



techtoday

vol.4 Issue.1

# DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING



**FISAT<sup>®</sup>** | FEDERAL INSTITUTE OF  
SCIENCE AND TECHNOLOGY



# table of CONTENTS

1.	AGILE OFFERS NOT ONLY A LIGHTWEIGHT FRAMEWORK BUT ALSO MOST RELEVANT METRICS - <i>Gautham Krishna</i> .....	6
2.	GENERATIVE ADVERSARIAL NETWORK - <i>Anjaly A Satheesan</i> .....	8
3.	DAWN OF QUANTUM COMPUTING - <i>Aswin Alex Remy</i> .....	9
4.	PROJECT BLUE GENE - <i>Eby Kurian</i> .....	10
5.	SAPPHIRE CLOCK IN DEFENCE AND QUANTUM COMPUTING - <i>Anagha Jayaraj</i> .....	11
6.	TinyML - <i>Ashmi Subramanian</i> .....	12
7.	FULLY CONVOLUTIONAL NETWORKS FOR WEED DETECTION IN PRECISION FARMING - <i>Darsana</i> .....	13

# ditor's Message



**Basil Leju**  
Student Chief Editor

It gives me pleasure beyond limits to release the latest edition of TechToday in our endeavour to engage and inspire our readers while reflecting the values and quality of FISAT. The successful release of this magazine would not have been possible without the combined efforts of the entire Editorial Board. I highly appreciate all the young writers and artists who have submitted their works for this magazine. I am proud that this magazine has successfully attained the mission of bringing both knowledge and creativity under the same cover. I heartily wish the readers my best wishes and hope they will enjoy reading.



# **The Editorial Board**



**Staff Editors       :**     **Ms. Merin Cherian**  
                                  **Ms. Neenu Johnson**

**Student Editors   :**     **Basil Leju**  
                                  **Navaneetha M**

**Design               :**     **Mr. Vishnu Prasad G Nair**



# AGILE OFFERS NOT ONLY A LIGHTWEIGHT FRAMEWORK BUT ALSO MOST RELEVANT METRICS

The meaning of Agile is swift or versatile. "Agile process model" refers to a software development approach based on iterative development. Agile in simple terms is a philosophy to rapidly deploy an application in much more organized way.

## THE MANIFESTO FOR AGILE SOFTWARE DEVELOPMENT :-

### AGILE SOFTWARE DEVELOPMENT VALUES

Based on their combined experience of developing software and helping others do that, the seventeen signatories to the manifesto proclaimed that they value:

1) Individuals and interactions over processes and tools

This is mainly development centric and client centric environment. That is, People are given prime importance here.

2) Working software over comprehensive documentation

In Agile, the functional application is given much more importance than that of documentation.

3) Customer collaboration over contract negotiation

Agile is really feedback dependant. That is, it can be modified at any point of time before bringing it into the table

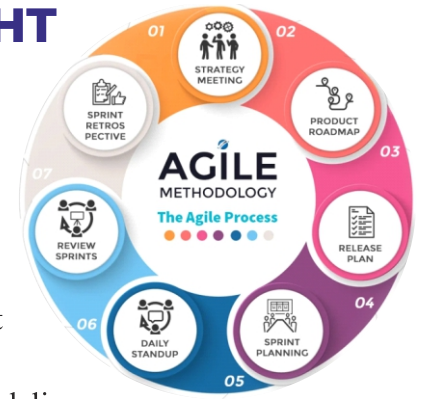
4) Responding to change over following a plan

Principle of Agile includes :-

- \* Satisfy the costumer
- \* Welcome changing requirements
- \* Deliver working software frequently
- \* Frequent interactions with stakeholders
- \* Motivated individuals
- \* Face to face communication
- \* Measure by working software
- \* Maintain constant pace
- \* Sustain technical excellence and good design
- \* Keep it simple
- \* Empower self organizing teams
- \* Reflect and adjust continuously

