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# Where2P4Free

Bachelor of Science (Honours) Software Development

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**Research Manual**

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# 1. Abstract

The purpose of this research document is to provide a written account of the research conducted into developing the mobile application 'Where2P4Free'. The document will outline both the various technologies and the methodologies used in the development of the project.

## 2. Introduction

This document will contain a researched analysis for the mobile application “Where2P4Free”. Relevant technologies for the mobile application will be researched and outlined below. The back-end technologies will also be researched and outlined, including all existing crowdsourcing systems and mobile applications that perform similar functions.

The following areas will be covered in this document:

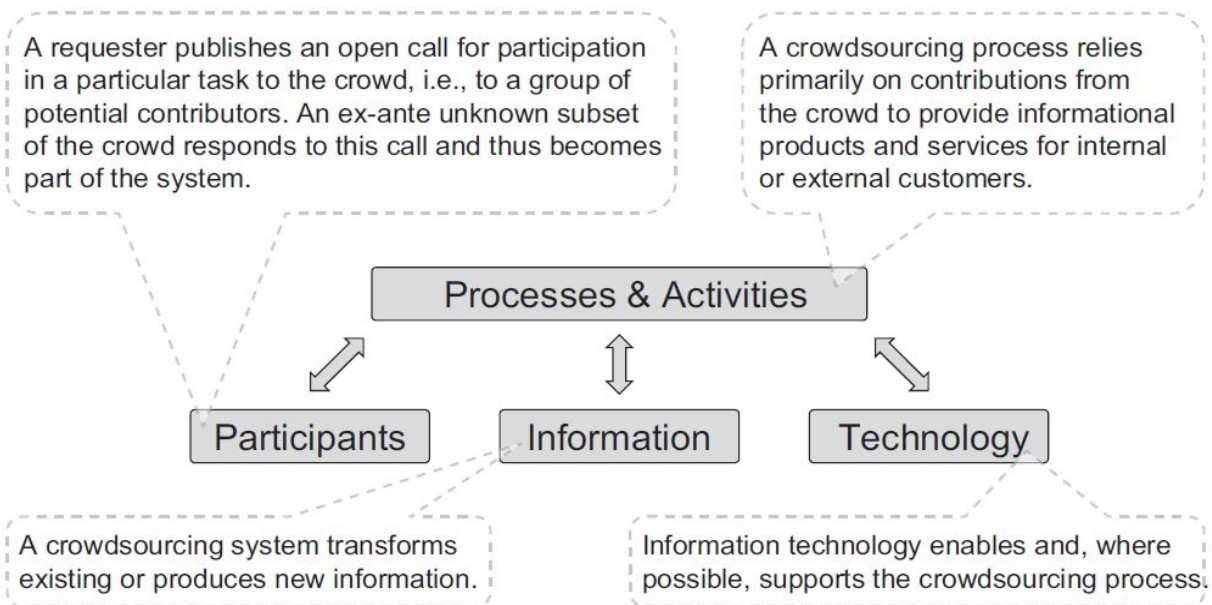
- Crowdsourcing Systems.
- Mobile Applications.
- Development Technologies.

## 3. Existing Systems

### 3.1 What are Crowdsourcing Systems?

Crowdsourcing is [1]to outsource work to an unspecified group of people, typically by making an appeal to the general public on the internet.[1]

A crowdsourcing system is where users continuously source, update, curate and verify the data which the system manages. Such systems have in place architecture which provides the functionality to allow users to interact with the data.

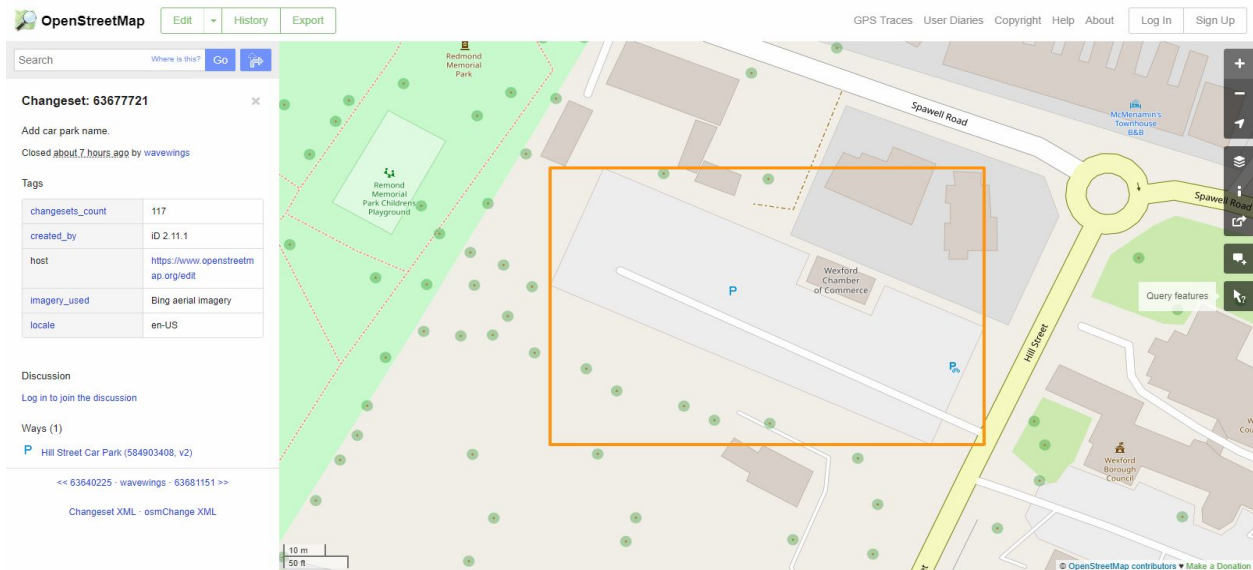


**Figure 1.1 Crowdsourcing Systems [2]**

#### 3.1.1 OpenStreetMap

OpenStreetMap is a project which is a collaboration between users worldwide to create a free editable map of the world. [3]OpenStreetMap is built by a community of mappers that contribute and maintain data about roads, trails, cafés, railway stations, and much more, all over the world.[3] Users can edit the map to add various “nodes” which contain information relating to specific places in the world. Such information includes, name of the location, street address, city address, amenity, opening hours, phone, etc. Coordinates of the location are also made available to edit which are then display on-screen for users to see. Each edit is known as a

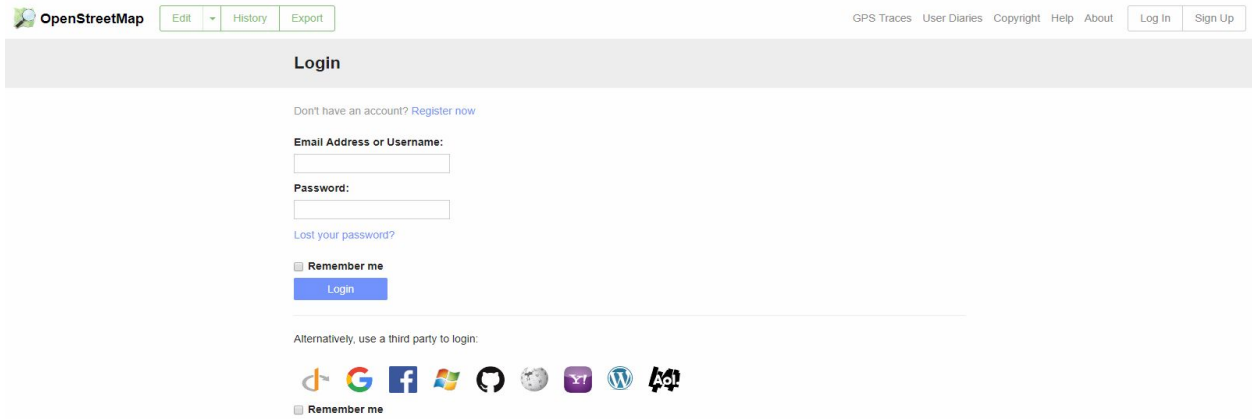
“changeset” and is giving its own unique ID whilst being assigned to the user who made that edit.



**Figure 1.1 OpenStreetMap**

Users are encouraged to provide detailed information on landmarks within their own locale. [4]OpenStreetMap emphasizes local knowledge. Contributors use aerial imagery, GPS devices, and low-tech field maps to verify that OSM is accurate and up to date.[4] As a result, OpenStreetMaps can provide people with the most accurate data as possible for locations around the world. This is because contributors can share local knowledge of places which would otherwise be only made available through third-party research.

