Ross Mcinerney 2021 BSC(Hons)ISD

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**Development of Plant life identification**

**Application** **using AI machine**

**and Image recognition**

**Ross Mcinerney**

BSc (Honours) in Internet System Development

2021

**Development of Plant life identification Application**

**using AI machine and Image recognition**

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A Final Year Project submitted in partial fulfilment of

the requirements of Limerick Institute of Technology

for the degree of Bachelor of Science in

Internet Systems Development

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# Ethical Declaration

I declare that this project and document is wholly my own work except where I have made

Explicit reference to the work of other. I have read the Department of Information Technology

Final Year Project guideline and relevant institutional regulations and herby declare that this

Document is in line with these requirements.

I have discussed, agreed, and complied with whatever confidentiality or anonymity terms of Reference were deemed appropriate by those participating in the research and dealt appropriately with any other ethical matters arising, in line with the TUS Research Ethics Guidelines for Undergraduate and Taught Postgraduate Programmes policy document.

Ross Mcinerney 17/OCT/2021

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# Table of Contents

Table of Contents

[Ethical Declaration 3](file:///C:\Users\ross1\Documents\A-collegethings\A-LITfiles\year4\fyp\FpyDocument-Literature_Review.docx#_Toc89435702)

[Table of Contents 4](#_Toc89435703)

[Acknowledgements 7](#_Toc89435704)

[Abstract 7](#_Toc89435705)

[Lists of Figures, Tables, and Abbreviations 7](#_Toc89435706)

[Figures 7](#_Toc89435707)

[Abbreviations: 8](#_Toc89435708)

[1 Introduction 8](#_Toc89435709)

[1.1 Research Aim’s 9](#_Toc89435710)

[1.2 Project Objectives: 10](#_Toc89435711)

[1.3 Research questions (RQ) 10](#_Toc89435712)

[1.4 Research Method 10](#_Toc89435713)

[Chapter 2 Literature review 11](#_Toc89435714)

[Introduction 11](#_Toc89435715)

[2.1.1 Background 11](#_Toc89435716)

[2.1.2 Scope 11](#_Toc89435717)

[2.1.3 Main Technologies 12](#_Toc89435718)

[2.1.4 features: 12](#_Toc89435719)

[2.1.5 Plant identification methods 13](#_Toc89435720)

[Review of Technology’s 15](#_Toc89435721)

[2.2 Android 15](#_Toc89435722)

[2.2.1 Introduction 15](#_Toc89435723)

[2.2.2 Android Architecture 16](#_Toc89435724)

[2.2.2.1 Kernel Layer: 17](#_Toc89435725)

[2.2.2.2 Native Libraries Layer: 18](#_Toc89435726)

[2.2.2.3 Applications Framework Layer 18](#_Toc89435727)

[2.2.3 Android Benefits 19](#_Toc89435728)

[2.2.4 Brief history 20](#_Toc89435729)

[2.2.5 Intended use for the project 20](#_Toc89435730)

[2.3 Machine Learning 21](#_Toc89435731)

[2.3.1 Introduction 21](#_Toc89435732)

[2.3.2 How Machine Learning works 21](#_Toc89435733)

[2.3.3 Supervised Learning 21](#_Toc89435734)

[2.3.4 Unsupervised Learning 22](#_Toc89435735)

[2.3.5 Semi-supervised learning 22](#_Toc89435736)

[2.3.6 Reinforcement machine learning 22](#_Toc89435737)

[2.3.7 Uses of machine learning 23](#_Toc89435738)

[2.3.8 Brief History of machine learning 23](#_Toc89435739)

[2.3.8 Why it used in this project. 25](#_Toc89435740)

[2.4 image recognition 25](#_Toc89435741)

[2.4.1 How image recognition works. 25](#_Toc89435742)

[2.4.2 How AI is Trained to Recognize the Image? 26](#_Toc89435743)

[2.4.3 Neural Networks in AI Image Recognition 26](#_Toc89435744)

[2.4.4 How Does AI Recognize Images? 26](#_Toc89435745)

[2.4.5 Object Recognition 26](#_Toc89435746)

[2.4.6 Pattern recognition 27](#_Toc89435747)

[2.4.7 Image Annotation for Object Recognition by AI Model 27](#_Toc89435748)

[2.4.8 Uses of image Recognition 27](#_Toc89435749)

[2.4.9 Brief History of image Recognition 28](#_Toc89435750)

[2.4.10 Intended use for the project 29](#_Toc89435751)

[2.5 Conclusion 29](#_Toc89435752)

[Analysis and Design 30](#_Toc89435753)

[List of Functional requirements 31](#_Toc89435754)

[Future features 31](#_Toc89435755)

[Wire frame Application Design: 32](#_Toc89435756)

[Home page 32](#_Toc89435757)

[Camera page 33](#_Toc89435758)

[My snaps 34](#_Toc89435759)

[Snap garden 35](#_Toc89435760)

[Information page 36](#_Toc89435761)

[Login page 37](#_Toc89435762)

[Register page 38](#_Toc89435763)

[Use cases 39](#_Toc89435764)

[UML(Unified Modelling Language ) Diagram 49](#_Toc89435765)

[SQLite Database ERD (Entity Relationship Diagram) 50](#_Toc89435766)

[Results (Implementation/Testing/Findings) 52](#_Toc89435767)

[Discussion 52](#_Toc89435768)

[Conclusions 52](#_Toc89435769)

[Reference List/Bibliography 53](#_Toc89435770)

[Appendices (supporting materials) 56](#_Toc89435771)

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# Abstract

The research I intend to undertake is to develop a system using AI, Mobile Application (MA) Development, Machine Learning, and Image Recognition to help solve the problem of plant identification. This can be an arduous task as any plants look similar and can often be identified incorrectly.   
 The app which I will implement will simplify the process of identification by using a camera with image recognition which will scan the plant, AI with machine learning to find the information and image of the plant. This will save considerable research time for my target audience.