Advantages of Agile includes :-

- \* Inspect and Adapt
- \* Design is important
- \* Daily interactions
- \* Persistent software delivery
- \* Increased Stakeholder Satisfaction
- \* Welcome to changes at any stage



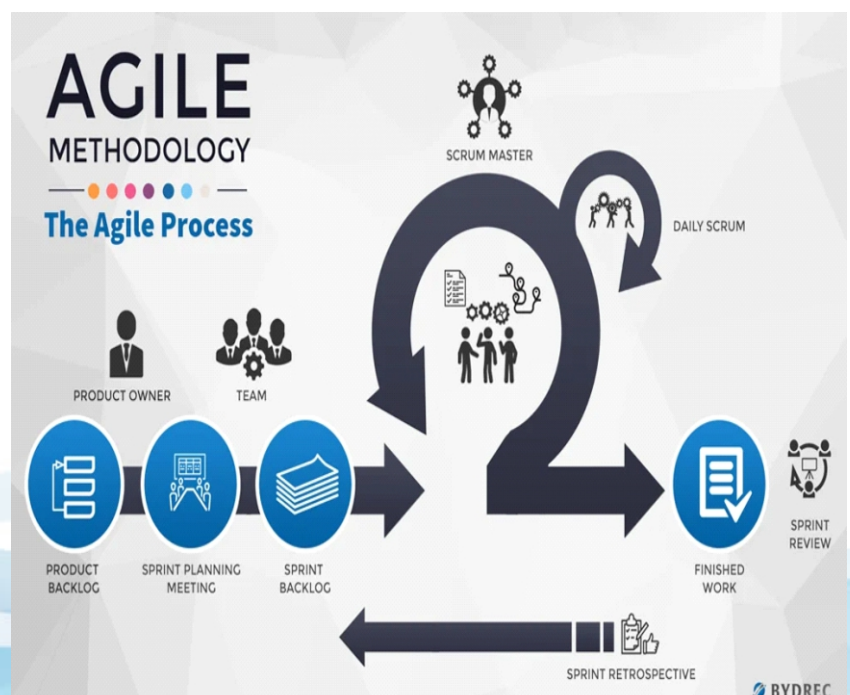
## AGILE MODEL

It is a combination of iterative and incremental process models. The main aim is to help a project to adapt to change request quickly to facilitate quick project completion by removing unnecessary activities that wasted time and effort.

The requirements are decomposed into different small parts that can be incrementally developed. The division of the entire project into small parts helps us to reduce project risks and to reduce the overall project delivery time requirements.

Each iterations are short time frames that typically last from one to four weeks. Each iteration involves a cross functional team working in all functions : planning, analysis, design, coding, unit texting, and acceptance testing.

At the end of the iteration a working model is demonstrated to the stakeholders.



## AGILE METHODOLOGIES

There are several Agile Methodologies that supports Agile Development and they are :-

- \* Scrum
- \* Crystal
- \* Dynamic Software Development Method ( DSDM)
- \* Feature Driven Development ( FDD)
- \* Lean Software Development
- \* eXtreme Programming ( XP)