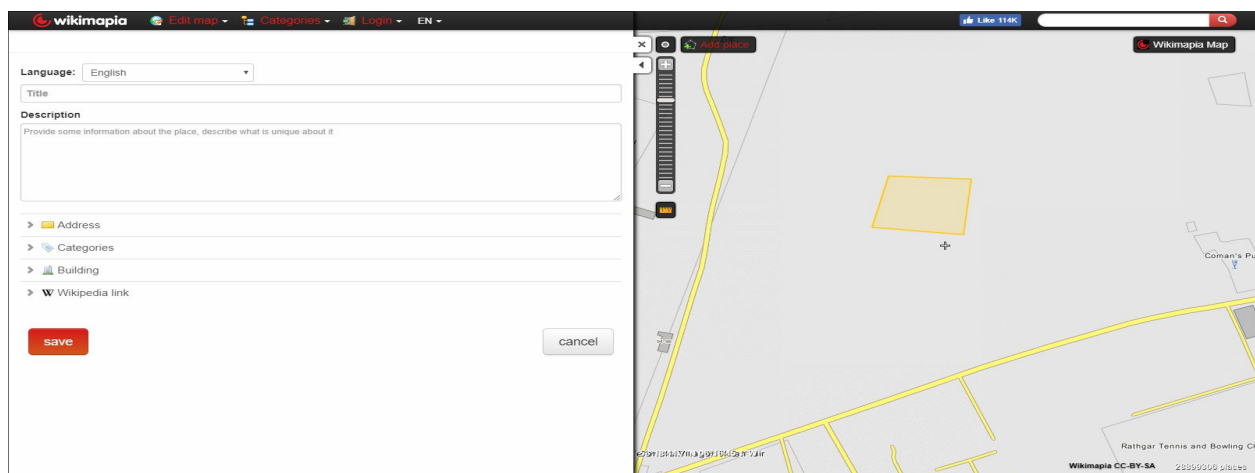
In order for users to make contributions to OpenStreetMap, they must have registered access to the system. Once registered, they can access their account using either their OpenStreetMap account or via a third-party account such as; Facebook, Gmail, Wikipedia, Windows Live, GitHub, and so on.



**Figure 1.2 OpenStreetMap Login**

### 3.1.2 Wikimapia

Wikimapia is an open-content project which allows collaboration between users worldwide to create an editable world map. [5] Wikimapia is a multilingual open-content collaborative map, where anyone can create place tags and share their knowledge.[5] Users can directly edit the map using the online map editor on the website. In order to do this, a certain distance of zoom is needed to allow for adding places. Once the user is zoomed in sufficiently, they can draw a shape around the area they wish to add. When the shape is drawn, options for adding title, description, address, categories, building, and wikipedia appear. The user can enter in the information they wish and then click save. The new landmark now has been successfully added to the map.

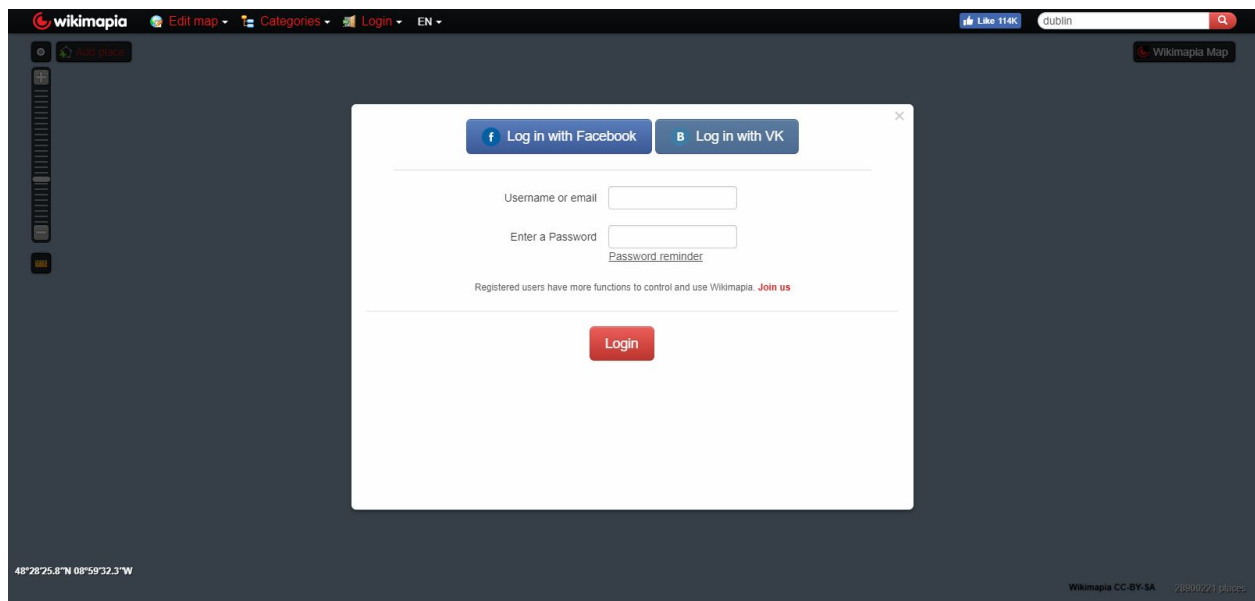


**Figure 2.1 Wikimapia**



Wikimapia also allows users to search for places on the map using either search bar or via categories. Each category displays the number of places relevant to each individual category. The search features also allows for traversal of the map, either by entering in the name of a place or by coordinates.

In order to make edits to the map, Wikimapia requires users to have registered access via accounts. Once registered, they can access their account using either their Wikimapia login or a third-party login such as Facebook.



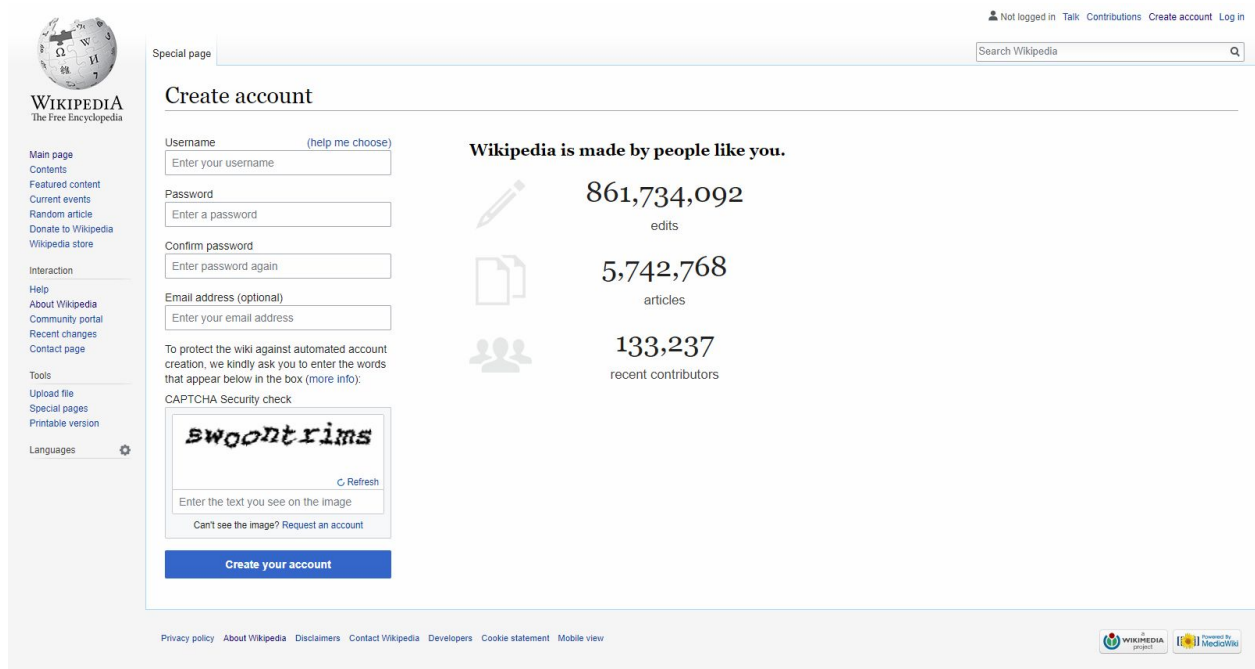
**Figure 2.2 Wikimapia Login**

### 3.1.3 Wikipedia

Wikipedia is a multilingual, online encyclopedia which is developed by the Wikimedia Foundation. [6]Wikipedia is written collaboratively by largely anonymous volunteers who write without pay. Anyone with Internet access can write and make changes to Wikipedia articles, except in limited cases where editing is restricted to prevent disruption or vandalism. Users can contribute anonymously, under a pseudonym, or, if they choose to, with their real identity.[6] People who edit the online articles on the website are known as “contributors”. In order to edit Wikipedia articles, users must follow various protocols laid out to ensure reliable information. There are also helpful resources available to both new and long-time contributors. These resources provide help in setting up accounts, editing articles, writing advice, etc. Wikipedia also has a large community with active forums to resolve any questions users may have