# Lists of Figures, Tables, and Abbreviations

## Figures

[Figure 1, Android Architecture 17](#_Toc89435781)

[Figure 2,Project System Overview 30](#_Toc89435782)

[Figure 3,prototype home page 32](#_Toc89435783)

[Figure 4, prototype camera view 33](#_Toc89435784)

[Figure 5, prototype my snaps 34](#_Toc89435785)

[Figure 6, prototype snap garden 35](#_Toc89435786)

[Figure 7, prototype information page 36](#_Toc89435787)

[Figure 8, prototype login page 37](#_Toc89435788)

[Figure 9,prototype Register page 38](#_Toc89435789)

[Figure 10,UML Diagram 49](#_Toc89435790)

[Figure 11, ERD Diagram 50](#_Toc89435791)

[Figure 12,Supervised learning Diagram (Loon, 2018) 51](#_Toc89435792)

## Abbreviations:

* IDE- integrated Development Environment
* ML- Machine learning
* IR- Image recognition
* Mapp- Develop a mobile application
* RQ- Research questions
* MA-Mobile Application
* PI-Plant Identification
* ERD Entity relationship diagram
* UML (Unified Modelling Language)

## Tables

[Table 1, use case table: Plant/seed/fruit identification 39](#_Toc89436071)

[Table 2, use case table: Plant/seed/fruit information retrieval 40](#_Toc89436072)

[Table 3, use case table: Add/delete/update Plant/seeds/fruit snaps 41](#_Toc89436073)

[Table 4, use case table: Search information 42](#_Toc89436074)

[Table 5, use case table: Login 43](#_Toc89436075)

[Table 6, use case table: register user 44](#_Toc89436076)

[Table 7, use case table: Log out 45](#_Toc89436077)

[Table 8, use case table: data comparison process 46](#_Toc89436078)

[Table 9, use case table: view plant/fruit/seed details. 47](#_Toc89436079)

[Table 10, Navigation 48](#_Toc89436080)

# 1 Introduction

The purpose of this research is to provide an application that will encourage people to engage with local plant life in Ireland. The reason the app is being made is to help reduce global warming in Ireland as we realize harmful materials, gas, and other pollutants into our environment the more of it is destroyed. This will lead eventually to the end of Ireland and world civilization on the planet earth. But plants can help combat global warming of the planet through photosynthesizing which removes carbon dioxide from the air and produce clean air for the world they also return nutrients to the planet when decomposing and many other methods (D.Mauseth, 2014). My application will help new people gain an interest in plant life and might start their gardens or start to care about the health of the planet's plant life in the process of using our app Plant Life.

The application plans to be the world of botany to the modern era, first my application will be developed on the android platform using the android studio (Android Studio, n.d.) integrated Development Environment (IDE) which is a development tool for googles android operating system. The reason that the application is developed in android is that it’s one of the most popular systems in the mobile market the reason for this is that of its open-source nature which allows the developer to be more creative because they are allowed to experiment while developing a mobile application. Another thing is most tools to develop mobile apps on the android system is free this fact helps to produce application at a fast rate, but open source can lead to security problems but if the developer is careful and accounts for that fact it should be fine to develop an app using this system. This project application will use this system because of the benefits listed above. As my application is developed It will incorporate machine learning and image recognition so it can complete the identification feature of this application. (Li Ma, 2014)

Machine learning (ML) is used in the application to compare image data provide by the image recognition part of the application and the data from the MSQL database that has been collected to use in the app. Machine learning is a computational method using experience to improve performance or to make accurate predictions and to simulate human learning example of this being useful is to predict the topic of a document which could make it easy to name things. In my project, my app will be using this concept to use images taken by users and to display similar images and information about the plant as accurately as possible. (The MIT Press Cambridge, 2018)

Image recognition (IR) is the way the data will be provided to the machine learning algorithm that identifies the plant life my application will make use of smartphone camera hardware as it’s the most common Phone people have in this modern age. The app does this by scanning the images provided with image recognition and giving them to the ML algorithm. (Mujtaba, 2020)

Main benefits of the application:

Make it easy for people in Ireland to Identify plant life

Cheap for people to use.

Saves time in the long run.

## 1.1 Research Aim’s

My project aims to be the plant life to a wider audience so the community of plant lovers can grow in Ireland. Thought the use of well produce app.

## 1.2 Project Objectives:

* Develop a mobile application (mapp)with android operating system.
* Build a (mapp) that is developed to identify plant in the outside world.
* Implementation of machine learning in the (mapp) for comparing images contained in a database with images taken by users.
* Put image recognition in place to scan images and provide data for the machine learning algorithm to use for image comparison process.
* Build a feature that will allow my application identify plants with there fruit or seeds so the application can stand out in the marketplace.

## 1.3 Research questions (RQ)

RQ1 How Ai and image recognition can be used to identify plants.

RQ1.1 what machine learning algorithms will be used to develop the app.

RQ1.2 What images will be used and its identifying marks for each plant.

RQ2. How can this app benefit people in everyday life?

RQ2.1 How plants are normally identified.

RQ2.2 What are the problems with the old way of identifying plants?

RQ3. In What way will the database store image on plant life.

RQ4. why Android was chosen over other OS.

RQ5. why image recognition and machine learning are the best to be used in this application.

RQ 6. why identifying fruit and seeds will benefit my application.

## 1.4 Research Method

1. Google Scholar: This is used to find research materials for the project.
2. Using library resources at my university. Books and articles
3. Previous Final Year Projects.
4. Use existing programs to improve or use a similar feature for my project.
5. Websites articles and other website information sources.
6. Experts on the topic or people that may know information on the topic.

