells us how much of the crop/plant is affected by that disease.Furthermore, "SeverityRating" is also a formula which mainly relates the probability of occuring of the disease with the "SeverityIndex" value of that disease. Since, the probability and SeverityIndex of that particular disease is known, thus the formula can be stated as:

$$SeverityRating(S_r) = Probability\ of\ occuring\ of\ disease \times SeverityIndex \quad (2)$$

Here, another variable named "DiseaseVal" is being used which we need for the Loss function and this equals the "SeverityRating" value which is then forwarded as input for the Loss function.

However, if the plant leaf is healthy then there is no calculation needed for the probability and the DiseaseVal=0 and an output of "HEALTHY" is given from plant disease analysis. It is to be noted, here the DiseaseVal=0 indicates that the leaf is healthy and there is no disease present. This "DiseaseVal" value is forwarded as input for the Loss Function.

| **Plant Disease** | **SeverityIndex** |
|---|---|
| Apple(Scab) | 0.1987381 |
| Apple(black-rot) | 0.1955836 |
| Apple(cedar-apple-rust) | 0.0867508 |
| Cherry(powdery-mildew) | 0.5517693 |
| Corn(common-rust) | 0.3094156 |
| Corn(cercospora-leaf-spot) | 0.1331169 |
| Corn(leaf-blight) | 0.2558442 |
| Grape(black-measles) | 0.3405106 |
| Grape(black-rot) | 0.2903722 |
| Grape(leaf-blight) | 0.2648416 |
| Peach(bacterial-spot) | 0.8645343 |
| Pepper-bell(bacterial-spot) | 0.4025253 |
| Potato(early-blight) | 0.4648460 |
| Potato(late-blight) | 0.4648460 |
| Strawberry(leaf-scorch) | 0.7090323 |
| Tomato(curl-virus) | 0.2949962 |
| Tomato(bacterial-spot) | 0.1171450 |
| Tomato(early-blight) | 0.0550623 |
| Tomato(late-blight) | 0.1051001 |
| Tomato(leaf-mold) | 0.0523780 |
| Tomato(leaf-spot) | 0.0975291 |
| Tomato(spider-mite) | 0.0922982 |
| Tomato(target-spot) | 0.0772937 |
| Tomato(mosaic-virus) | 0.0205796 |

Table 4.2: Plant Diseases with their SeverityIndex

| Plant | Probability | SeverityIndex | SeverityRating | DiseaseVal |
|---|---|---|---|---|
| Apple-healthy | null | null | null | 0 |
| Apple-scab | 0.80421984 | 0.1987381 | 0.159829123 | 0.159829123 |
| Apple(black-rot) | 0.99837816 | 0.1955836 | 0.1952663947 | 0.1952663947 |
| Apple(cedar-apple-rust) | 0.5837525 | 0.0867508 | 0.05064099638 | 0.05064099638 |
| Grape-healthy | null | null | null | 0 |
| Grape(black-measles) | 0.5331898 | 0.3405106 | 0.1815567787 | 0.1815567787 |
| Grape(black-rot) | 0.558076 | 0.2903722 | 0.1620497559 | 0.1620497559 |
| Grape(Leaf-blight) | 0.9999999 | 0.2648416 | 0.2648415735 | 0.2648415735 |

Table 4.3: Plant Disease Analysis

## 4.3 Loss Function Computation

For our Loss Function, we are considering two variables which are "WeatherVal" and "DiseaseVal" as input.We are getting the values of these two from Weather Analysis and Plant Disease Analysis.Moreover, we know that these variables can have either 0 or 1 or between them as value.Firstly, Weather factor Analysis will occur and from there particular inputs for weather factors which are AirTemp,Humidity, pH and Rainfall will be taken.Then by "Decision Tree" algorithm a suitable plant will be suggested for that area.It will be checked if Suitable Plant is the Required plant or not.If it is "yes" then "WeatherVal=1" but if it is "No" then "WeatherVal=0".This "WeatherVal" goes as input for the Loss Function.If "WeatherVal=0", then there is no need to check for any disease presence on plant.However, if "WeatherVal=1" then the plant is further checked for any disease presence and we move on to Plant Disease Analysis.Firstly, a plant leaf is taken and by using the "Sequential Model" it is checked if the plant is healthy or has any disease.If the plant is healthy then "DiseaseVal=0".Here, "DiseaseVal=0" means there is no disease presence and plant is healthy.But if the plant is diseased then the "SeverityIndex" value of the disease is found out.After that the "SeverityRating" of the disease is figured out and "DiseaseVal=SeverityRating".This "DiseaseVal" is another input for the Loss Function.From the Loss Function, there can be three scenarios and outputs: i) "WeatherVal=0" and "DiseaseVal=Don't care", this gives output of "Area not recommended for planting the required plant". ii) "WeatherVal=1" and "DiseaseVal=0" , this gives output of "Area is recommended and plant is diseasefree". iii) "WeatherVal=1" and "DiseaseVal=SeverityRating",this gives output of "DiseaseVal value which indicates amount of crop affected". Below here is our overall model and how it is working.