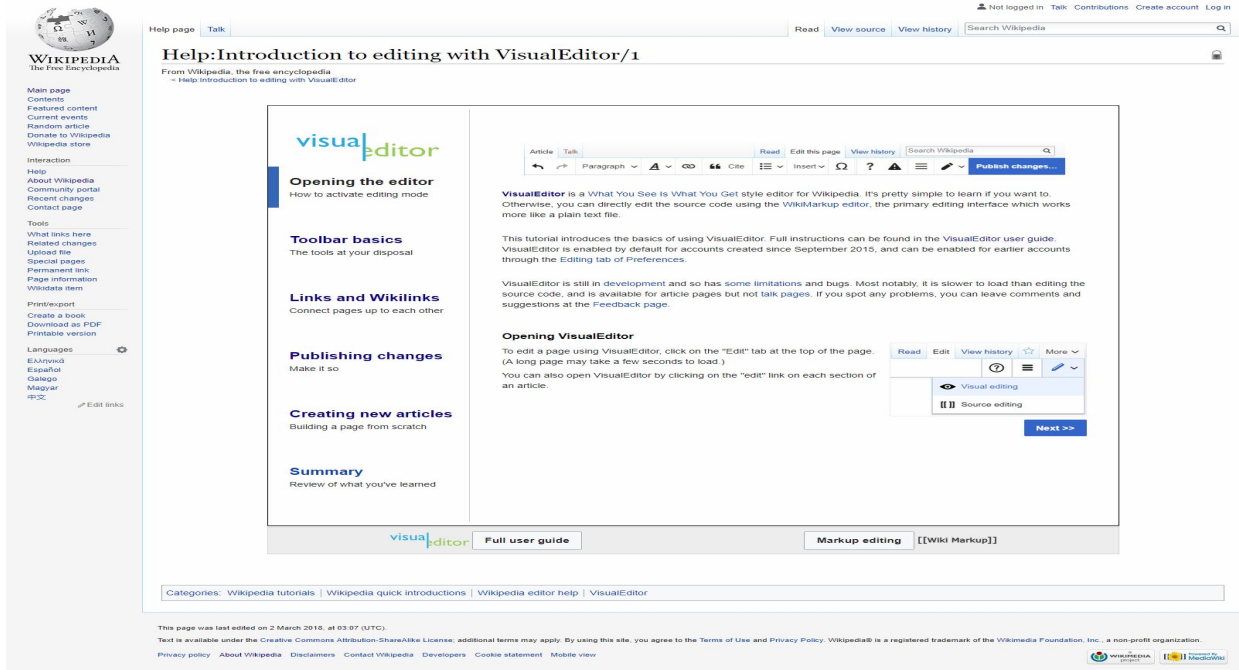
about the site or contributing in general. Users can also avail of an interactive help desk to answer any queries they may have.

Wikipedia does not require a user to create an account in order to create or edit articles. [7]Creating an account is free and has several benefits (for example, the ability to create pages, upload media and edit without one's IP address being visible to the public).[7] When registering for an account, the user must provide a username, password and email(optional). There is also a CAPTCHA check to determine whether or not the user is human or a bot.



**Figure 3.1 Wikipedia Login**

Wikipedia provides a web-based editor called ‘Visual Editor’ which allows users to create or edit pages. The editor comes with various features such as; connecting pages via links, article wizard to have experienced editors review written articles, image editing, etc. As the name suggests, Visual Editor is used for visually editing articles. This is a very useful features for users who are not familiar with the ‘Wikicode’ used throughout Wikipedia. Wikicode is essentially HTML markup used to structure the articles on every page. All text, links, images, etc are laid out using the markup to make the site pleasing to visit. However, if they so wish, contributors may use the ‘source editing feature’ to edit the structure of the article using the Wikicode markup.



**Figure 3.2 VisualEditor**

### 3.1.4 Wikidata

Wikidata is a collaborative, multilingual knowledge base which is developed by the Wikimedia Foundation. [8]The data in Wikidata is published under the Creative Commons Public Domain Dedication 1.0, allowing the reuse of the data in many different scenarios. You can copy, modify, distribute and perform the data, even for commercial purposes, without asking for permission.[8]

Wikidata stores the sources and connections to databases for entries. This ensures the verifiability of the information being submitted by contributors. Structured data is implemented throughout the Wikidata database. This allows for simpler reuse of the data from third-parties.

Wikidata is an easily accessible central storage repository that can be accessed by users. Similar to the other wikis maintained by the Wikimedia Foundation. Content is loaded dynamically into the Wiki, which means it does not need to be maintained for individual wikiprojects. Examples would include, dates, locations statistics, or other common data. These are all centralized in Wikidata.

The repository consists mainly of what are known as “items”. Each item has a label, a description and any number of aliases. They are uniquely identifiable by a ‘Q’, followed by a random number. The characteristics of an item is described by ‘statements’ which consist of a ‘property’ and ‘value’. Wikidata properties have a ‘P’ followed by a number.

These values can be added to data to uniquely identify them in the database. For example, when adding buildings to the database, geographic coordinates can be assigned to specific buildings using longitude and latitude values. Databases can also be linked via properties. Properties which links items to and external database are known as ‘identifiers’. Client wikis are used to access these values, which are the most up-to-date versions of the data.

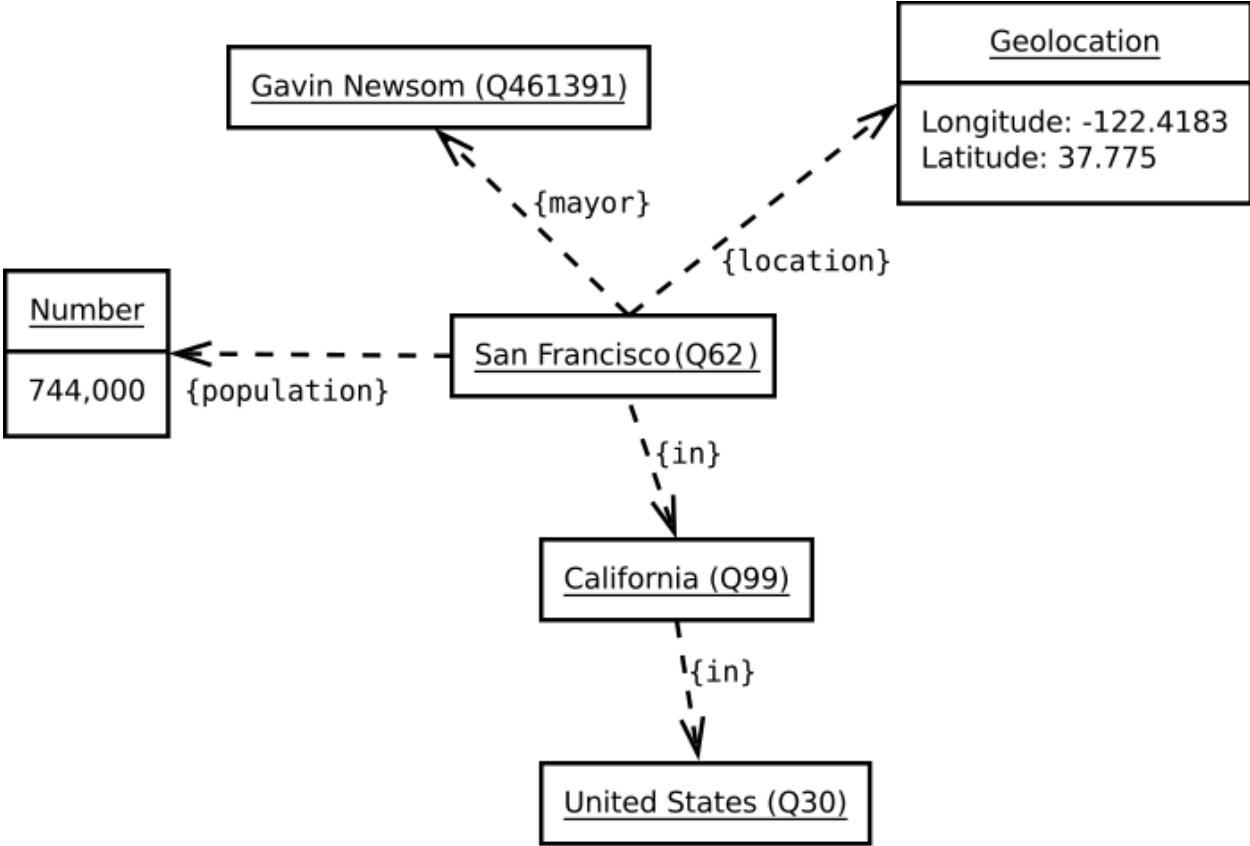
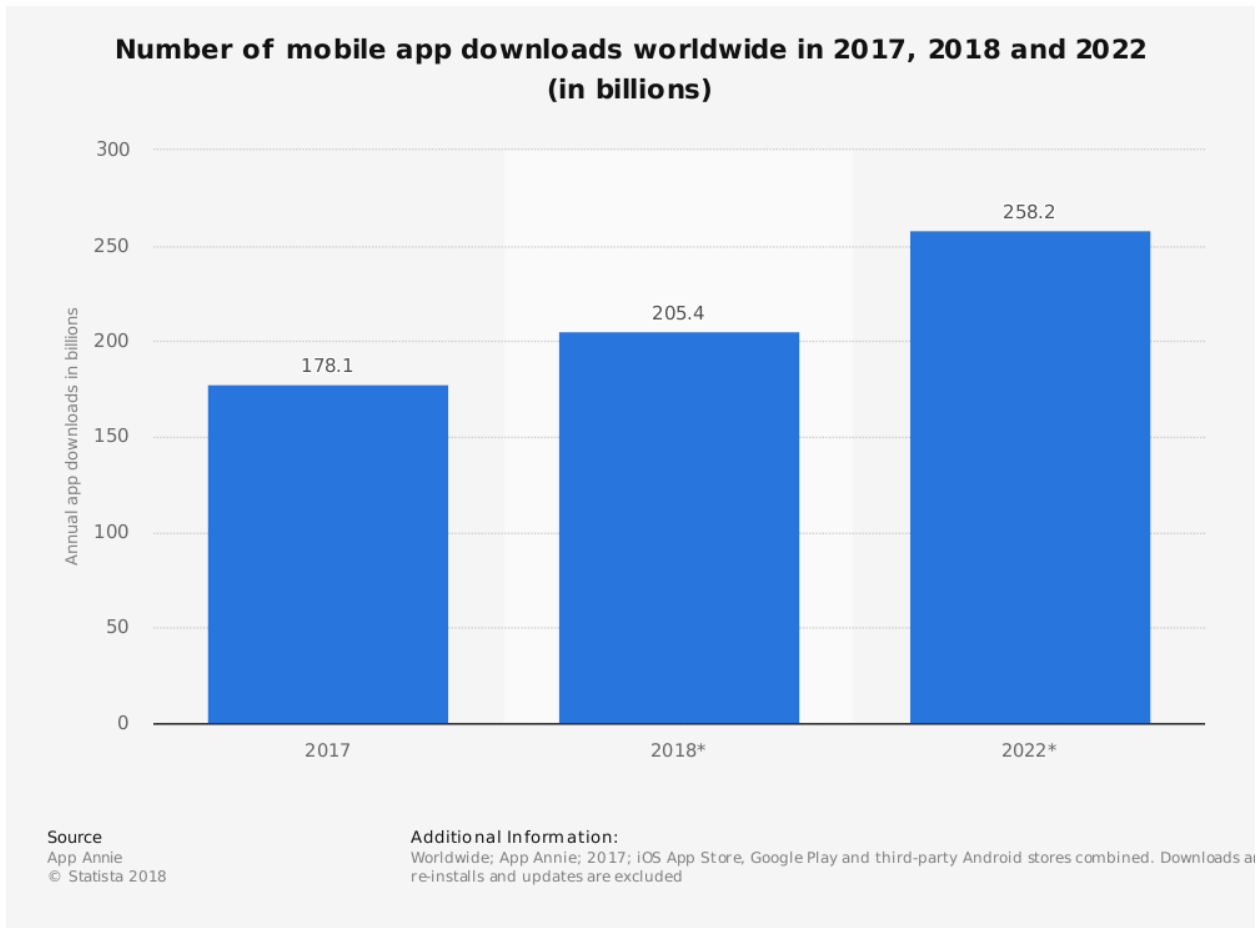