# Chapter 2 Literature review

# Introduction

## 2.1.1 Background

The main goal of the project is to reduce the time it takes to identify plants for people all around the world because the normal process of completing this task is long and arduous due to the many tasks that must be performed which can be difficult if you’re new to the field of botany. As a result, the project will investigate existing and new information in order to develop the best plant identification mobile application.

## 2.1.2 Scope

To collect data for the project the author used images from many sources online, books and images taken by the author and users of the application to collect data for the project. This was used by the machine learning algorithm which the author has written for this project to match images with linked to information from a database created by the author and display it to users. The author will devise a method for collecting image data for machine learning to use in the process of identifying plants, fruits, and seeds using image recognition. The author created a mobile application with a simple and easy user interface for users to interact with in order to provide a good user experience. The main goal of the project is to get these systems/methods to communicate with one another.

## 2.1.3 Main Technologies

**Mobile applications:**

Mobile application development, according to IBM (2020), is the process to creating software for smartphones and digital assistants, most commonly for Android and IOS. The software can come preinstalled on the device, downloaded from mobile app store, or accessed via a mobile web browser. Java, Swift, C#, and HTML5 are some of the programming and markup languages used in this type of software development.

**Machine learning**

Machine learning refers to the idea that a computer program can learn and adapt to new data without the need for human intervention. Machine learning is a branch of artificial intelligence (AI) that keeps a computer's built-in algorithms up to date regardless of global economic changes. (FRANKENFIELD, 2020)

**Image recognition**

The ability of a computer-powered camera to identify and detect objects or features in a digital image or video is known as image recognition. It is a technique for capturing, processing, analysing, and sympathizing with images. (sigthcorp)

## 2.1.4 features:

* Image recognition to detect plants, seeds, fruits in images.
* Machine learning with deep learning to interrupt the data from the images and make predictions.
* A well-designed User interface build on the android Platform.
* Database of images and information on plant, seeds, fruit.

## 2.1.5 Plant identification methods

The Author has described the methods currently used by experts to identify plants in the workplace and gardens. In addition, to assist novices in identifying plants in everyday life.

**Plant Type:**

If the plant type is identified, it narrows the plant down from the many plant species because it reduces the need to check other types of plant life and increases the likelihood of successfully identifying the plant.

**Location:**

The Location of the plant is also important because plant species only grow in certain areas where the conditions are met for the plant’s growth. Examples of information that are needed to identify plants in terms of location are where in the world it grows, climate, type of ground and if it grows in direct sun light or not.

**Flowers:**

The plant's location is also important because plant species only grow in specific areas where the conditions for growth are met. Examples of information required to identify plants in terms of location include where they grow in the world, the climate, the type of ground, and whether they grow in direct sunlight.

**Bark or Stem Structure and Texture**

Tree barks are sometimes the best way to identify trees because the texture of the bark varies between trees and this identifying factor can help distinguish between them. Another example is that the leaves on trees or any other plant can provide a good indication of what the plant is. However, some leaves will resemble others, so the color of them can help. Texture can be a valuable tool in identifying any plant because some plants have a distinct texture that makes it easy to identify the plant and tell which family it belongs to.

**Foliage Type**

What type of leaves does the plant have? Plants can be identified simply by having unique or recognizable leaves. Also, the texture of the leaves, such as whether or not it has needles, can be useful.

**Leaf Attachment**

How do the plant's leaves develop?

Examples:

• A rosette of leaves grows at the plant's base. • Alternate leaves (grow out of a leaf node in an alternate pattern on the stem.) • Opposite leaves are when a pair of leaves grow symmetrically out of a leaf node.

• Whorled leaves are made up of three or more leaves that grow out of a leaf node in a circular pattern around the stem.

**Leaf Shape, Margin and Vein**

There are numerous terms for leaf shapes, such as lanceolate, elliptical, Obovate, cordage, and rein undulate. Leaf margins are longitudinal, palmate, and reticulate, indicating veining. This may appear difficult to grasp, but there are numerous charts available to assist you in identifying these important characteristics. For these charts, the author recommends using the internet or Field guides.

**Sap**

Does the plant excrete sap from its leaves, flowers, and branches? Several questions must be answered, including the color of the sap and its consistency. Where does the sap come from on the plant, for example, thick, gooey, sticky, watery, and milky? Sap can uniquely identify plants, making it an important factor to consider.

**Berries, Fruit or Seed**

Because many plants only produce specific seeds, fruits, or berries, if the plant produces berries, fruit, or seeds, this can be a great way to identify the plant. However, the shape, color, and texture of what a plant produces can be beneficial. There are charts available in field guides and online for the specific seed structures of fruit, seeds, and berries to help identify the plant.

**Special interest**

A special interest is a distinct but noticeable characteristic of a plant, such as if a plant has an unusually bright color during one season and another, or if a specific insect or animal only eats a certain plant. So, if a plant has a distinguishing feature, it can be used to identify the plant.

In short, the methods listed above take a long time because they require knowledge of some botany literature, but my project will help identify plants without prior knowledge of a plant, which will be convenient for new/seasoned plant enthusiasts. (Larum, 2017)

The reader will gain an understanding of the main concepts of machine learning, image recognition, mobile application development, and other assisting technologies required to complete the project implementation in the following chapter.

# Review of Technology’s

# 2.2 Android

## 2.2.1 Introduction

Android is a Linux-based operating system designed for smart devices that have or do not have touch screens. It is supported by Google and owned by the Open Handset Alliance. The alliance's main goal was to provide everyone with a high-quality, low-cost, and better mobile experience.