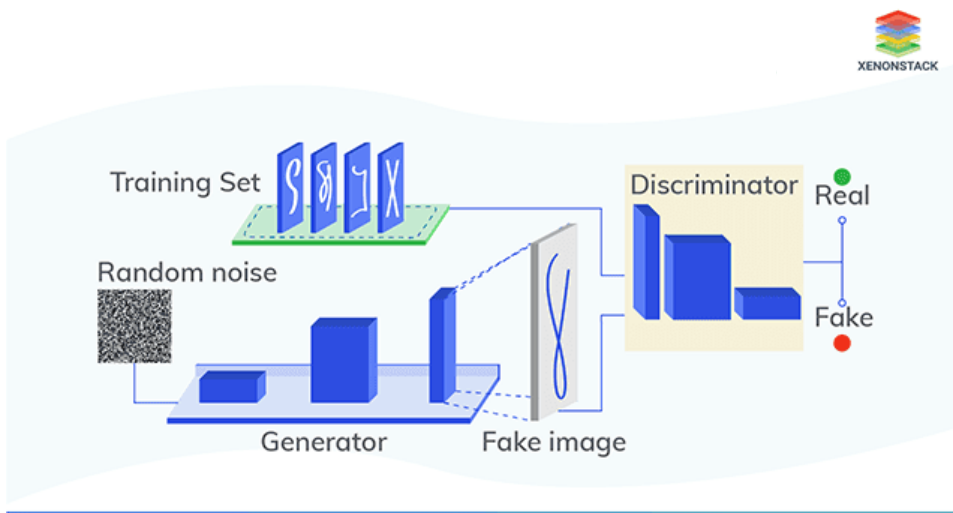
## ADVANTAGES AND DISADVANTAGES

- \* Deployment of software is quicker.
- \* Can adapt to rapidly changing requirements and respond faster.

- \* Customer satisfaction and interactions is done in each iterations.
- \* Helps in getting immediate feedback which can be used to improve software in the next iteration.
- \* Depends heavily on customer interactions.
- \* Not suitable for handling complete dependencies.
- \* More code focused and produces less documentation.

Gautham Krishna  
S7 CSE

# GENERATIVE ADVERSARIAL NETWORK



Ian J. Goodfellow, born on 1985 is an American citizen, who is a director in machine learning working at Apple. At Apple is the director of machine learning in the Special Projects group. Before joining Apple he was working at Google Brain as a research scientist. He has made several contributions in the field of Machine Learning and Artificial Intelligence. He has also written chapters on deep learning for the book *Artificial Intelligence : A Modern Approach*. He took his M.S. and B.S. from Stanford University. He also has a Ph.D. in Machine Learning.

His famous thesis is "Deep Learning of Representation and its Application to Computer Vision". He is well known for his greatest invention GAN - Generative Adversarial Network. He is one of the lead authors of the textbook *Deep Learning*. He also developed a system that enables Google Maps to automatically transcribe addresses from photos taken by the Street View cars.

Machine Learning (ML) is a part of Artificial Intelligence (AI) which deals with the study of computer algorithms. Machine learning algorithms are widely used in applications for email filtering, speech recognition and computer vision. Some implementations of machine learning use data and neural networks in a way that mimics the working

of a biological brain. Machine learning is also referred to as Predictive Analysis. Some of the applications of machine learning include Behaviorism, Telecommunication, Robot locomotion, Computer Networks, Search Engines etc.

Generative Adversarial Network (GAN) is a class of machine learning. The core idea of generative adversarial network is based on the indirect training through the discriminator which

itself is also being updated dynamically.

In recent times, image segmentation has been an important part in every field including disease diagnosis to autonomous vehicle driving. Image segmentation is a complicated task compared to others. GAN has provided a remarkable outcome on image segmentation. GAN was first used with human faces to adopt image enhancement and produce better illusion. GAN plays an important role in fashion, art, advertising, science, video games. In science field, GAN is used to improve astronomical images and stimulate gravitational lensing for dark matter research. GAN is also used in the making of *Final Fantasy VIII*, *Resident Evil*, and *Max Payne*. GAN has another classification, Bidirectional GAN and Adversarial Autoencoders. These allow real or generated examples to be projected back into latent space. Applications of bidirectional models include semisupervised learning, interpretable machine learning and neural machine translation.