Figure 4.1 The Wikidata Repository [7]

### 3.2 Mobile Applications

Mobile applications are software designed to run on handheld devices such as smartphones and tablets. These applications are available to download from “app stores” for a variety of different platforms. [9]Some of the most popular operating system-native stores are Apple's App Store, Google Play, as well as Windows Phone Store and BlackBerry App World. As of March 2017, there were 2.8 million available apps at Google Play Store and 2.2 million apps available in the Apple’s App Store, the two leading app stores in the world.[9] From the information shown, it is clear that the mobile app market is growing exponentially as is the reachability for said apps to users worldwide. Making it a popular platform for developers to develop applications on.

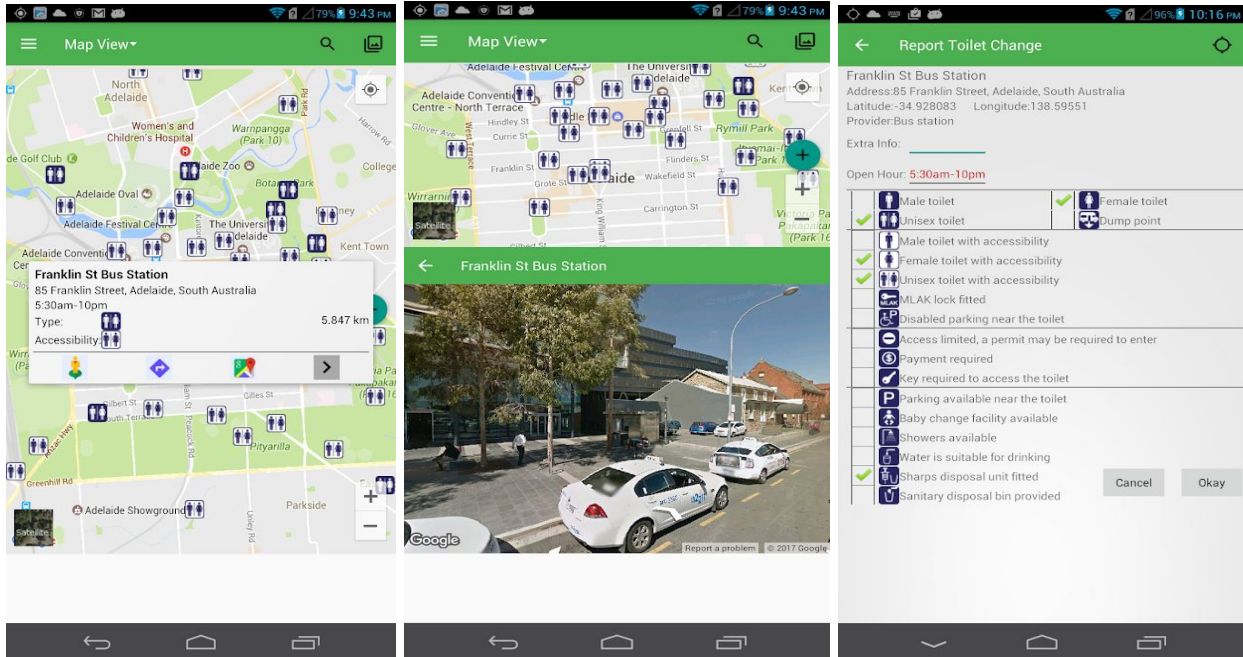


**Figure 3.1 Number of mobile app downloads worldwide [6]**

### 3.2.1 Where is Public Toilet

This is an app available on the Google Play Store which is the highest rated app in its category. The app utilises various databases to compile a list of free public toilets worldwide. [10] More than 280,000 public toilets in World are available for you when just in need. Support world-level/continent-level/Australia database, "Download Database" can be used to switch between World version and Continent version anytime.[10] A map is included in the app which can give directions via Google Routes. The current location of the user is displayed on the map and nearby toilets are also shown. The Google API is used to retrieve the map and route finder.

Another useful feature of the app is a list which can provide information about nearby toilets. Such information includes distance from the user, opening times, accessibility, available parking, etc. Users can change toilets, add, delete and report toilets to improve the data accuracy.



**Details of nearby toilets**

**Google Street View**

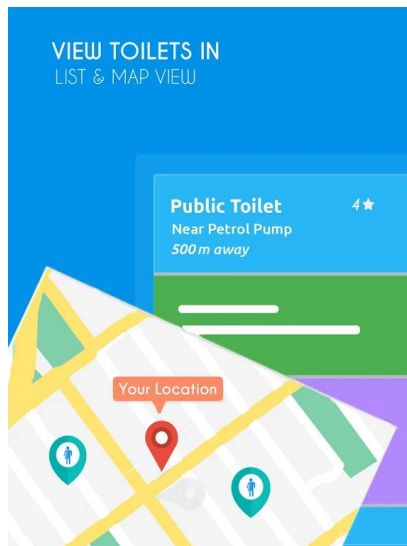
**Report change to toilet**

### 3.2.2 ToiFi (Toilet Finder): Find Public Toilets Near Me

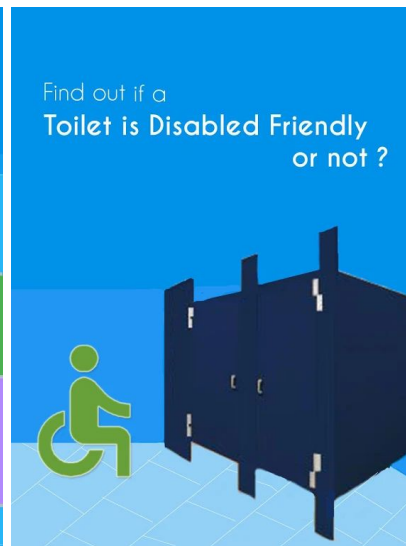
This is another app which is available on the Google Play Store. ToiFi uses a database which contains over 350,000 toilets worldwide. [11]From Map View, you can find the nearest, most suitable restrooms for yourself in several seconds based on your current location and it can guide you to the restroom via Google maps directions.[11] The map feature allows users to locate toilets nearby based on their current location and the app can give directions using Google maps directions.

The app also features a “List View”. This gives detailed information about a nearby toilet that the visitor may find helpful. Relevant information would include the following; whether the toilet is free or not, opening times, accessibility, and available parking. The app also give users the ability to request a toilet when there are none available. Toilets can also be either added or deleted to improve the reliability of the service and also allow more toilets to be made accessible.