Because of its open platform that separates the hardware from the software that runs on devices, the open-source nature of Android for mobile helped to revolutionize the mobile market for the first time. This means that developers can create applications at a faster rate than in the past, resulting in more creative and innovative ideas for mobile apps that benefit our society. (Gargenta, 2011)

Android is a stack-based mobile operating system that also includes middleware and key applications. The Android SDK includes the tools and API required to start developing applications for the Android platform in a variety of programming languages. (Holla & Katti, 2012) (java,C#,C++, lua, etc) (Back4app, ND)

## 2.2.2 Android Architecture

A screenshot of a computer

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Figure 1, Android Architecture

(Wang, Duan, Ma, & Wang, 2011)

The android operating system is broken down into these layers:

### 2.2.2.1 Kernel Layer:

The kernel used by the Android operating system is a modified version of the Linux kernel designed to meet the platform's unique requirements. Because it is open source and has verified pathway evidence, Linux was chosen. Drivers must be rewritten in a variety of situations. The Linux kernel includes networking, driver, virtual memory management, and power management mechanisms. It works well with hardware and includes all necessary hardware drivers. Drivers control and communicate with hardware. For example, because all devices include Bluetooth hardware, the kernel must also include a Bluetooth driver to allow Bluetooth hardware to communicate. The Linux kernel is responsible for process management, memory management, networking, security settings, and so on. Android can be ported to a variety of hardware, which is a relatively simple and painless task

### 2.2.2.2 Native Libraries Layer:

The native libraries layer is the second layer of the Android operating system architecture, and it allows devices to handle various types of data. C/C++ is used to write these libraries. These are some of the most important libraries:

• Surface Manager – used for window manager offscreen buffering, which means that instead of drawing directly on the screen, the drawing is routed to an off-screen buffer, where it is joined with other drawings to form the final screen presented to the user.

• Media framework – consists of various types of media codecs that allow various media formats to be recorded and played.

• SQLite – For data storage, Android employs SQLite as a database engine.

• WebKit – a framework for displaying HTML content.

• OpenGL – used to display 2D and 3D graphics on a computer screen. The runtime layer is on the same level as the libraries layer, which contains the DVM (Dalvik Virtual Machine) and core Java libraries. These libraries are in charge of providing various core classes that are available in a JVM. The Dalvik Virtual Machine, which was previously used as a runtime, has been replaced by Android's new runtime ART. The DVM uses special file types (.dex) in place of.class files. During compilation,.class files are converted to.dex files, which provide greater efficiency in low-resource environments.

### 2.2.2.3 Applications Framework Layer

User applications interact directly with the applications framework layer, which manages basic phone functions such as resource management and voice calls. The APIs provided by the applications framework layer are used by applications for data sharing, telephony system access, and notification. The application framework consists of the following components: • Activity Manager: manages the activity life cycle of apps.

• Content Providers: control data sharing between apps.

• Telephony Manager: allows you to manage and access voice calls from within the application.

• Location Manager: For location management, GPS or a cell tower are used.

• Resource Manager: Manage the various resources used in our apps.

**2.2.2.4 Applications Layer**

Applications are written in Java and then interpreted by the Dalvik virtual machine, which has since been replaced by the Android RunTime (ART). This layer contains even the most basic features, such as a phone and contacts application. This layer is made up of apps written by the Android team as well as some third-party software that is installed on the device. By granting third-party developers access to this layer, the user interface can be redeveloped relatively easily and quickly. All devices come with a number of standard applications pre-installed, including a dialler app, contact manager app, SMS client app, and a web browser app. New apps can be created to replace existing system apps. . It means that developers have the ability to access any specific feature and do whatever they want with Android. As a result, Android developers have a plethora of options. (Jamil Khan & Shahzad, 2015)

### 2.2.3 Android Benefits

* An open eco-system: Android has many app stores where you can download apps that demonstrate how popular Android has become. Google Play is one of the most popular app stores and has a large library to choose from. One reason for this could be that the approval rate for IOS applications on Apple platforms is much higher. Third-party applications are also permitted to be sold on Android devices; however, there are security risks associated with this; however, the benefit of rapid distribution of an application may persuade developers to take that risk.
* Customizable user interface
* With the addition of many customizable widgets, Google has made the Android user interface as flexible and customizable as possible, and you can even add your own to your devices.
* Open source
* Shorter time to market for applications
* Customized Roms
* Affordability of Development
* Fast App Distribution
* Affordable products for customers (t4tutorials)

### 2.2.4 Brief history

* 2003 Android, Inc is founded in Palo Alto, California
* 2005 Google buys Android, Inc
* 2007 The open Handset Alliance is announced. This Alliance consists of a consortium of hardware, software and telecommunication companies devoted to advanceing open standards for mobile devices.

Google releases Android code as open source under the Apache License.

The Android Open-Source Project, led by google, is tasked with the maintenance and further development of Android.

* 2008 Android Software Development 1.0 is released. This kit contains all of the tools needed to develop Android apps.

The first Android phones become available.

* 2009-present new versions of the android SDK continue to be released.

Android devices continue to proliferate

Millions of apps are developed

Billions of apps are downloaded

(Murach, 2015)

### 2.2.5 Intended use for the project

Because of its open source and highly customizable features, as well as its low cost, the Android operating system will serve as the user interface for my Plant Identification application. The vast market that Android provides is also advantageous to the application because it will provide it with extensive exposure to the mobile application market. It will also serve as a user interface for my machine learning and image recognition.

# 2.3 Machine Learning

## 2.3.1 Introduction

Machine learning (ML) is the study of computer algorithms that can improve themselves automatically based on experience and data. It is regarded as a component of artificial intelligence. Machine learning algorithms construct a model from sample data, referred to as "training data," in order to make predictions or decisions without being explicitly programmed to do so. (Wikipedia, nd)

## 2.3.2 How Machine Learning works

The machine learning process relies on a variety of types of learning to help predict set parameters that the author established during the creation of the machine learning algorithm.