Anjaly A Satheesan



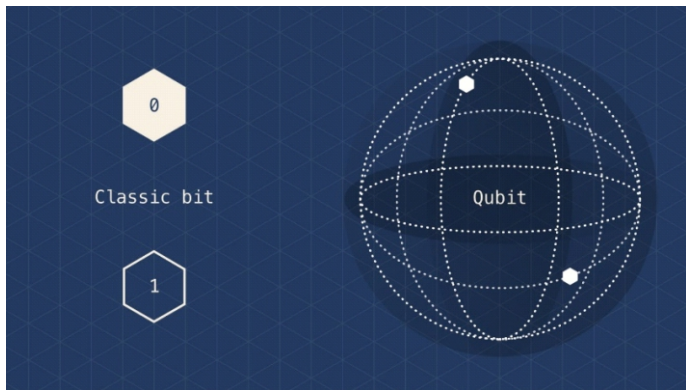
## DAWN OF QUANTUM COMPUTING

It's been millions of years since the inception of life on earth but time became quantifiable only when humanity dawned upon this piece of heaven. The hunger to create, conquer and express always persisted throughout human history.... And it's this same thirst and hunger that has given progress, technology and freedom on many levels.

When you experiment and hustle on developing technology you either end up being disappointed or enjoy the benefits of brilliance. The epic synonym of computing brilliance in one word is "quantum computing". Simply technically miraculous... Or nothing.!!!

That's when the first question arises: What exactly is quantum computing? The answer to this vast topic lies in within our limited knowledge from several resources Quantum computing is a branch of computing that focuses on developing computer technology based on quantum theory's concepts. Computers nowadays can only encode data in bits with values of 1 or 0, severely limiting their capabilities.

Quantum computing, on the other hand, makes use of quantum bits, also known as qubits. It takes advantage of subatomic particles' unique capacity to exist in many states



Asking ourselves the second question : What is the need for quantum computing?

The answer to this question can be best delivered by the maker of a quantum computer itself that is IBM the inventors of the first modern-day quantum computer that state that most problems nowadays are set to be solved by classical supercomputers but not all problems can be solved by these machines that is where we have the gem named quantum computers these machines are capable of solving these particular problems in addition to solving a set of very heavy duty questions of their own.

The difference between a normal supercomputer and a quantum computer is when superposition of all

possible states takes place, In superposition quantum particles are a combination of all possible states they fluctuate, they're observed and measured.

Some of the common applications of quantum computing are:-

**Weather forecasting** - In the current scenario we use traditional computers which use a lot of time to process and deliver the data but on the other hand with the help of quantum computers we can crunch vast amounts of data in short periods of time to produce the same data in much smaller periods of time

**Artificial intelligence & Machine Learning** - As developing technologies have pervaded practically every part of human life, artificial intelligence and machine learning are two of the most prominent areas right now. Voice, picture, and handwriting recognition are just a few of the common applications we see on a daily basis. However, as the number of applications grows, traditional computers face a difficult problem in matching accuracy and speed. And this is where quantum computing can aid in solving complicated issues in a fraction of the time it would take ordinary computers thousands of years to solve.

**Cyber Security & Cryptography** -Due to the increasing amount of cyber-attacks that occur on a daily basis around the world, the online security environment has become rather vulnerable. Despite the fact that businesses are putting in place the essential security frameworks, the procedure is difficult and unfeasible for traditional digital systems. As a result, cybersecurity has remained a critical concern around the world. We are becoming even more vulnerable to these risks as our reliance on technology grows. Quantum computing, along with machine learning, can aid in the development of various strategies to combat these cyber-threats. Quantum computing can also aid in the development of encryption systems, commonly known as quantum cryptography.

As we are aware, the field of quantum computing is a very vast area which cannot be fully explored because we are bound to our current constraints of resources and time. Let's join hands to excavate the true essence of quantum computing because what we know is a drop but what we don't know is an ocean.....

Aswin Alex Remy



## PROJECT BLUE GENE

Blue Gene is a computer architecture project aiming to produce a number of supercomputers with PFLOPS (peta-FLOPS) operating speeds and low power consumption. The project created three generations of supercomputers, Blue Gene/L, Blue Gene/P, and Blue Gene/Q. Blue Gene systems frequently topped the TOP500 and Green500 of the most powerful and energy-efficient supercomputers.