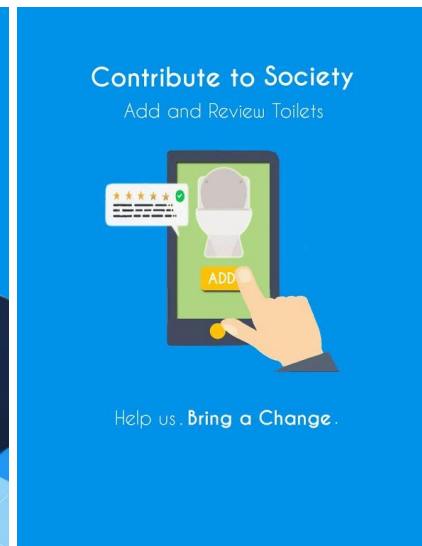
If there are issues with restrooms, users can “report” them using the report feature. This will make others aware not to visit the particular restroom in question. Toilets which do not exist can also be reported and thus deleted to prevent misinforming visitors. After a user visits a restroom a review can be left of that particular visit. The reviews are written text to allow for other to make decisions on whether or not a toilet is appropriate to visit. Feedback can also be left for the developers to ensure the service is kept up-to-date as possible.



**Map and list view**



**Display toilet amenities**

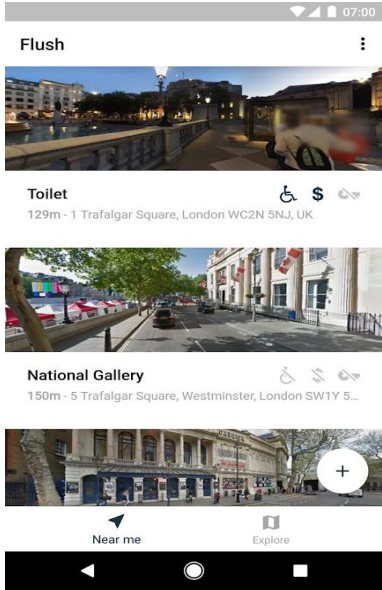


**Add and review toilets**

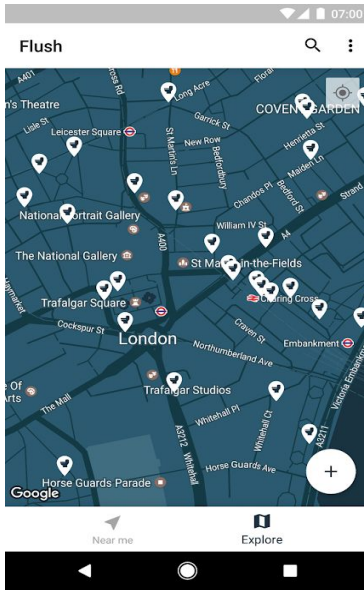
### 3.2.3 Flush - Crowdsourced Toilets

Flush is an android app for finding public toilets using crowdsourced data. [12]A database of over 200,000 toilets available, constantly being increased.[12] The unique feature of this particular app is that the database is stored locally on the device for quick access. The built-in map provided by Google Maps gives directions to the nearest available toilet(s). However, if the visitor requires an immediate use of a restroom, the “finder” option automatically find the closest toilet and provide directions using Google Maps.

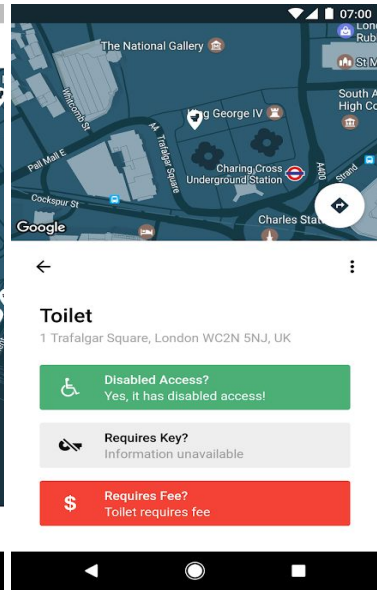
Detailed information about each toilet is displayed on the list of toilets. The information provided includes address, accessibility, parking, etc. Google Street View can be used to view the area near the toilet to get a better idea of the location. The app also works offline so users can search without having to be connected to wifi, cellular, etc.



List of nearby toilets



Map of nearby toilets



Details of each toilet



## 4. Mobile Platforms

### 4.1 Overview

Mobile platforms form a part of the overall usage of software on various devices globally. [13]The hardware/software environment for laptops, tablets, smartphones and other portable devices.[13] With the rapid development of more modern smartphones, the mobile platform has become extremely popular to develop on. In 2015, the daily average internet usage per device was almost three hours. This trend continues to grow at a steady pace each year as more and more smartphones become available. Not just expensive devices with the latest version of their respective operating systems, but more cheaper handsets being sold globally.

Discussed below are two of the most popular and most used mobile platforms on the market currently:

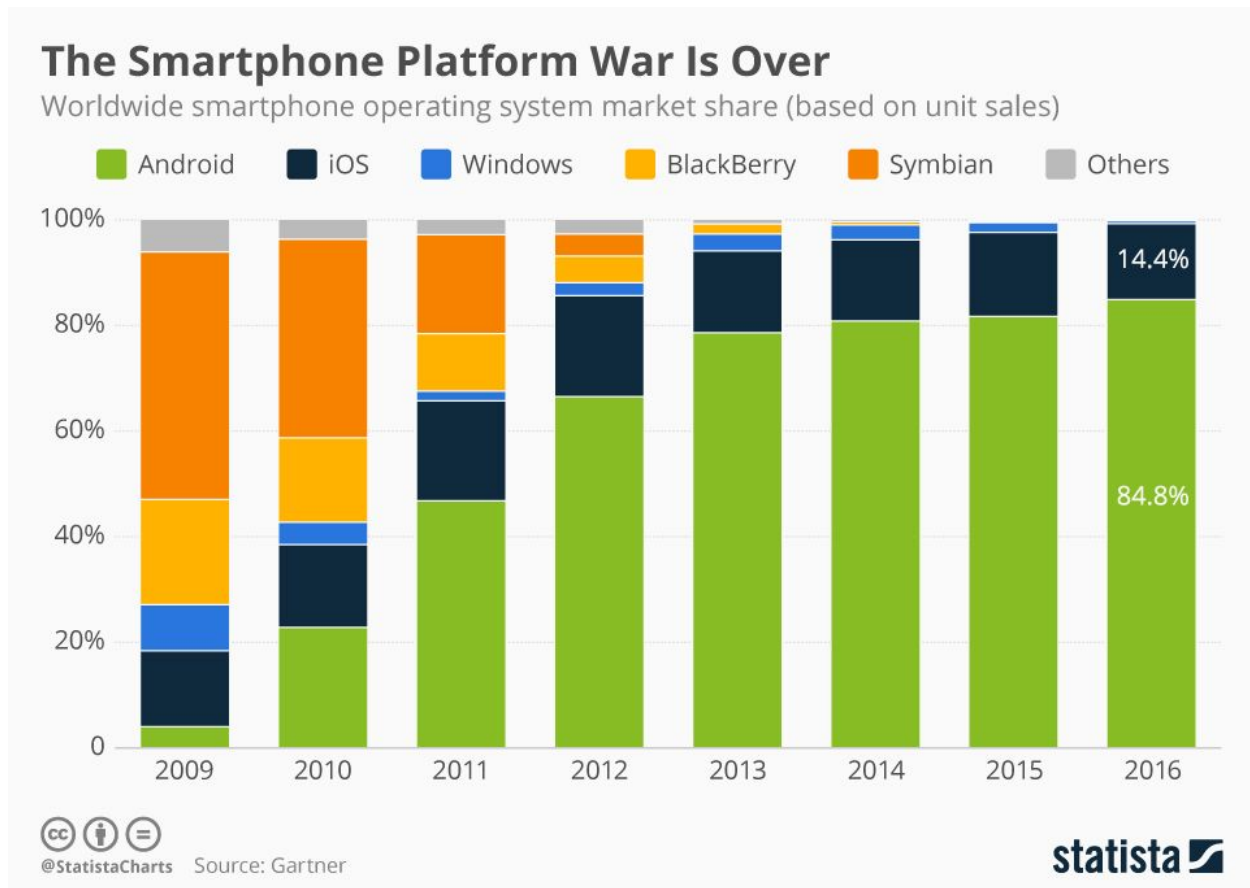
#### 4.1.1 Android

Android is currently the dominant mobile platform on the market(see graph below). Since its inception in 2007, the mobile operating system has been at the forefront of the smartphone market. Android was originally developed by Android Inc. which was then bought by Google. The search engine giant has since integrated its technology into the mobile OS. Users can avail of a variety of Google-based features that are standard on every smartphone running Android. The operating system is currently at version 9.0 “Pie”, released back in August this year. Unlike other mobile platforms, Android is customisable. Users can tailor the OS within reason to suit their requirements. In earlier versions, “rooting” was a popular method of adding additional functionality to Android mobile systems. This is no mostly redundant in newer releases due to increasing focus of security and data privacy. Android is built using the Java programming language.

#### 4.1.2 iOS

iOS is the other significant player in the mobile platform market. Although not nearly as extensive as Android, iOS has enjoyed a steady share of the market since it’s first launch in 2007. Apple has marketed it’s smartphone products at premium prices including its mobile operating systems. iOS is currently at version 12.1, and has undergone significant improvements

over the years. Android has taken some share of the market over the last few years, but Apple's premium pricing of its device has ensured that users view them as valuable, hence making them still popular. iOS has a large community of developers which create applications for all of Apple's products. Apps boast the 'Swift' programming language exclusive for iOS app development.