## ****2.3.3 Supervised Learning****

Supervised learning is a process that trains the system on known input and output data so that the system can predict future outputs more accurately.

To put it another way, supervised learning necessitates someone being in charge of providing feedback to the AI system and training the system to make the right decisions by labeling the data.

Essentially, supervised learning shows the system what conclusions it should reach by displaying previous sets of data and the conclusions it should have reached based on that data.

This assists in training the system to look for data patterns, interpret those patterns, and calculate the correct answer based on previous results.

Supervised learning is typically used when the system needs to make a prediction, such as estimating house prices or determining whether a picture is of a cat or a dog.

## ****2.3.4 Unsupervised Learning****

Unsupervised learning is a method of training an AI system to discover hidden patterns or intrinsic structures in input data without regard for outputs.

* Unsupervised learning allows the AI system to draw inferences directly from the data fed into the system.
* Unsupervised learning is typically used for problems that necessitate data exploration and the search for internal representations within the data, or what machine learning specialists refer to as "clustering."
* Clustering is the process of automatically grouping together similar points of data and assigning them to "clusters." (CSU Global, 2021)

## 2.3.5 Semi-supervised learning

Semi-supervised learning provides a comfortable middle ground between supervised and unsupervised learning. It uses a smaller labelled data set to guide classification and feature extraction from a larger, unlabelled data set during training. Semi-supervised learning can address the issue of not having enough labelled data (or not being able to afford labelling enough data) to train a supervised learning algorithm.

## 2.3.6 Reinforcement machine learning

Reinforcement machine learning is a behavioral machine learning model similar to supervised learning, except that the algorithm is not trained on sample data. Using trial and error, this model learns as it goes. To develop the best recommendation or policy for a given problem, a series of successful outcomes will be reinforced.

A good example is the IBM Watson® system, which won the Jeopardy! competition in 2011. The system used reinforcement learning to determine whether to attempt an answer (or question), which square to choose on the board, and how much to wager—particularly on daily doubles.

## 2.3.7 Uses of machine learning

* Speech recognition
* Customer service
* Computer vision
* **Recommendation engines**
* **Automated stock trading** (IBM Cloud Education, 2020)

## 2.3.8 Brief History of machine learning

Machine Learning (ML) is a critical component of modern business and research. It employs algorithms and neural network models to help computer systems gradually improve their performance. Machine Learning algorithms create a mathematical model from sample data – also known as "training data" – to make decisions without being explicitly programmed to do so.

Machine Learning is based on a model of brain cell interaction in part. Donald Hebb developed the model in his 1949 book The Organization of Behavior. Hebb's theories on neuron excitement and neuron communication are presented in the book.

**Machine Learning the Game of Checkers**

In the 1950s, Arthur Samuel of IBM created a computer program for playing checkers. Samuel initiated alpha-beta pruning because the program had a very limited amount of computer memory available. His design included a scoring function that was based on the positions of the pieces on the board. The scoring function attempted to calculate the likelihood of each side winning. The minimax strategy, which eventually evolved into the minimax algorithm, is used by the program to determine its next move.

Samuel also created a number of mechanisms to help his program improve. In rote learning, Samuel's program recorded/remembered all positions it had previously seen and combined this with the values of the reward function. In 1952, Arthur Samuel coined the phrase "Machine Learning."

**Machine Learning at Present**

Stanford University recently defined Machine Learning as "the science of getting computers to act without being explicitly programmed." Machine Learning is now responsible for some of the most significant technological advancements, such as the new self-driving vehicle industry. Machine Learning has spawned a slew of new ideas and technologies, such as supervised and unsupervised learning, new algorithms for robots, the Internet of Things, analytics tools, chatbots, and more. The following are seven common applications of Machine Learning in the business world today:

**Analyzing Sales Data:** Streamlining the data

**Real-Time Mobile Personalization:** Promoting the experience

**Fraud Detection:** Detecting pattern changes

**Product Recommendations:** Customer personalization

**Learning Management Systems:** Decision-making programs

**Dynamic Pricing:** Flexible pricing based on a need or demand

**Natural Language Processing:** Speaking with humans

Machine Learning models have become quite adaptive in terms of continuous learning, which makes them more accurate the longer they run. Scalability and efficiency are increased when machine learning algorithms are combined with new computing technologies. Machine Learning, when combined with business analytics, has the potential to solve a wide range of organizational complexities. Modern ML models can predict everything from disease outbreaks to stock market fluctuations. (Foote, 2019)

## 2.3.8 Why it used in this project.

Machine learning will be used in the plant identification process in terms of predicting if an image provide to the algorithm matches an image in the datasets in the database. The project will be using image recognition and deep learning which are subsets of machine learning to help in the prediction process for more accurate results.

# 2.4 image recognition

Image recognition technologies identify locations, logos, people, objects, buildings, and a variety of other variables in digital images. Humans, such as you and me, may find it very easy to recognize various images, such as images of animals. We can easily recognize a cat image and distinguish it from a horse image. However, it may not be as simple for a computer.

A digital image is an image composed of picture elements, also known as pixels, each with finite, discrete quantities of numeric representation for its intensity or grey level. So the computer sees an image as numerical values of these pixels and in order to recognise a certain image, it has to recognise the patterns and regularities in this numerical data. (Mujtaba, image-recognition, 2020)

## 2.4.1 How image recognition works.

Humans recognize images by utilizing a natural neural network that assists them in identifying objects in images learned from previous experiences. Similarly, the artificial neural network aids machines in image recognition.