IBM, in 1999 announced the launch of a 100 million dollar initiative to fund a research led by William R Pulleyblack to build a massive parallel computer to study the various biomolecular phenomena such as protein folding. The initial research and development work was pursued at IBM T.J Watson Research Center.

The supercomputer exhibited several interesting features-

- \* They used 131,000 processors. A single scientist with a calculator would have to work nonstop for 177,000 years to perform the operations that Blue Gene could do in one second!!
- \* The blue gene uses the Linux operating system to support open source softwares.

- \* It trades speed for lower power consumption.
- \* The blue takes up less space than a typical supercomputer, the processors of this supercomputer are engineered to be so tiny that 32 of them fit on a single microchip.

Blue Gene supercomputers play an important role in the blue brain project, a project that uses digital reconstructions and simulations of the mammalian brain to understand the fundamental principles of brain structure and function.

According to Green500.org, Blue Gene Q is called the “greenest supercomputer in the world”, also it is also worth noting that most of the energy efficient supercomputers in the world are built on IBM high-performance computing technology which is also mentioned in “Green500 list”.

Such advancements in technology mean that there are no limits to the human mind and imagination. When we hear of such new technology we have no way but to wonder about the brilliance of the human mind.

Eby Kurian





## SAPPHIRE CLOCK IN DEFENCE AND QUANTUM COMPUTING

Haven't we all at some point or the other paid some attention to the tick-tick rhythm of a clock? Well, this rhythm or the oscillation decides the preciseness of the clock. The more the tick-ticks or the oscillations are similar to one another the more precise is the clock. There are several fields where the precision of a clock makes a huge impact and even slight deviations in oscillations can be a huge problem. In this backdrop, while there was a lookout for a more precise clock, the Cryogenic Sapphire Oscillator made its entry.

The Cryogenic Sapphire Oscillator also called the Sapphire clock is now largely accredited as the most precise clock ever known and has been finding its place in several fields including quantum computing and military applications. This clock has been developed by a group headed by Prof. Andre Luiten who is currently serving as the director of the Institute of Photonics and Advanced Sensings(IPAS), University of Adelaide, Australia.

Sapphire, a crystal of aluminium oxide in its purest forms, is used for this purpose since sapphire is a material that can sustain electromagnetic oscillations more than other materials used for similar purposes like the caesium atom.

A cylindrical crystal of sapphire is injected with a microwave but it would often cause a ripple effect and travel to the outer surface of the sapphire. So a metal isolation technique was adopted in which the sapphire is placed inside liquid helium. This ensured good thermal connectivity between the sapphire and the fridge in which the sapphire is placed. At the same time, it ensured that the vibrations wouldn't get through.

Even though the clock was being highly lauded, its size and high expenses made it less popular for adoption in practical applications.

But firstly, the Royal Australian Airforce understood its potential to be used in their radar system known as JORN. JORN helped monitor the Australian coast by the transfer of signals which ultimately gave them information regarding any target. Here, to measure the changes in the returning echoes from the targets, precise ticks were essential and if it is inaccurate then the distance to the target is inaccurately measured. This is

when the Australian military used the sapphire clock which was a giant leap in identifying slow-moving targets and differentiating them from the background clutter.

Secondly, it has been paving its way in quantum computing. To brush up, a qubit is the basic unit of quantum information which can have the values 0 and 1 also at the same time. To improve the performance of quantum computing, the number of qubits it can process needs to be increased. One of the current problems in quantum computing deals with the master clock. The master clock helps synchronize microwaves that match the natural frequency of the qubit. An unstable clock can hence cause errors. This is where the sapphire clock comes into picture. Quantum Control Laboratory (QCL) used this kind of clock and found that the useful lifetime of qubits increased by around nine folds. The developments hence happening in quantum computing can also indirectly advance other fields such as pharmacy and cryptography. That is to say, quantum computers can simulate and compare much larger molecules and can break encryption algorithms in respective fields.