**Figure 4.2 Smartphone OS Market Share [14]**

From the above the chart we can see that android has steadily risen to become the dominant OS in the smartphone market. From having less than 5% of a share in 2009 to almost 85% total market share in 2016. In seven years, android has increased its market share by almost seventeen times what it was in 2009. IOS remains the same at 14.4%, but it is obvious that Android is the platform of choice for development due to the sheer reach it has over its users.

## 5. Development Technologies

### 5.1 Native Application Development

Native Applications are programs which are developed for use of specific platforms or devices. These applications are capable of using device-specific hardware and software. As a result, they can avail of some of the latest technology available to devices. These include GPS, NFC, etc, compared with cloud or non-native applications. Some come pre-installed on most modern devices and are manufacturer-specific, i.e., they are developed usually by the device manufacturer. Samsung for example, have applications for email, internet browsing, social media, texting, and so on, preinstalled on all their smartphones. These are part of the ‘firmware’ of the device and cannot be uninstalled, modified or installed. There are also native apps available from the major online ‘app stores’, such as ‘Google Play Store’ and Apple’s; ‘App Store’. Such applications need to be downloaded and installed before use and require permission(s) to access certain hardware features.

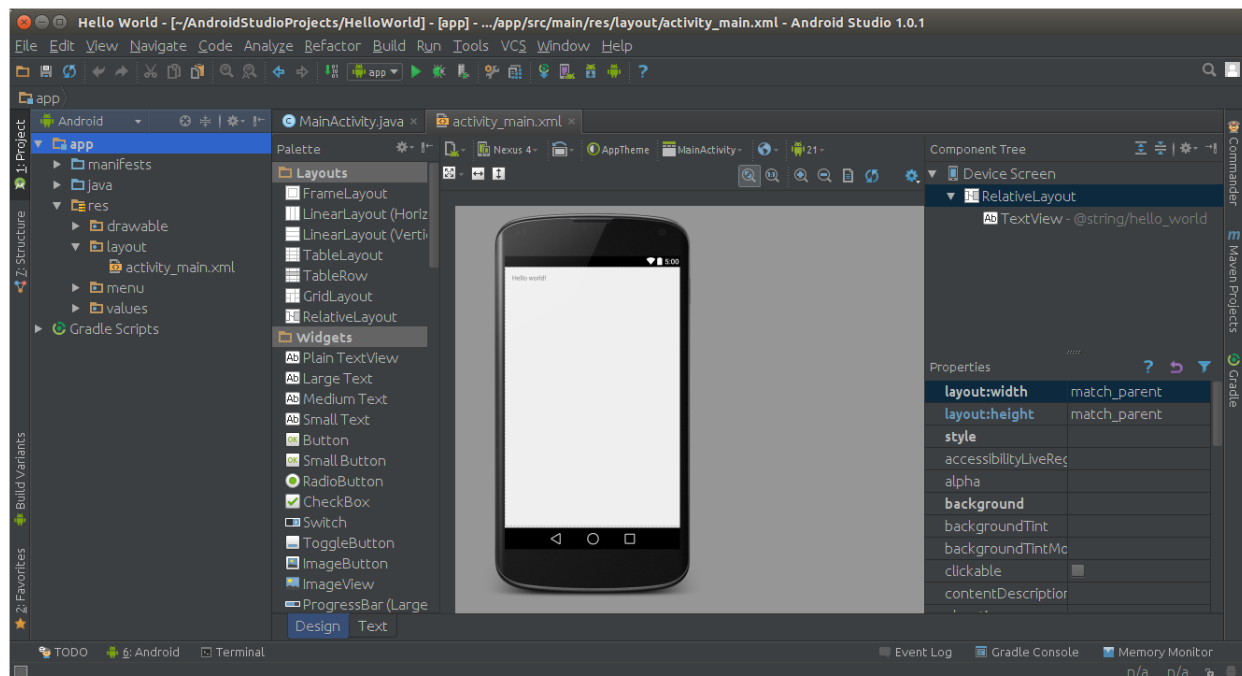
Discussed below are some of the technologies used to develop native applications:

#### 5.1.1 Android Studio

Android Studio is an IDE developed by Google for developing applications on the Android platform. [15] Android Studio provides a complete integrated development environment (IDE) including an advanced code editor and a set of app templates. In addition, it contains tools for development, debugging, testing, and performance that make it faster and easier to develop apps. [15] It is built on the IntelliJ IDEA and so comes with a the powerful code editor and developer tools offered by the IntelliJ IDEA. The IDEA users a fast emulator to create virtual applications within the development environment.

There are also many code templates available to the developer to quickly start developing a working app. Github integration also allows for projects to be push to repositories for each stage of the development process. Android Studio also comes with support for Grade. [15]Gradle is an advanced general purpose build management system based on Groovy and Kotlin. Gradle supports the automatic download and configuration of dependencies or other libraries. It supports Maven and Ivy repositories for retrieving these dependencies. This allows reusing the artifacts of existing build systems.[15] It supports multi-project and multi-artifact.

Android Studio provides support for template-based wizards. These allow for creating Android designs and components for applications. By providing templates for developers to use, the development process can be sped up due to increased productivity. As the provided templates may be the required layout of the app being developed. These templates are complemented by an extensive set of tools and frameworks. They can be integrated into Android projects to allow for native or non-native mobile applications. Almost all of the frameworks available are free to use for development.

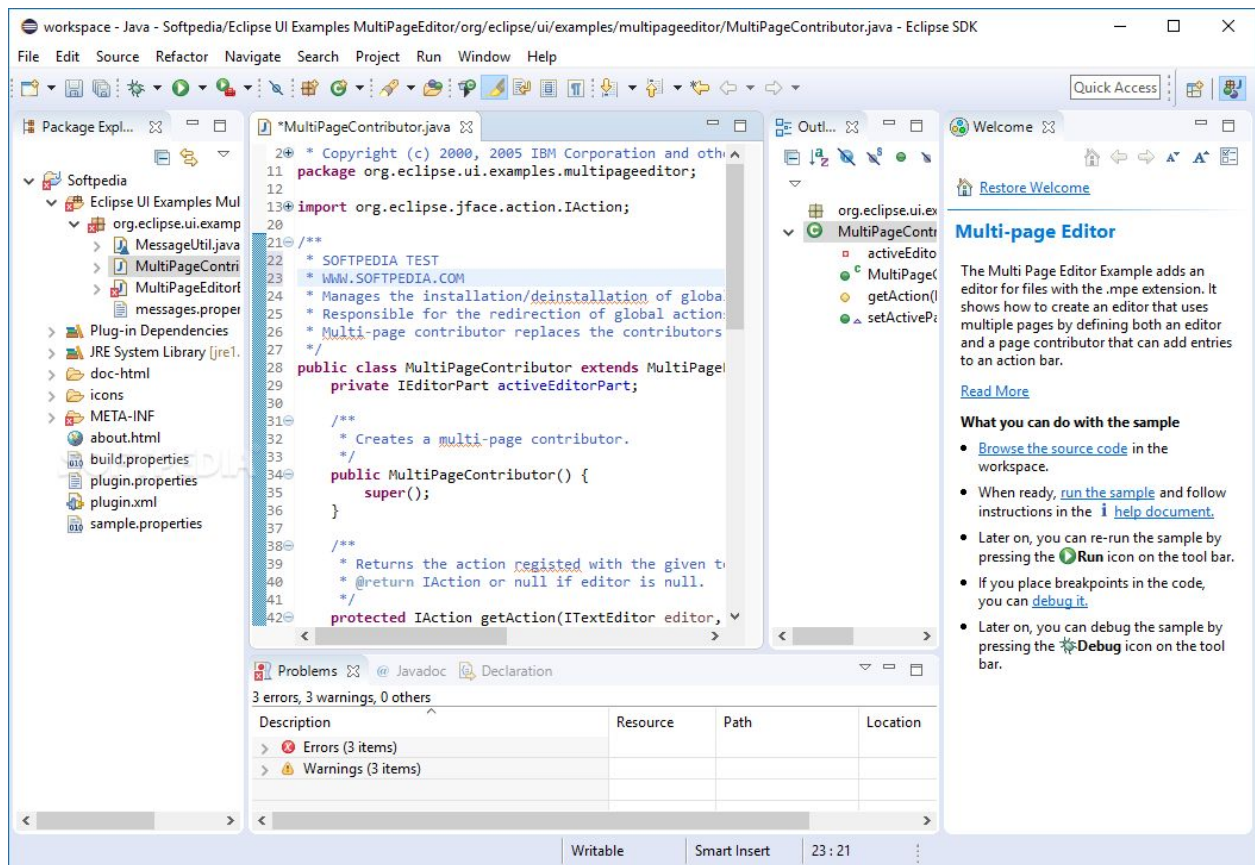


**Figure 5.1 Android Studio IDEA**

### 5.1.2 Eclipse IDE

Eclipse is an IDE for Java and other programming languages such as C, C++, PHP, etc. The Java Development Tools (JDT) are provided by Eclipse along with CDT for C/C++, PDT for PHP and others. Developed using Java, Eclipse can be used to develop client applications, integrated development environment and other software. Eclipse is licensed under the Eclipse Public License (EPL). This ensures that Eclipse is free to download and install. It can also be freely modified and/or extended. It is an important tool for developers as it allows for applications to be developed in multiple languages. Meaning it is flexible and capable of performing the work of more than one IDE all in one. It targets both Windows and Mac OS X for multi-platform application development.