Multiple layers of neurons in an AI neural network can influence each other. And the complexity of a neural network's structure and architecture is determined by the type of information required. Image recognition is more complicated than you might think because it requires deep learning, neural networks, and sophisticated image recognition algorithms to be possible for machines.

## ****2.4.2 How AI is Trained to Recognize the Image?****

To make image recognition possible through machines, we need to train the algorithms that can learn and predict with accurate results. Let’s take an example – if you look at the image of a cat, you can easily tell it is a cat, but the image recognition algorithm works differently.

Due to similar attributes, a machine can see it 75% cat, 10% dog, and 5% like other similar looks like an animal that are referred to as confidence score. And to predict the object accurately, the machine has to understand what exactly sees, then analyze comparing with the previous training to make the final prediction.

## ****2.4.3 Neural Networks in AI Image Recognition****

Machines visualize and analyze the visual content in images differently from humans. Compare to humans, machines perceive images as a raster which a combination of pixels or through the vector. Convolutional neural networks help to achieve this task for machines that can explicitly explain what going on in images.

A convolutional neural network is right now assisting AI to recognize the images. But the question arises how varied images are made recognizable to AI. The answer is, these images are annotated with the right data labeling techniques to produce high-quality training datasets.

## ****2.4.4 How Does AI Recognize Images?****

While recognizing the images, various aspects considered helping AI to recognize the object of interest. Let’s find out how and what type of things are identified in image recognition.

## ****2.4.5 Object Recognition****

Image recognition is performed to recognize the object of interest in that image. Visual search technology works by recognizing the objects in the image and look for the same on the web.

## ****2.4.6 Pattern recognition****

Similarly, to recognize a certain pattern in a picture image recognition is used. Like face expressions, textures, or body actions performed in various situations.

## ****2.4.7 Image Annotation for Object Recognition by AI Model****

Making object recognition becomes possible with data labeling service. Human annotators spent time and effort in manually annotating each image producing a huge quantity of datasets. Machine learning algorithms need the bulk of the huge amount of training data to make train the model.

Though, in unsupervised machine learning, there is no such requirement, while in supervised machine learning without labeled datasets it is not possible to develop the AI model. And if you want your image recognition algorithm to become capable of predicting accurately, you need to label your data.

In data annotation, thousands of images are annotated using various image annotation techniques assigning a specific class to each image. Usually, most AI companies don’t spend their workforce or deploy such resources to generate the labeled training datasets.

Outsourcing is a great way to get such jobs done by dedicated experts at a lower cost. Companies involved in data annotation do this job better helping AI companies save their cost of training an in-house labeling team and money spend on other resources.

**Anolytics** is the industry leader in providing high-quality training datasets for machine learning and deep learning. Working with renowned clients, it is offering data annotation for **computer vision** and NLP-based AI model developments.

World-class infrastructure, certified with international data security standards, **Anolytics** offers a great platform to get datasets for diverse sectors. Working with a fully scalable solution, it works with a collaborative approach making AI possible in diverse unknown fields. (Anolytics, 2021)

## 2.4.8 Uses of image ****Recognition****

* Automated Image Organization – from Cloud Apps to Telecoms
* Stock Photography and Video Websites
* Visual Search for Improved Product Discoverability
* Image Classification for Websites with Large Visual Databases
* Image and Face Recognition on Social Networks (GOLEMANOVA, 2019)

## 2.4.9 Brief History of image Recognition

Our story begins in 2001; the year an efficient algorithm for face detection was invented by Paul Viola and Michael Jones. Their demo that showed faces being detected in real time on a webcam feed was the most stunning demonstration of computer vision and its potential at the time. Soon, it was implemented in OpenCV, and face detection became synonymous with Viola and Jones algorithm.

Every few years a new idea comes along that forces people to pause and take note. In object detection, that idea came in 2005 with a paper by Navneet Dalal and Bill Triggs. Their feature descriptor, Histograms of Oriented Gradients (HOG), significantly outperformed existing algorithms in pedestrian detection.

Every decade or so a new idea comes along that is so effective and powerful that you abandon everything that came before it and wholeheartedly embrace it. Deep Learning is that idea of this decade. Deep Learning algorithms had been around for a long time, but they became mainstream in computer vision with its resounding success at the ImageNet Large Scale Visual Recognition Challenge (ILSVRC) of 2012. In that competition, an algorithm based on Deep Learning by Alex Krizhevsky, Ilya Sutskever, and Geoffrey Hinton shook the computer vision world with an astounding 85% accuracy — 11% better than the algorithm that won the second place! In ILSVRC 2012, this was the only Deep Learning based entry. In 2013, all winning entries were based on Deep Learning and in 2015 multiple Convolutional Neural Network (CNN) based algorithms surpassed the human recognition rate of 95%.

With such huge success in image recognition, Deep Learning based object detection was inevitable. Techniques like Faster R-CNN produce jaw-dropping results over multiple object classes. We will learn about these in later posts, but for now keep in mind that if you have not looked at Deep Learning based image recognition and object detection algorithms for your applications, you may be missing out on a huge opportunity to get better results.

With that overview, we are ready to return to the main goal of this post — understand image recognition using traditional computer vision techniques. (Mallick, 2016)

## 2.4.10 Intended use for the project

Image recognition will use to find plants, fruits and seeds in images using object detection neural networks and image recognition algorithm to recognize plant life objects in images.

# 2.5 Conclusion

This literature review has given you an understanding of main technology’s image recognition, machine learning and the accompanying tech that help to build my plant identification app in order to provide greater understand of the plant world.

# Analysis and Design

**Project System Overview**

The project overview will give a drilldown of the project components to demonstrate the functionality for each technology and the operations that follow in within the application in addition to the role in the application that the author intends on developing.

