

# **Software Engineering Project Management**

## **Personal Food Log App**

### **Project Report**

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# 1. Project Overview

## 1.1 Purpose, Scope and Objectives

### Purpose

The purpose of this project is to make a cross-platform application which will calculate the calories intake. The project consists of two steps: identifying food from an image and then estimating the food calorie.

In our project plan, we are proposing a new deep learning-based algorithm to address this challenge.

### Objective

The main objective of this project is:

1. To create a cross platform application for food image recognition
2. Calorie Estimation from the image.

### Scope

1. This application will work for Android and IOS version beyond 3.0.
2. It can't recognize the smallest of the spices like oil, salt, pepper etc.
3. Food items which can be recognized by the application is limited to Ottawa region.
4. Software tool License will be provided by the company

## 1.2 Assumptions and Constraints

### 1.2.1 Assumptions

1. We have assumed that the workers need not to be trained a lot. The staff is highly skilled and have an average experience of at least 5 years.
2. There is historical data related to the similar application.
3. We have added Transportation and Maintenance cost in Assumptions.

### 1.2.2 Constraints

1. If the platform or software gets outdated.
2. Training unskilled developers can take more time based on their skills which may effect the estimated budget.

## 1.3 Project deliverables

Deliverables after each phase	Timeline	Description
Front-end Design	1/11/2019-12/12/2019	Front end (User Interface Design) including menu
Camera Functionality	12/12/2019-2/1/2020	Camera function to click picture of food

Image Recognition	26/3/2020-6/5/2020	Artificial intelligence to recognize food image
Weight & Calorie Estimation	6/5/2020-28/7/2020	AI methods for calorie and weight estimation
Backend User and Image Dataset	31/8/2020-6/11/2020	Interacting with AWS for user & image dataset
Frontend & Backend Communication	6/11/2020-1/1/2020	Connecting frontend & backend
Documentation	26/2/2021-26/3/2021	Documentation includes readme file
Deployment	26/3/2021-9/4/2021	Final deployment (delivery of project)

Table 1: Project Deliverables

## 1.4 Schedule and Budget Summary

The details for the budget are explained in the Budget Allocation section.

Requirement	Description	Cost (In CAD)
Project Manager	Managing Project	98,000 (per year)
Google Play Services	For uploading Application on Android Platform	25 (Registration fee)
Apple App Store	For uploading Application on IOS Platform	99 (Per year)
Server (Cloud)	Amazon Web Services	403,750
AI Programmers (Model Training)	Coding time	379,246
Testing	Human Effort	190,000
Backend (Data Collection)	Human Effort	253,333
Quality Assurance Analyst	Human Effort	159,916
Documentation Writer	For all the documentation purpose	17 (per hour)

Table 2: Schedule and Budget Summary

The estimated budget cost is based upon the time duration of the project, which is 1 year 7 months.

The approx total cost is around 1,486,129 (CAD)

## 2. Project Organization

### 2.1 External Interfaces

There will be frequent meetings with the client regarding the project. Project deliverables will be discussed and if possible, more features can be added/dropped according to the budget. The software development team will be the parent organization. The customer will be the client itself. There will be formal communication between the client and the team. The communication is done face to face. All team members are expected to participate in the client

meetings.

## 2.2 Internal Structure

We are having a team of 19 professionals.

1. A development manager
2. Two analysts who have extensive experience in developing applications
3. One programmer/analyst who has extensive experience with this specific type of application
4. Eight programmers with five or more years of experience in developing applications
5. Seven programmers with less than five years of experience

## 2.3 Roles & Responsibilities

Roles	Responsibilities
Project Manager	<ul style="list-style-type: none"><li>• Leads the team in the development of the Schedule Management Plan.</li><li>• Reviews, evaluates and provides feedback on reports</li><li>• Provides regular status information in meetings with the Project Sponsor and steering committees.</li></ul>
QA Analyst and Testers	<ul style="list-style-type: none"><li>• Quality assurance</li><li>• Testing the code for</li></ul>
UI Designers and AI programmers	<ul style="list-style-type: none"><li>• Designing the UI interface</li><li>• Training the AI model</li></ul>
Technical writer	<ul style="list-style-type: none"><li>• Responsible for all the documentation of the project</li></ul>