Eclipse utilises various extensions or ‘plugins’ that allow it to support many different programming languages. The Java Development Tools allows Eclipse to be used as a Java IDE. PyDev, a Python plugin, allows Eclipse to be used for developing with Python. C/C++ Development Tools enables application development with both C and C++ respectively. Scala development can be configured through the Scala plugin-in available on the Eclipse store. Finally, the IDE allows for PHP tools to be installed using the PHPEclipse plugin for PHP support.



**Figure 6.1 Eclipse Integrated Development Environment (IDE)**

### 5.1.3 XCode

XCode is an Integrated Development Environment developed by Apple. The IDE is used to create applications for the various products made by Apple. These include the iPad, iPhone, Apple Watch, Apple TV, and Mac. Tools are available to manage the workflow of the

development process - from creating the app, testing, optimizing, and submitting to the App Store.

The necessary files and resources for developing apps are kept organized in what are known as ‘projects’. Projects in XCode are created using pre existing templates. Template are available for each of the various Apple operating systems; iOS, watchOS, tvOS, and macOS. They are also available for common types of apps, frameworks, and libraries. Templates are preconfigured with default settings and is ready to build and run.

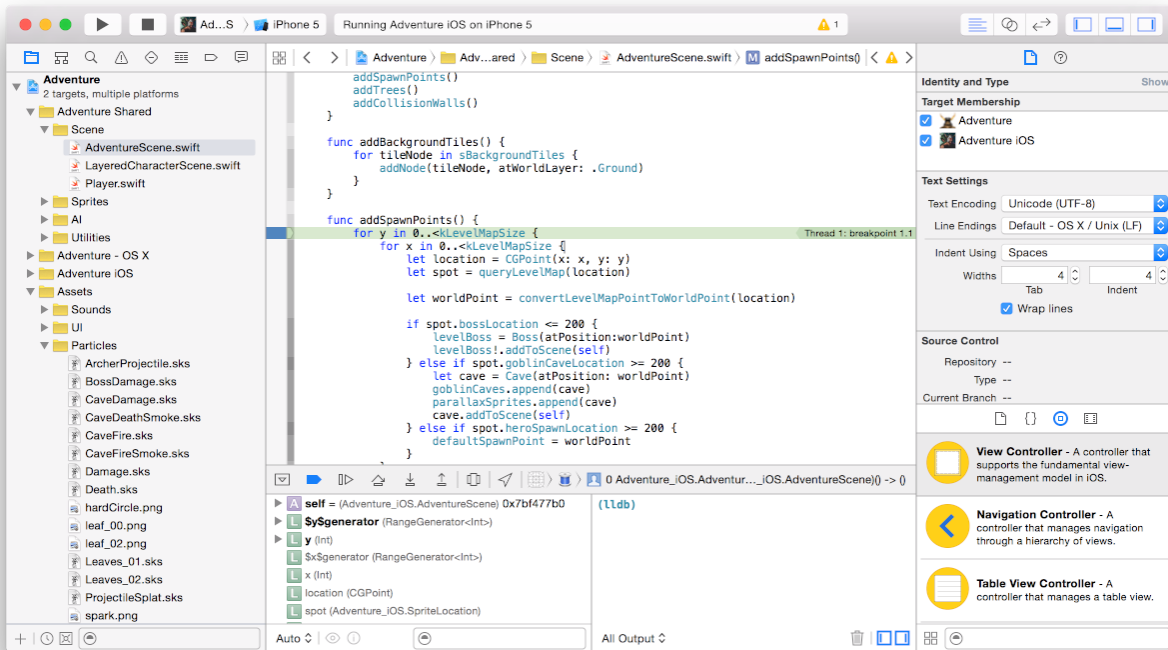


Figure 7.1 XCode Integrated Development Environment

## 5.2 Non-Native(Web) Application Development

Web-based applications are programs which are developed for communicating via HTTP. They are accessed via a network and run on a host, usually a server. Because they do not run directly from the hardware of a device, the apps are not capable of accessing most of the advanced features. Limited functionality is what is available through the use of such applications. They can be downloaded and installed onto a client’s device, but the processing is done server-side. Due to the various sizes of screens being used to display these applications, they must be “responsive” in their design. Responsive is where the applications is capable of being viewed

properly on any display, regardless of size. Since the requirement for running directly from device hardware is non-existent, Web Applications can be cross-platform. This means that such an app can be run on more than one platform, regardless of the device being used.

Outlined below are some of the technologies used to develop Non-native applications:

### 5.2.1 Flask

Flask is a web application framework written in Python. More specifically, it is what is known as a “microframework”. [16]The “micro” in microframework means Flask aims to keep the core simple but extensible.[16] Development with Flask is straightforward due to the customizability of the framework. A developer can choose let’s say what database to use, either MariaDB or MySQL, it doesn’t matter. Integrating HTML templates is easy using the framework as it comes with “Jinja” templating engine. It comes with template inheritance, which makes it possible to use the same or similar or a similar layout for all templates.

```
{% extends "layout.html" %}
{% block body %}
<ul>
  {% for user in users %}
    <li><a href="{{ user.url }}">{{ user.username }}</a></li>
  {% endfor %}
</ul>
{% endblock %}
```

### 5.2.2 Django

Django is a web application framework for Python. Unlike Flask which is a microframework, Django offers scalability for web projects. Scalability refers to the ability of the framework to expand to meet the requirements of the ever-growing web application. [17]Django includes rich support for URL routing, page templates, and working with data.[17] Django inherits Python’s “batteries-included” approach and includes support for out-of-the-box tasks in web development. These include; user authentication, templates, routes, views, administrative interface, robust security, support for multiple database backends, etc. With all this included functionality, it makes the job of the developer easier, as they do not need to “reinvent the wheel” when it comes to basic web development functionality.

### 5.2.3 Ruby on Rails

Rails is a web application framework written in the open-source programming language “Rails”. Similar to both the previous two frameworks mentioned, Ruby on Rails takes into consideration what a developer would need to get started. It includes prebuilt functionalities allowing for focus to be placed on developing the important aspect of the application. This saves time and makes it easier to integrate custom code into existing code templates. [18] Experienced Rails developers also report that it makes web application development more fun.[18]

## 5.3 Hybrid Application Development

### 5.3.1 Apache Cordova

Apache Cordova is an open-source framework for mobile development, it is also open-source. [19]It allows you to use standard web technologies - HTML5, CSS3, and JavaScript for cross-platform development. Applications execute within wrappers targeted to each platform, and rely on standards-compliant API bindings to access each device's capabilities such as sensors, data, network status, etc.[19] It is useful for developing applications to be extended across multiple platforms without implementing it to each specific platform’s language and tool set. Apps can also be packaged for distribution within app stores on different platforms. Another feature is being able to mix native application components with what is known as a “Webview”. This would be used to access APIs at the device-level. Plugin interfaces can also be developed between native and Webview components.

### 5.3.2 BuildFire.js

BuildFire.js give developers the ability to use the BuildFire SDK and JavaScript to develop applications. [20]BuildFire is already programmed with features to support many common businesses. The only thing left is for the programmer to customise the program to suit a client’s unique specifications instead of having, to build from scratch.[20]. Hence, developers can build apps quickly as it is easy to work with. It features client-side JavaScript programs such as jQuery, Underscore, React, Angular, etc.



### 5.3.3 Ionic Framework

Ionic is an open source mobile framework for developing hybrid mobile applications. [21]It provides tools and services for building Mobile UI with native look and feel. Ionic framework needs native wrapper to be able to run on mobile devices.[21] The frontend library features building blocks and pre-built UI components that allow for design either mobile or Progressive Web Apps using HTML, CSS, and JavaScript. Web components can integrate with JavaScript frameworks such as Angular, React, or Vue. Ionic applications can also interact with backend services like AWS, Azure and Firebase. As the framework is cross-platform, both web and native mobile apps can be built for every major app store.

## 5.4 Building Android Apps Using Buildozer(Python)

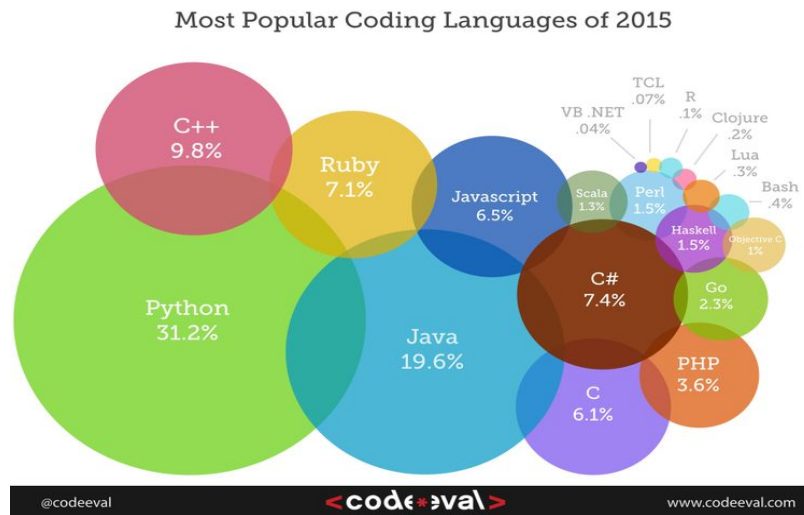
Buildozer is an automation and deployment tool for build for mobile development. The tool is supported on iOS and Android. When building apps using the Python framework “Kivy”, Buildozer is used to package the project as an Android app. Once installed, it automates the process of building said app. Buildozer is only available on Ubuntu, hence the Linux distribution is required for developing apps using this tool.

```
buildozer init  
buildozer -v android debug  
buildozer android deploy run logcat
```

The above commands demonstrate a typical example of building an Android app using buildozer. The tool creates an APK file with the Python code for building the app. All the Android SDK, NDK and other tools are downloaded and installed also.