According to Luiten, there is also the potential of using the sapphire clock in aeroplanes and 5G telecommunication systems.



Anagha Jayaraj  
S6, CSA

# TinyML

Big doesn't need to be always better. ML is a type of Artificial Intelligence(AI) that allows more accurate predictions on data that helps our life work easier. Even if there are large-scale machine learning applications, small-scale applications are necessary as they are easier to implement.

TinyML stands for Tiny Machine Language. IT is an emerging technology to the public, but it is going to gain more attention in the future. TinyML is a field of study in Machine Language and Embedded systems that allows running complex models on low-powered microcontrollers. No internet is needed to operate these models.

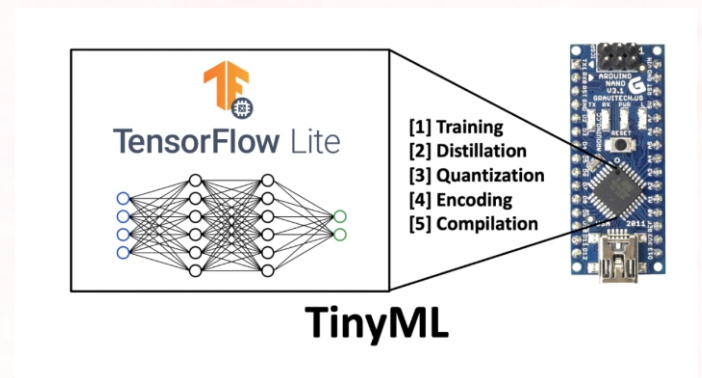
TinyML uses edge computing, even if IoT devices widely use cloud services it requires round-the-clock power and connectivity all the time this is where the importance of edge devices comes forward. Edge devices are designed to perform specific tasks based on machine learning models without cloud services. We make use of cheap 32-bit microcontrollers to run such ML models in the case of TinyML. A typical microcontroller consumes only milliwatts or microwatts of power compared to standard CPU's which consume high power which are almost a thousand times larger. So as the power consumption is so low that we can use batteries to run TinyML devices for weeks, months, or years in some cases.

TinyML has a big and bright future. As discussed before TinyML models have low power consumption while running ML applications on edge. For TinyML models latency of the output is reduced as edge devices don't have to send data to servers to run the interface, these models are less expensive as we are using microcontrollers. These models have low bandwidth as data doesn't have to be sent to servers constantly and data privacy is secured as we are not using cloud services.

Though TinyML is relatively a new field, has been in production for a long time by MNCs like Apple,

Google to name a few. The wake words like "OK Google", "Hey Siri" are examples of TinyML as an internet connection is not a necessary condition for its working. TinyML have a wide range of application, some are speech recognition, image processing, industrial predictive maintenance, agriculture, healthcare, gesture detection using a motion sensor, etc. There are about 250 billion embedded devices active right now, and it is estimated that there would be a growth of 20 percent each year. As the day progresses, it is becoming more difficult to process large amounts of data in the cloud. Thus, a shift towards TinyML devices could prove to be very effective. But only around 3 billion out of those 250 billion devices are currently able to support TinyML libraries.

According to Pete Warden, the founder of the TinyML community, this technology has to be made accessible to developers so that mass deployment of inexpensive, independent, and less power-consuming microcontrollers for ML applications is possible. Such smart embedded systems can be implemented literally anywhere as they are not connected to the internet. TinyML is an embedded system that is fast growing and bright.