Table 3: Roles & Responsibilities

## 3. Managerial Process Plans.

### 3.1 Startup Plan

#### 3.1.1 Estimates

During the early stages of the project we have used Analogous method to estimate the cost of the project which uses historical data. As it is less accurate, so we have used Bottom-Up method for estimating cost. The whole project is divided into small components and cost of each component is computed and finally, it is aggregated to determine the project's cost estimate. The total budget cost is based on the time duration of the project which is one year and seven months.

Requirement	Description	Cost (In CAD)
Project Manager	Managing Project	98000 (per year)
Google Play Services	For uploading Application on Android Platform	25 (Registration fee)
Apple App Store	For uploading Application on IOS Platform	99 (Per year)



Server (Cloud)	Amazon Web Services	403750
AI Programmers (Model Training)	Coding time	379,246
Testing	Human Effort	190,000
Backend (Data Collection)	Human Effort	253,333
Quality Assurance Analyst	Human Effort	159,916
Documentation Writer	For all the documentation purpose	17 (per hour)

Table 4: Estimates

The total estimated cost according to these different costs will be around 1,486,129(CAD)

### 3.1.2 Staffing

Name	Description	Skill level
1 development manager	For managing the development of application	Expert
2 analysts	Experienced in developing applications	Moderate
1 specialist	Experienced in designing food recognition applications	Expert
5 programmers (front end) with more than 5 years of experience	For designing the application	Expert
2 programmers (artificial intelligence)	For working on the artificial intelligence	Expert
3 testers	For testing the working of application	Moderate
3 back end programmers	Dealing with the database	Moderate
Technical writer	Dealing with documentation	Expert
Backup team	For replacing the team in extreme cases	Moderate

Table 5: Staffing

### 3.1.3 Project Staff Training

Type of training	Number of people	Training method	Description
Technical	4	Lectures, computer-assisted training	Training given related to developing the applications

Supporting activities skills	4	Computer-assisted training	Related to tools used for developing and testing
Managerial	2	Mentoring	Management skills

Table 6: Staff Training

## 3.2 Work Plan

There will be different categories (Layers) in the project. The basic architecture of the project is as follows:

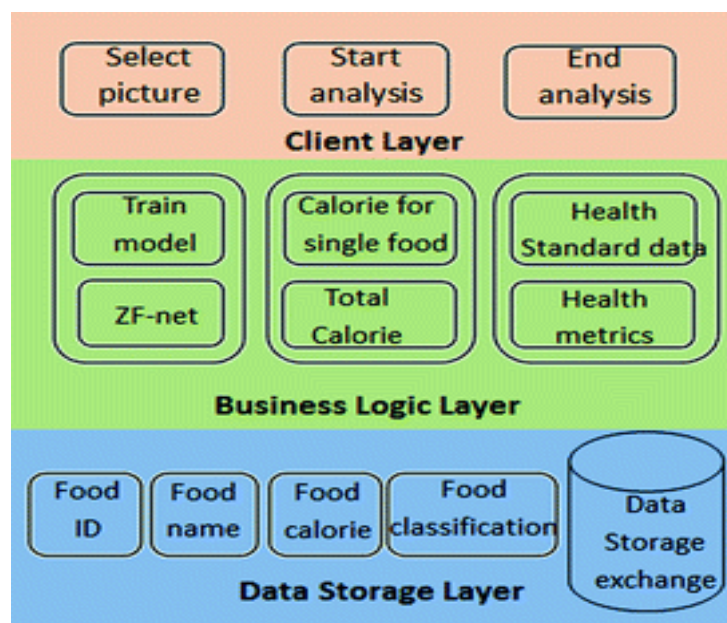


Figure 1: Work Plan

### 3.2.1 Work Breakdown Structure

The below work breakdown structure depicts various activities to be accomplished as part of this.[1]