## 6. Mobile Development Languages

The following section will outline the various languages relevant to the area of Mobile App Development. Below is a chart of the most popular languages of choice for developing of Software:



**Figure 4.1 Popular Coding Languages [10]**

Although the image is relevant to 2015, there hasn't been much change in the past few years regarding language popularity. Clearly we can see that Python and Java are the most popular amongst developers.

Whilst programming languages are important for developing mobile apps, the various operating systems are also important. They essentially provide the functionality of modern smartphones and smart devices. Below is a chart which shows the market share of the top mobile operating systems up to 2016:

### 6.1 Java

[22]Java is one of the most widely used programming languages in the world with an estimated 9 million developers.[22] The Google mobile operating system Android uses “Android Java” to build mobile apps. The key features of Java are; Object Oriented Programming, APIs, Open Source Libraries, Strong community support, and many IDEs with powerful error-checking capabilities.

## 6.2 Swift

Swift is a new programming language launched in 2014 for the IOS platform. It is a general-purpose language intended to replace existing C, C++ and Objective-C. [23]The goal of the Swift project is to create the best available language for uses ranging from systems programming, to mobile and desktop apps, scaling up to cloud services. Most importantly, Swift is designed to make writing and maintaining correct programs easier for the developer.[23] The language offers several features such as inferred types to make code cleaners and modules to eliminate headers. Swift also provides built-in error handling. The entire language is licensed under the Apache 2.0 license.

## 6.3 Python

Python is one of the most popular programming languages of recent years. The popularity of the programming language has increased since it's first introduction in 1989. [24]Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. Its high-level built in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or 'glue' language to connect existing components together.[24] Python is a popular language because of its easy to learn syntax and uses modules to extend new or existing applications. As a result, programs can be modularised and code can be reused throughout applications, hence driving up productivity. There are many different frameworks available for Python, one such framework relevant to the area of mobile app development is "Kivy".

[25]Kivy is an OpenGL ES 2 accelerated framework for the creation of new user interfaces. It supports multiple platforms namely Windows, MacOSX, Linux, Android iOS and Raspberry Pi. It is open source and comes with over 20 widgets in its toolkit.[25] Kivy has a stable framework and the API is well documented. There is also a strong community of developers continuously providing solutions to problems users may encounter. Widgets also form a large part of the Kivy framework. They are pre-built and provide advanced functionality for applications without having to worry about styling or design. This means that the developer can focus on the development of the application functionality rather than worrying about the appearance of the UI/GUI. Kivy is also free to use and is licensed under the MIT license 1.7.2.

## 8. Hosting Platforms

### 8.1 Local Hosting

#### 5.2.3 Couchbase Mobile

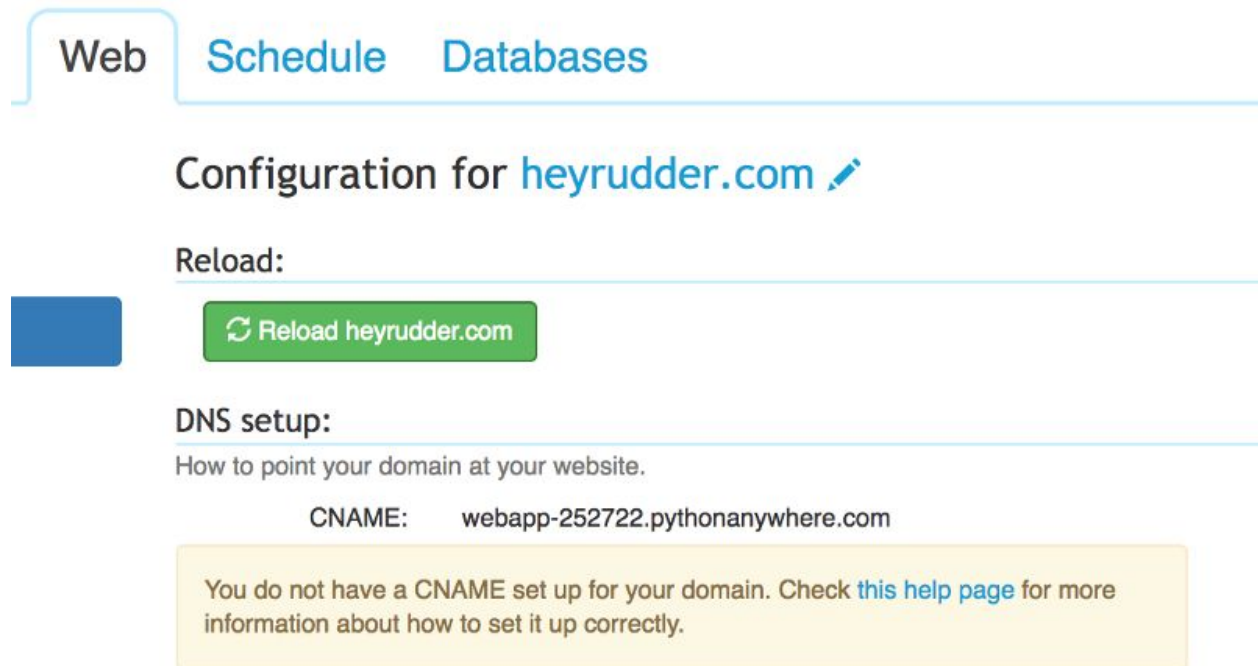
[26] Couchbase Mobile is a collection of software consisting of an embedded NoSQL database distributed with your Android and iOS mobile applications and a middleware service used to securely synchronize that locally stored data with Couchbase Server and other devices.[26] The database runs in the background while the application runs resulting in less processing usage. A RESTful web service can be accessed through the Couchbase Lite API or custom HTTP requests. As Couchbase uses NoSQL, the database uses scheme-less documents for storing data. When the data changes, there is no need for an upgrade to the database. Offline development is also a feature of Couchbase Mobile. An locally stored database which the code can interface with provides the ability to develop without internet functionality. Receiving responses from the database it quicker as it is local on the device rather than remote.

### 8.2 Cloud Hosting

#### 8.2.1 Google Firebase

Firebase is a mobile and web application development platform acquired by Google in 2014. [27] The Firebase Realtime Database is a cloud-hosted NoSQL database that lets you store and sync between your users in real time.[27] The database is a real time, cloud-hosted NoSQL database which means data is synced across all clients. This means the data is still available when devices go offline. Firebase also boasts SDKs and pre-built UI libraries to allow user authentication to apps.


## 8.2.2 PythonAnywhere



Web Schedule Databases

### Configuration for [heyrudder.com](#)

Reload:

 [Reload heyrudder.com](#)

DNS setup:

How to point your domain at your website.

CNAME: `webapp-252722.pythonanywhere.com`

You do not have a CNAME set up for your domain. Check [this help page](#) for more information about how to set it up correctly.

[28]PythonAnywhere is a popular and growing platform-as-a-service that makes it easy for programmers to create, store and run their software in the cloud.[28] This particular web host is specifically built for the development of Python applications. Code can be written using the provided web-based editor or console session from any browser. MySQLdb which runs on PythonAnywhere is an interface for connecting to MySQL database servers from Python. It implements the Python Database API v2.0 and is built upon the MySQL C API. However, the MySQLdb interface is not supported by Python3 and above.

Oracle, the developers of MySQL, have created a “connector” allowing Python to interact directly with MySQL databases. This connector is essentially a standardise database driver, which is supported by Oracle and is supports Python3 and above. It is also easier to implement than MySQLdb as the library can simply be installed into any Python application. MySQL Connector/Python also runs on PythonAnywhere and supports the new X DevAPI for development with MySQL Server 8.0.

### 8.2.3 AWS Mobile

AWS Mobile is a suite of Amazon Web Services designed to allow developers to build, test, and configure cloud-based applications for mobile devices. AWS Mobile packages available tools as consoles, allowing for quick selection of desired features and integrate them into code. There are a variety of tools available on the platform. Such tools include; push notifications, content delivery, back-end services, end-user management, and so on. AWS Mobile utilises an array of native services, including Amazon Mobile Analytics, Amazon DynamoDB, and Amazon Simple Notification Service to provide these features. There is no limit to how many projects a developer can create using the platform. The service auto-provisions application resources for projects in Android, iOS, Objective-C or Swift. A quick-start app project can also be downloaded to demonstrate integrated features. AWS Mobile can then test and monitor the usage of said application.

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