Overview of TinyML with embedded devices

Reference(image):[https://miro.medium.com/max/1838/1\\*ofX7aZroN2tkwOjJhECmNQ.png](https://miro.medium.com/max/1838/1*ofX7aZroN2tkwOjJhECmNQ.png)

Ashmi Subramanian



# FULLY CONVOLUTIONAL NETWORKS FOR WEED DETECTION IN PRECISION FARMING

Among the species that endanger agricultural production are weeds that, when invading crops, can cause high losses in yield and quality of yield. Therefore, in order to improve crop production and quality, agricultural weed removal is essential. Considering that the use of agrochemicals, such as herbicides, has caused significant environmental pollution, due to its widespread use, it has become increasingly important to conduct toxicity testing of these compounds so that its use can be reduced.

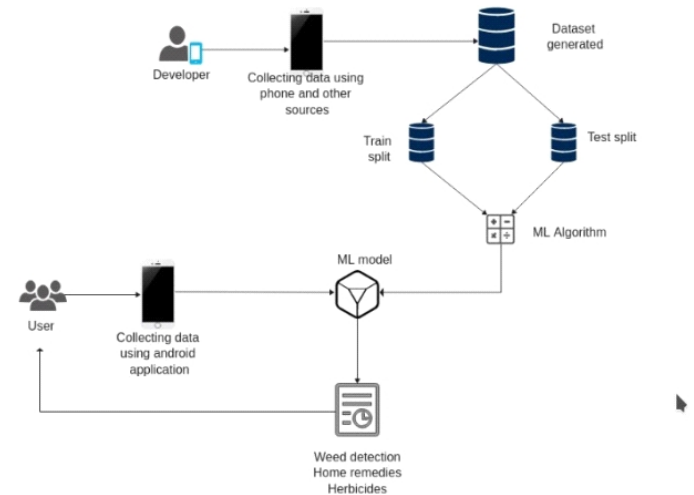
To reduce the use of these chemicals, an android/ios application for the classification of weeds is generated named Kisan Ki Dosth(KKD) meaning 'Farmer's Friend'. The app correctly identifies the photograph of the weed clicked using a smartphone. It gives information about the herbicide to be used against those specific weeds. The dataset contains pictures collected from various sources like internet, cameras etc. Those pictures are processed and the model is trained. It may also suggest any organic remedies existing. There are apps that can identify the weeds but KKD can identify the weeds and also give information about the herbicide that need to be used for that specific weed.

## System Architecture and Methodology

A total of 10,400 images were collected with 1300 images of each weed. Out of these 1300 images of each weed, 900 images were taken for training. The validation dataset consists of 300 images and remaining 100 images were for test dataset.

The architecture all together has five main phases. The first phase, which is dataset collection and pre-processing, while the second one is data augmentation phase and then deep learning training is used as the third phase. Image samples of eight types of weeds are collected from various sources and the dataset is generated. It is given to the first phase for pre-processing, where feature extraction takes place, after which only important features are obtained. In the second phase, augmentation using different classical augmentation techniques is done, after which we will obtain an enlarged dataset. This is then given to deep learning phase for classification. In the fourth phase, a database containing information and the specific type of herbicide for each weed is created and connected

with the deep Learning model. Finally, An app named "Kisan Ki Dosth" is developed using the flutter framework as Graphical User Interface(GUI).



## CNN Model

A 2D CNN model is implemented. The layers of a CNN consist of an input layer, an output layer and a hidden layer that includes multiple convolutional layers, pooling layers, fully connected layers and normalization layers. The dimensions of our images were 100x100. The dataset after augmentation phase is taken and is converted to suitable form for training. This is then split into 80 training and 20 validation sets. The first required Conv2D parameter is the number of filters that the convolutional layer will learn. In the first three layers, including the input layer, 64 filters are used with (3,3) kernel padding

and a max pooling layer of size (2,2). The next three layers use 128 filters with (3,3) kernel padding. Next, a flattening layer is used to flatten the matrix into a single dimensional vector. The dense layer used 512 neurons. The activation function used in all the layers was "relu" except the last layer. The output layer used "softmax" as the activation function. The model was trained using both Adam optimizer and RMSProp optimizer.