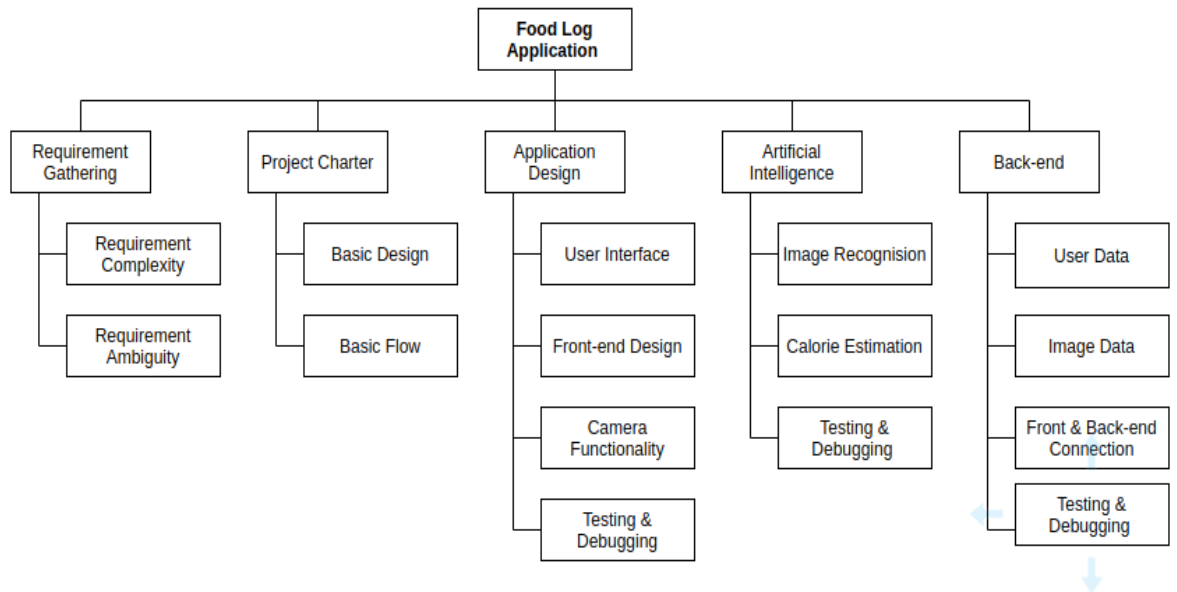


Figure 2: Work breakdown Structure A

Moreover, another Work breakdown structure has been maintained by considering all the possible risk factors.

The methods to avoid and to further deal with these risks are mentioned in the Risk Management Section.

We have tried to include all the possible risks in the below structure:

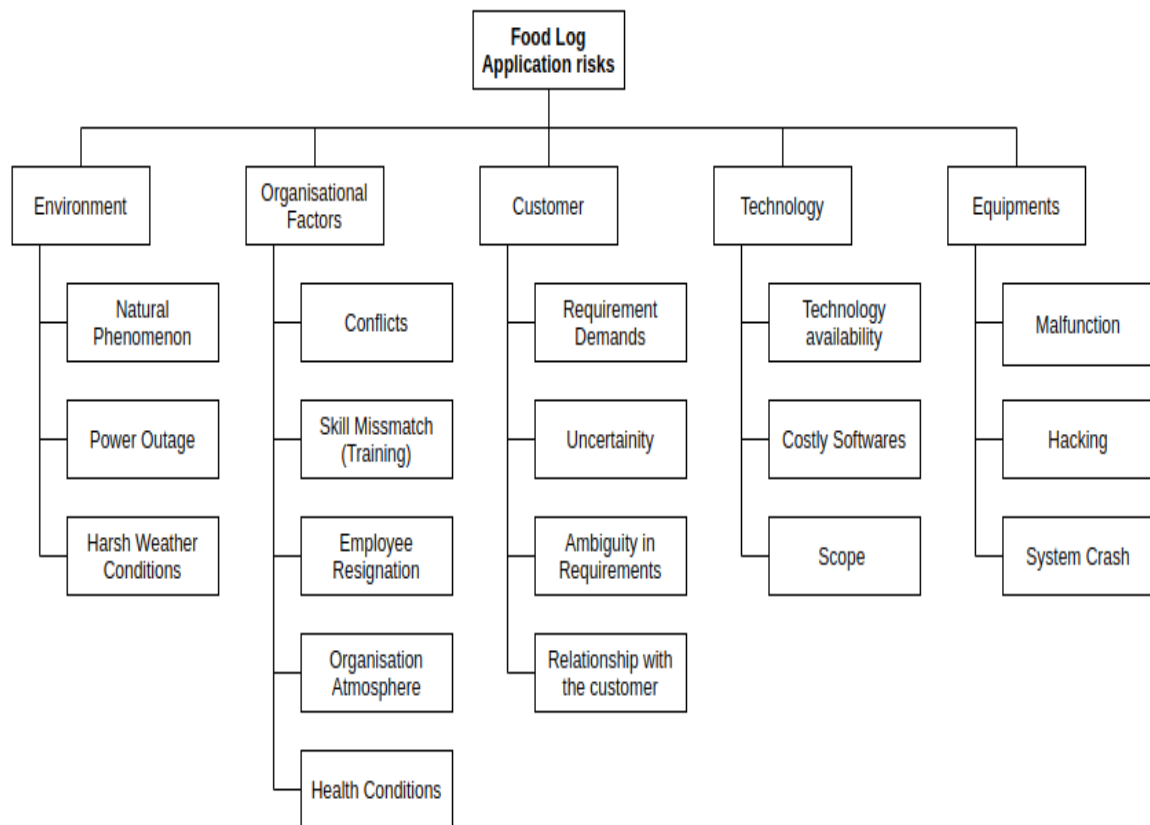


Figure 3: Work Breakdown Structure B

### 3.2.2 Schedule Allocation

We have depicted the schedule of our project using a free and open source project management tool, that is: Open Proj.

The below diagram depicts how a Gantt Chart of our estimated development timeline. The tasks identified in the timeline were to be completed by the group members. We managed to follow the timeline to an acceptable degree.[2]

Thus, this chart represents the timeline with respect to particular activity of the project.