Diagram

Description automatically generated

Figure 2,Project System Overview

The system overview diagram above explains the process and transfer of data between each part of the system. The non-user and the users would connect to the android mobile application and interact with the user interface to invoke functions that would request data from the database and carry out the plant image identification which connects to the image recognition to scan the image then transfer the datasets of images to the machine learning algorithm to begin the process. This requires many requests to the data base for comparison data so the right plant will be collected from the data base. The diagram will give a visualisation of the system.

## List of Functional requirements

* Plant identification
* Plant information retrieval
* Add Plant snaps (my snaps)
* Delete Plant snaps (my snaps)
* update Plant snaps (my snaps)
* Seed identification
* Add seed snaps (my snaps)
* Delete seed snaps (my snaps)
* update seed snaps (my snaps)
* Seed information retrieval
* Fruit identification
* Add Fruit snaps (my snaps)
* Delete Fruit snaps (my snaps)
* update Fruit snaps (my snaps)
* Fruit information retrieval
* Search Plant information
* Login
* Log out
* View plant/seeds/fruit

## Future features

Geo location for plant origins.

Share snap feature/comments.

Chat Groups

# Wire frame Application Design:

## Home page

**Text

Description automatically generated**

Figure 3,prototype home page

This page in the application is the homepage where users can view list of plants/seeds and fruits also view the most popular plants for gardens.

## Camera page

**A screenshot of a cell phone

Description automatically generated with medium confidence**

Figure 4, prototype camera view

This page in the application is where the machine learning and image recognition will process images taken by the user and make a prediction and provide information on the image.

## My snaps

**Graphical user interface, text, application

Description automatically generated**

Figure 5, prototype my snaps

This page will show the photos taken by the user in a list and allows them to edit and add new snaps.

## Snap garden

**A screenshot of a cell phone

Description automatically generated with medium confidence**

Figure 6, prototype snap garden

This page is used to collect plants /fruits/seeds that you wish to put in your own garden. You can add, delete and update.

## Information page

**Diagram

Description automatically generated with low confidence**

Figure 7, prototype information page

This page is for the details of each plant, seed and fruit it gives the user detailed understanding of what the plant is.

## Login page

**Graphical user interface

Description automatically generated**

Figure 8, prototype login page

This page lets the user login to the app.

## Register page

**Graphical user interface

Description automatically generated**

Figure 9,prototype Register page

This lets the non-registered user to register to the application.

## Use cases

The use cases

|  |
| --- |
| * **Use Case Name:** Plant/seed/fruit identification |
| **Use Case Description:**  This function allows users to identify plants by simply taking a picture of plants |
| **Participating Actor(s):**  User |
| **Entry Conditions:**   1. The user has opened the application. And invoked the navigation menu function of the system. |
| **Flow of Events:**   1. The system responds to the photo been taken by invoking the image recognition process. 2. The system then responds to the image data sets by sending it to the machine learning algorithm. 3. The system responds by invoking the comparison dataset process. 4. The system then makes predictions on both datasets. 5. The system responds by starting the plant/seed/fruit information retrieval process. |
| **Exit Condition (s):**   * + 1. The user has successfully viewed and identified a specific plant/seed/fruit and learned about it. |
| **Alternatives:**  None. |
| **Exceptions:**  None. |

Table 1, use case table: Plant/seed/fruit identification

|  |
| --- |
| * **Use Case Name** Plant/seed/fruit information retrieval |
| **Use Case Description:**  This function retrieves plant/seed/fruit information from data base. |
| **Participating Actor(s):**  System |
| **Entry Conditions:**   1. The system requires the information on a certain plant/seed/fruit. |
| **Flow of Events:**   1. The system responds to the prediction and retrieves the information on a plant/seed/fruit. 2. Then system sends the information to the application plant/seed/fruit detail page. |
| **Exit Condition (s):**  1. Then system sends the information to the application plant/seed/fruit detail page. |
| **Alternatives:**  None. |
| **Exceptions:**  None. |

Table 2, use case table: Plant/seed/fruit information retrieval

|  |
| --- |
| * **Use Case Name** Add/delete/update Plant/seeds/fruit snaps * (My garden similar functions delete and update) |
| **Use Case Description:**  This function allows course to be booked by users on the system |
| **Participating Actor(s):**  user |
| **Entry Conditions:**   1. A user would like to Add/update/delete snaps 2. Opens the application. 3. Clicks on my snap’s icon on the navigation bar. 4. Which opens my snaps page? 5. The user can carry out add/delete/update by clicking on a button (add, update) or sliding the item for delete. |
| **Flow of Events:**   1. The user carrys out the desired function 2. If the user clicks delete   The system responds by removing the snap from the database and not displaying it.  If the user clicks add   1. The system responds by displaying the camera to the user and request a photo 2. The user takes the photo, and the system invokes the Plant/seed/fruit identification process 3. The system responds by being the user to the information of plant/seed/fruit taken.   If the user clicks update   1. The system responds by displaying the camera to the user and request a photo 2. The user takes the photo, and the system invokes the Plant/seed/fruit identification process 3. The system responds by being the user to the information of plant/seed/fruit taken |
| **Exit Condition (s):**   * + 1. The system fellow the route of acted. |
| **Alternatives:** None. |
| **Exceptions:** None. |

Table 3, use case table: Add/delete/update Plant/seeds/fruit snaps

|  |
| --- |
| * **Use Case Name** Search information |
| **Use Case Description:**  This function allows the user to search for plants, seeds, and fruits |
| **Participating Actor(s):**  user/non-user |
| **Entry Conditions:**   1. A user would like to search for a plant, seed, or fruit 2. Opens the app. 3. Clicks on the text field and types in there requested item. 4. Then press enter to start the search |
| **Flow of Events:**   1. The system responds by connecting to the database and retrieving information on requested plant 2. The system then shows it on the home page list of plants/seeds/fruit. 3. The user clicks on the plants/seeds/fruit from the list and then the system displays the item searched for. |
| **Exit Condition (s):**   * + 1. The system shows requested searched item on the details page. |
| **Alternatives:**  None. |
| **Exceptions:**  None. |