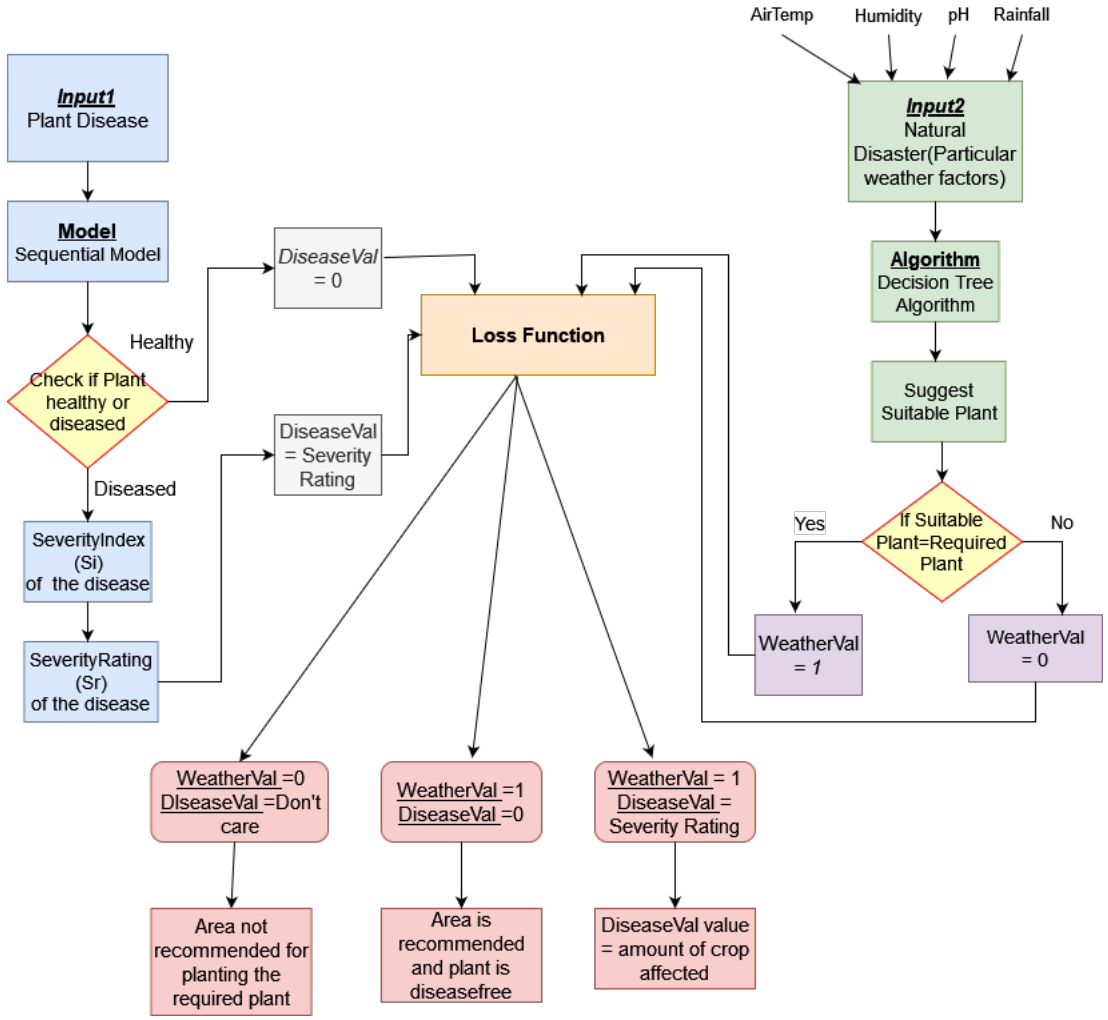


Figure 4.1: Loss function($LF_fr$) Model

From the above Model and explanations, we have stated an equation for the "Loss Function" which is stated below:

$$LossFunction(LF_fr) = WeatherVal \times DiseaseVal \tag{3}$$

Where,
WeatherVal=Value from Weather factor Analysis
DiseaseVal=Value from Plant Disease Analysis

| WeatherVal | DiseaseVal | LossFunction($LF_fr$) | Output |
|---|---|---|---|
| 0 | don't care | 0 | Area not recommended for planting the required plant |
| 1 | 0 | 0 | Area is recommended and plant is disease free |
| 1 | 0.1952663947 | 0.1952663947 | 0.1952663947 (indicates the amount of crop affected or 19.52663947percent affected) |

Table 4.4: Loss Function and Output for particular scenarios

### 4.3.1 Different scenario explanations of the Loss Function

According to Table 4.4, there can be 3 scenarios during observation of the plant and performing the Loss Function analysis on the plant.

***Scenario 1:*** The weather factor analysis has led to the result that the particular plant which the person wants to plant is not recommended or suitable for planting in that area. As a result, the variable "WeatherVal" equals to "0".Since, the area is not fit for the plant so there is no need to check whether there is any presence of disease on the plant and "DiseaseVal" is "don't care". Therefore, by computing the "LossFunction" the value of it equals to "0" and the output is given as " Area not recommended for planting the required plant".

***Scenario 2:*** The weather factor analysis recommends that the plant which the person wants to plant in the area is suitable for planting. As a result, "WeatherVal" equals to "1".Since, there "WeatherVal" equals to "1" so we can move on to check any presence of disease on the plant. After the Plant Disease analysis,if the plant leaf is healthy then "DiseaseVal" equals to "0".It is to be noted that,here "DiseaseVal=0" means that there is no disease and plant is healthy. Therefore, "LossFunction" computation leads to value equal to "0" and an output of "Area is recommended and plant is disease free" is given.

***Scenario 3:*** The weather factor analysis recommends that the required plant is suitable for planting in the area which makes "WeatherVal" equals to "1" and we can move on to check the presence of any disease on plant.This time the plant is not healthy and it is affected by a disease. Here, "DiseaseVal" equals to the "SeverityRating" of the disease.As a result, "DiseaseVal=0.1952663947". Therefore, the "LossFunction" computation provides a value of "0.1952663947" and gives this value as output. Here, this value indicates the amount of crop/plant affected which

is ”0.1952663947” or ”19.52663947 percent” and by looking at the value of whether it is close to ”1” or ”0” we can tell how much severely the plant has been affected or damaged.

# Chapter 5

# Future Study

Here, we have considered many different types of plant diseases which are very harmful for plant growth and structure. These plant diseases can be caused by particular insects which affect and are the main source for spreading a disease. For our future work we are going to look and find the insects related to the diseases of our dataset which we have worked on and we will particularly focus on an insect named "aphid" which mainly affects lemon leaves.

A Dataset named "LeLePhid" provides an image dataset of lemon type of leaves.The are 665 pictures of topside,backside of lemon type of leaves which contains normal and bad affected form of plants respectively.The data collection method was done in citrus type crops during the winter season when there is rain too.The work of assigning the dangerous level of the disease,3 annotators observed the pictures manually and labeled them by their severeness level by using the "Oirsa" way.The images are then used for train of images,test of images and validating process of calculating models which are connected to picture segmenting and detecting objects in diseased plant learning.These can also be helpful for researchers and experts who are good with image based models for image classifying and object detecting methods by use of normal and aphids presence leaf images.By annotating the data,it can be used for a better precision of determining infection severeness level of the leaves and detecting ways.This dataset gives lemon type leaves which are in good use for evaluation of the goodness of image segmenting type, detection of objects type and classifying problems type models which are connected with diseases of plants.

# Chapter 6

# Conclusion

Here, we have talked about how specific factors like Natural Disasters(particular weather factors) and Plant Diseases affect Plant growth. Depending on the parameters,we were able to make the "Loss Function" which will easily provide how much of the plant has been affected by these factors or if the plant is suitable or not for planting.This Loss Function is very helpful for a country like Bangladesh where Agriculture plays a huge role.For future we will also take into other factors into consideration such as market demand analysis for a particular plant and also the financial status of the person who wants to grow a plant.The financial status is observed to check if he/she will be able to handle the cost of monitoring the plant.Therefore, our Loss function is able to help in many ways.

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