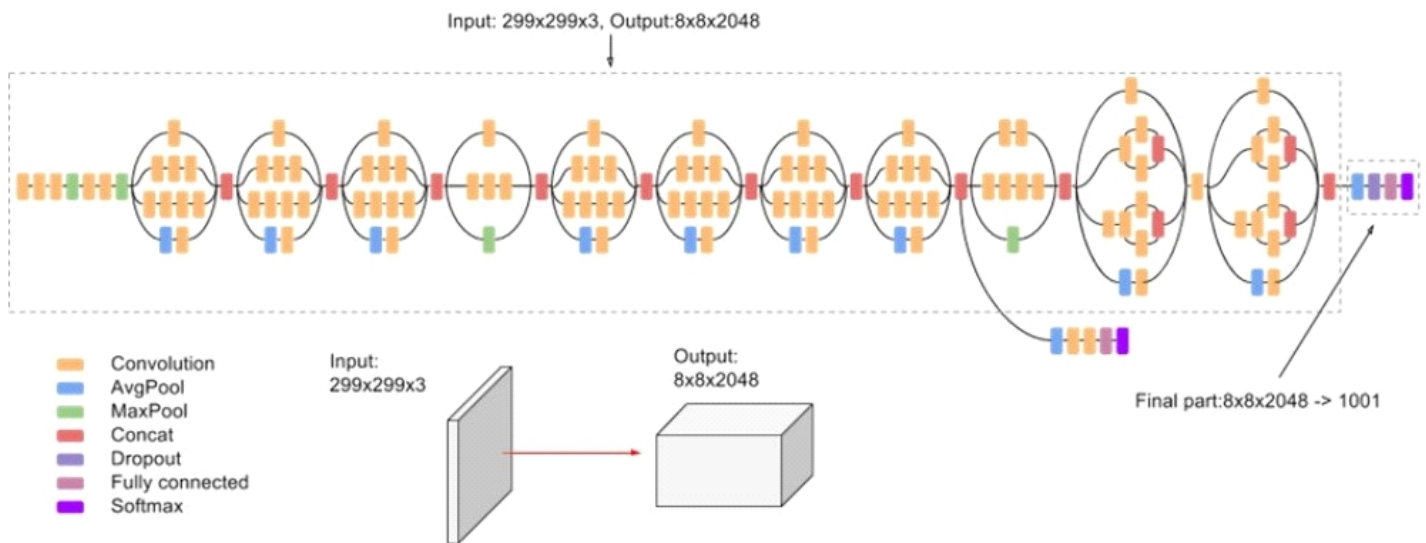
## Transfer Learning

Transfer learning is a method in deep learning where a neural network is first trained on a problem similar to the problem that is being solved. It is used here to achieve better performance for our Deep Learning Model. Transfer learning helps to decrease the training

time for a learning model and can also result in lower generalization error. We use the Inception v3 model here for weed classification. The model itself is made up of symmetric and asymmetric building blocks, including convolutions, average pooling, max pooling, concatenations, dropouts, and fully connected layers. Batchnorm is used extensively throughout the model and applied to activation inputs. Loss is computed via Softmax. We imported this pre-trained model and used it to train our dataset for better accuracy. A high level diagram of inception model is shown below:

## Model Evaluation

To evaluate the performance of the proposed approach, several measures are used, including the Confusion Matrix, Precision, Recall, Accuracy and F1-score. The metrics are defined by the confusion matrix. The evaluation parameters are verified by the inbuilt sklearn functions. The model was trained using both Conventional CNN and Transfer Learning with different optimizers.



## User Interface

The application was developed using the Flutter framework and imported the model as Tensorflowlite into the dart code of our app. The user could take a picture using their mobile phone and the app would correctly identify the class of weed and suggest appropriate measures and home remedies for the treatment.

Darsana







FEDERAL INSTITUTE OF SCIENCE AND TECHNOLOGY (FISAT)  
KORMIS NAGAR