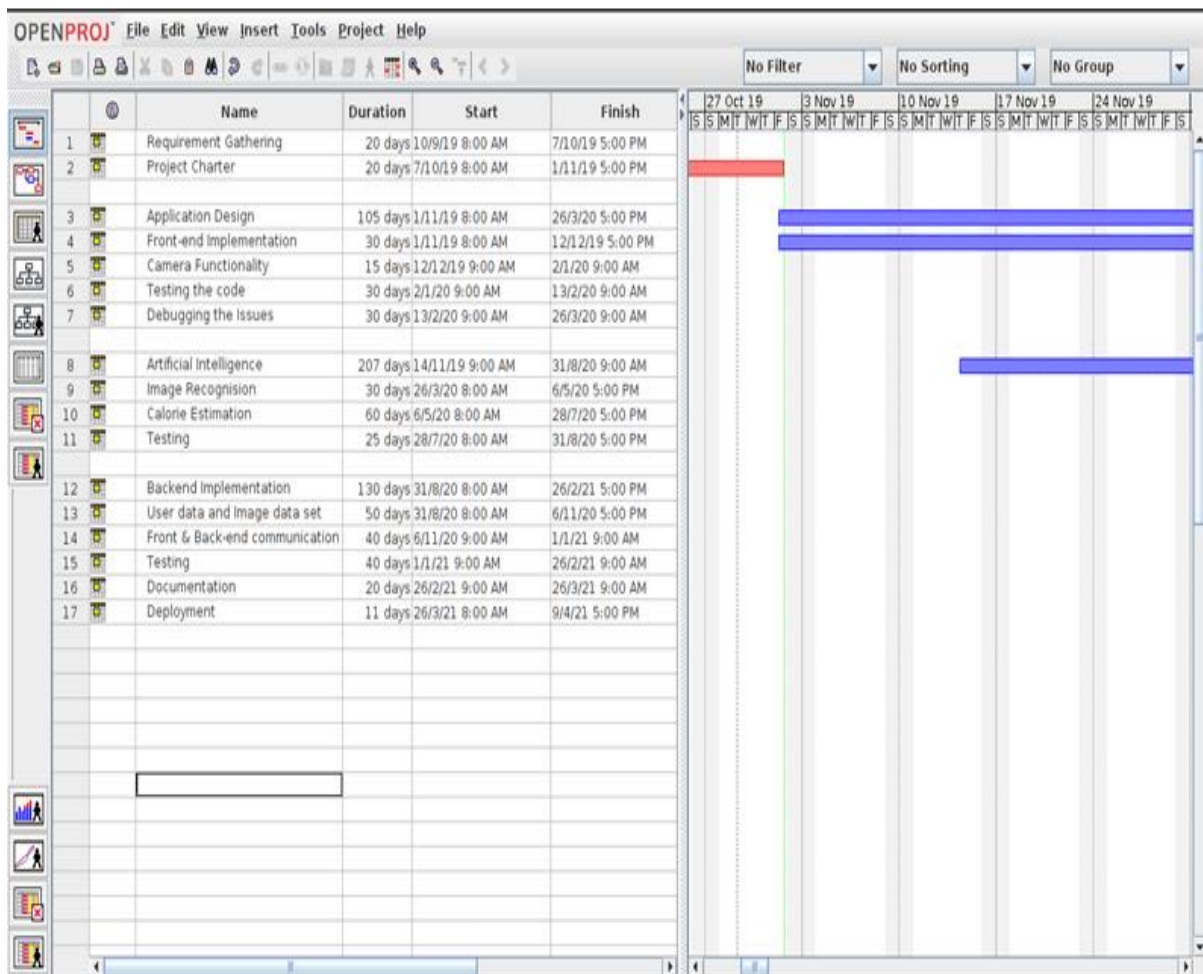


Figure 4: Schedule Allocation A

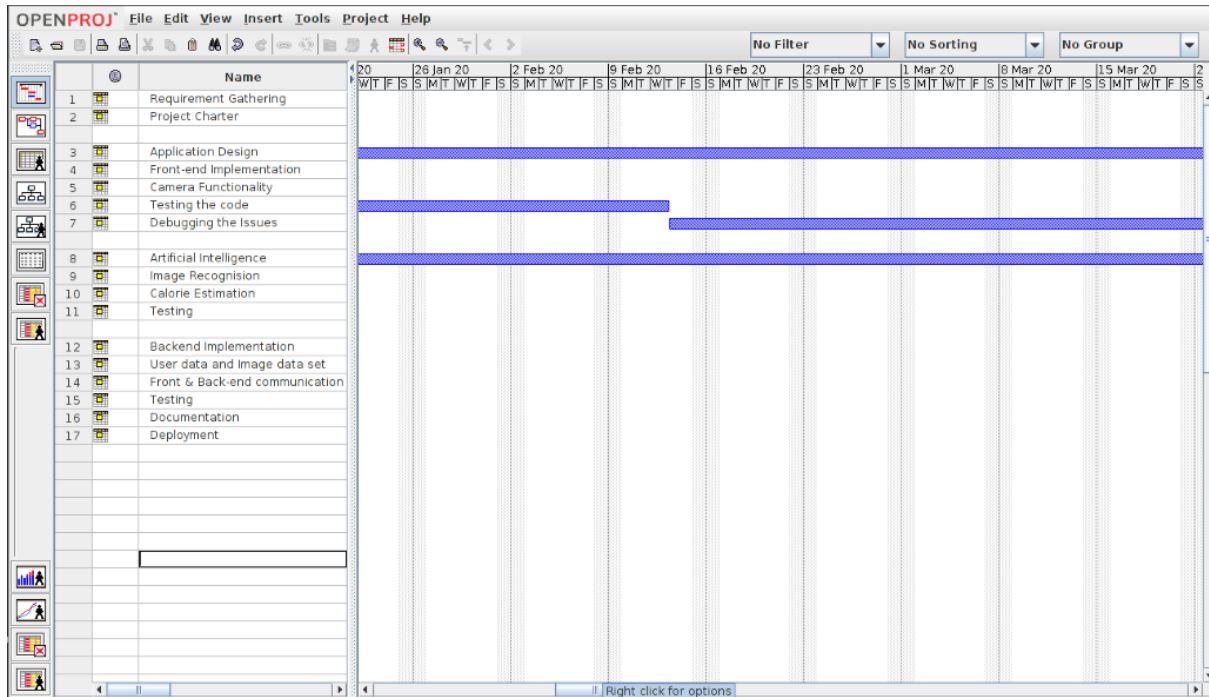


Figure 5: Schedule Allocation B

### 3.2.3 Resource Allocation

A structure is made to assign different resources for different activity. We have managed the resources