Table 4, use case table: Search information

|  |
| --- |
| * **Use Case Name** Login |
| **Use Case Description:**  This function allows the users to login into the application |
| **Participating Actor(s):**  user |
| **Entry Conditions:**   1. The user clicks the login page via the link in the menu 2. The user is brought to the login page 3. The user enters in the login credentials |
| **Flow of Events:**   1. The system responds by sending to the login page. 2. The system requests the user to enter in login information 3. The user enters the login information and clicks login 4. The system begins the user back to the home page |
| **Exit Condition (s):**   * + 1. **User is successfully logged in.** |
| **Alternatives:**  The User press cancel login or use the navigation bar to move pages |
| **Exceptions:**  None. |

Table 5, use case table: Login

|  |
| --- |
| * **Use Case Name** register user |
| **Use Case Description:**  This function allows course to be booked by users on the system |
| **Participating Actor(s):**  non-user |
| **Entry Conditions:**   1. A non-user wishes to register on the app 2. Non-user opens the application 3. Then clicks on the register icon on the navigation bar 4. Then the non-user fills in the details for a user. |
| **Flow of Events:**   1. The system responds by displaying the register page 2. The non-user fills in the required details. 3. The user then clicks register 4. The system responds by adding the user to the database and returning the user to the home page. |
| **Exit Condition (s):**   * + 1. The system has successfully registered the user. |
| **Alternatives:**  None. |
| **Exceptions:**  None. |

Table 6, use case table: register user

|  |
| --- |
| * **Use Case Name** Log out |
| **Use Case Description:**  This function allows the user to log out of the system |
| **Participating Actor(s):**  user |
| **Entry Conditions:**   1. Press the log out button |
| **Flow of Events:**   1. The system responds by log out the user within the current session. |
| **Exit Condition (s):**   * + 1. The system returns the user to the home page. |
| **Alternatives:**  None. |
| **Exceptions:**  None. |

Table 7, use case table: Log out

|  |
| --- |
| * **Use Case Name** data comparison process |
| **Use Case Description:**  This function retrieves plant information from data base. |
| **Participating Actor(s):**  System |
| **Entry Conditions:**   1. The system requires the image datasets. |
| **Flow of Events:**   1. The system responds to the request and collects the image datasets required. 2. Then system sends the image datasets to the identification process use case. |
| **Exit Condition (s):**  1. Then system sends the dataset to the machine learning algorithm. |
| **Alternatives:**  None. |
| **Exceptions:**  None. |
| **Alternatives:**  None. | |

Table 8, use case table: data comparison process

|  |
| --- |
| * **Use Case Name** view plant/fruit/seed details. |
| **Use Case Description:**  This user wishes to view details of a plant/fruit/seed |
| **Participating Actor(s):**  user, nonuser |
| **Entry Conditions:**  The user wishes to view details of a plant/fruit/seed  The user opens the application  The user clicks on plant/fruit/seed from homepage/my snaps  /My garden items and the non-user can only click on the home page items.  can click on the homepage plant/fruit/seed. |
| **Flow of Events:**   * 1. The system responds to the requested plant/seed/fruit and displays the plant/seed/fruit from the database.   2. The system also brings the user to the plant/seed/fruit details page. |
| **Exit Condition (s):**  1. Then system brings the user to the detail page of the plant/seed/fruit page. |
| **Alternatives:**  None. |
| **Exceptions:**  None. |
| **Alternatives:**  None. | |

Table 9, use case table: view plant/fruit/seed details.

|  |
| --- |
| * **Use Case Name** Navigation |
| **Use Case Description:**  This function opens the navigation which allows users to traverse the applcation |
| **Participating Actor(s):**  System |
| **Entry Conditions:**   1. The user opens the app |
| **Flow of Events:**   1. The system displays the navigation. 2. The user clicks an option 3. The system responds by being them to the desired page |
| **Exit Condition (s):**  1.The user view the desired page.. |
| **Alternatives:**  None. |
| **Exceptions:**  None. |

Table 10, Navigation

## UML(Unified Modelling Language ) Diagram

**Diagram

Description automatically generated**

Figure 10,UML Diagram

The UML diagram will give you a visualization of the design of the system and what each Actor using will interact with when using the system. Actors is the type of users that would use the system and what they have access to.

## SQLite Database ERD (Entity Relationship Diagram)

**Diagram

Description automatically generated**

Figure 11, ERD Diagram

The entity relationship diagram shows the relationships of entities in the database. The relationship between the comparison data entity and the information entity is that the temporary data stored in the comparison data entity is used in the machine algorithm to compare matching information in the other information tables.

The user table is used when a new user is added and the login process to check if it exists in the database.

**Machine learning type**

**A picture containing text, sign, outdoor, street

Description automatically generated**

Figure 12,Supervised learning Diagram (Loon, 2018)

This type of machine learning is called supervised because the intended out come is already know in the case of this application the goal is to identify a certain plant, fruit or seed it’s about how we get there that the machine learning algorithm must figure out. Another example if a student takes a lesson from a college. The student knows what is to be gained by taking this lesson.

So, developers using this type of machine learning feed the output information into the system and the system carries out the steps to get the desired output. So, for this application the result would be the plant identified through this type of machine learning.

# Results (Implementation/Testing/Findings)

# Discussion

# Conclusions

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# Appendices (supporting materials)