by aligning them with particular project tasks.

Below is the Resource breakdown Structure:

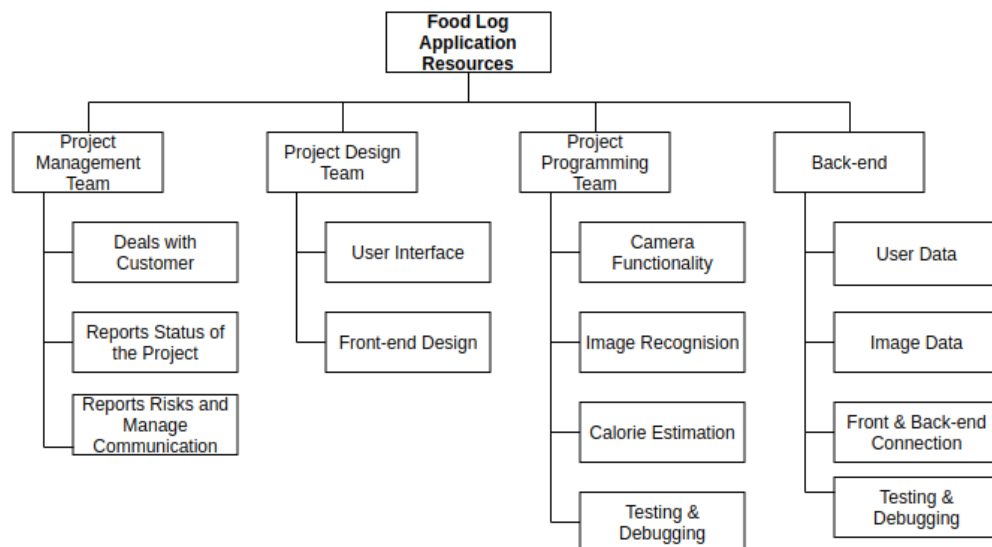


Figure 6: Resource Allocation

Moreover, a Gantt chart is prepared to assign different tasks to different resources based on their skill set.

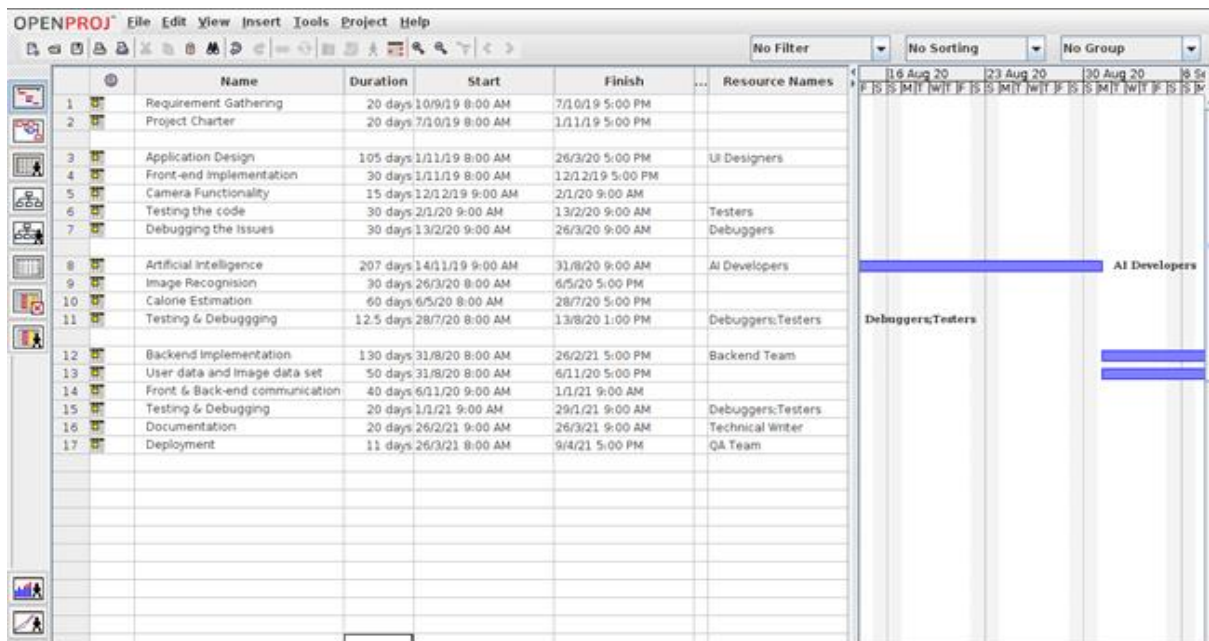


Figure 7: Resource

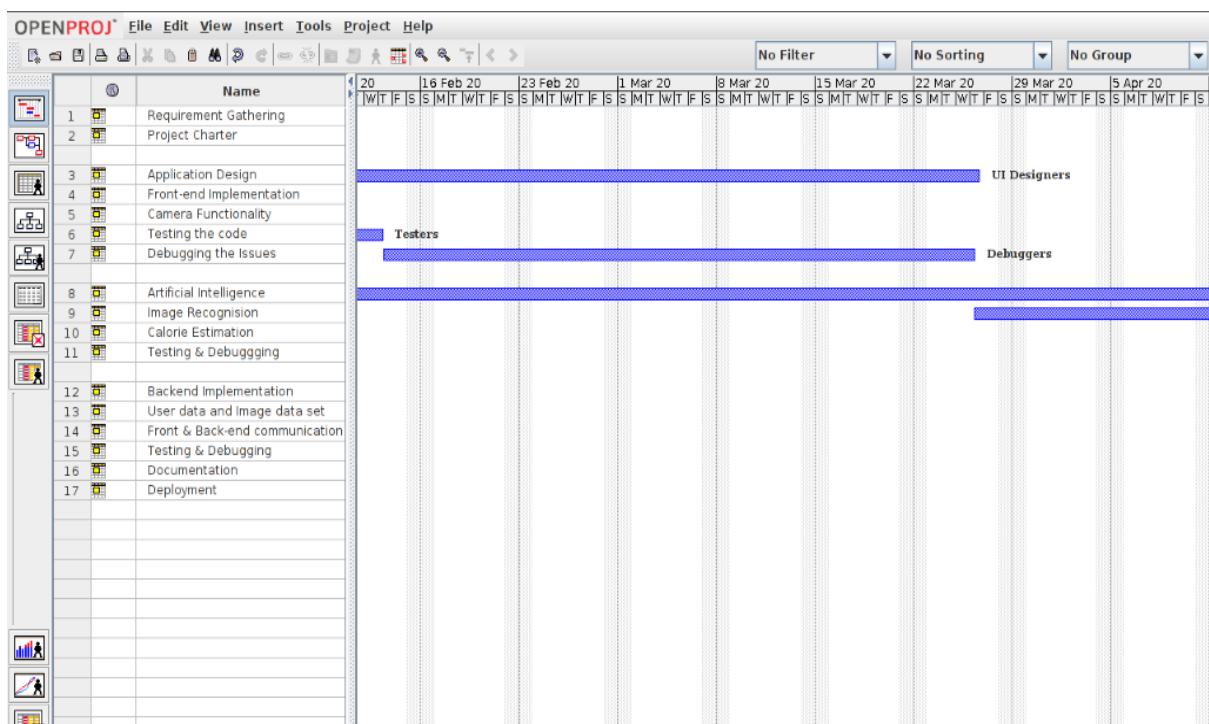


Figure 8: Resource

### 3.2.3 Budget Allocation

The main thing regarding profit calculation is money. It's obvious that you want to develop an app with a minimum cost without compromising on the quality.[5][6]

Requirement	Description	Cost (In CAD)
Project Manager	Managing Project	98000 (per year)
Google Play Services	For uploading Application on Android Platform	25 (Registration fee)
Apple App Store	For uploading Application on IOS Platform	99 (Per year)
Server (Cloud)	Amazon Web Services	403750
AI Programmers (Model Training)	Coding time	379,246
Testing	Human Effort	190,000
Backend (Data Collection)	Human Effort	253,333
Quality Assurance Analyst	Human Effort	159,916
Documentation Writer	For all the documentation purpose	17 (per hour)

Table 7: Budget Allocation

The budget is designed based on the distribution of resources [7]. Resources are assigned particular work. The team will be prepared as follows:

Employee Strength	Role
1	Development (Project) Manager
4	AI Developers
4	Testers
3	Backend Team
3	Frontend Team
2	Technical Writer
2	QA Analyst

Table 8: Employee Strength

### 3.3 Project Tracking Plan

#### 3.3.1 Requirements Management

It's not possible to have all the requirements in the start. It's obvious that the requirements will change, or new requirements will be added till the completion of the project.

##### A) Prototyping

The main idea behind showing the prototype or the basic proof of concept is to present something real which the customer can understand. As the prototype is demonstrated to the customer, it becomes possible to bring new changes and modify the existing in the final product.



### **B) Reviews**

It's beneficial for the final product to have reviews. Our team is planning to conduct Reviews after every milestone so that we could change it for better in the starting phase only before integrating with other modules.

Reviews could be in paperwork form, online forms etc. Reviews would be taken from the customer as well which will also help in increasing customer engagement.

### **C) Requirement Traceability**

It helps in risk reduction, and we will use traceability matrix in this project. We will be using Bi-directional traceability matrix which ensures that all the requirements will be covered and tested using test cases.

Traceability means that every deliverable produced after each milestone should be traced back to the requirements document. It will also be traced using meetings as well as design and code walkthroughs.

## **3.3.2 Schedule Control**

A plan is just the beginning but handling the schedule and monitoring the progress is the major task.

We are planning to use Project Management tools, which will help the organization in creating Timeline charts, Resource allocation and thus keeping an eye on daily progress and the timely completion of tasks.

### **A) Having Milestones**

Milestones depicts the beginning and the ending of a project. We will divide the project into different stages to monitor the progress of each module on time. Here, each time we complete the milestone on time, we will get to know that the things are going as planned or not.

Thus, we will assign each activity or task of this project as a Milestone.

### **B) Having Deadlines**

Deadlines are important to track the project progress. As the project is divided into different parts thus deadline to complete that particular activity will be assigned with that task.

### **C) Tools Used**

A project management tool will be used to monitor the resources and the work done by them on time. We are planning to use OpenProj tool which is a free and open-source tool. Thus, there would not be any expense for this tool.

## **3.3.3 Budget Control**

Budget control is a must for any organization. The team is prepared to work under a controlled budget. Following methods will be used for budgeting purpose:

1. Listing of every single thing will be done from the start to end. In this way, our team members will be aware of everything from the beginning.
2. The team will work according to the set plan and in this way the project will get completed timely and with proper budget.

3. The team members will also consider the risk mitigation cost if there would be any need till the completion of project. But the team will consider the probability and impact of risks and will try to overcome them.

### **3.3.4 Quality Control**

Quality control management is essential to provide the best deliverable in the end. Quality Assurance can be done in no. of steps.

Quality can be maintained by detecting errors at early stage and solving them in that phase only. Moreover, it can be achieved by using proper standards.

We will be checking the deliverables after every phase for quality assurance. Further, for coding part also, proper standards will be followed.

### **3.3.5 Reporting**

Communication is the major part of a company which leads to timely problem solving. We have used tools in our organization to communicate with other team members regarding different technologies, any issues etc.

There are many tools like Slack, Online communication platforms, Skype for Business and many more which can be used as its not feasible to visit in the cabin every now and then.

### **3.3.6 Project Metrics**



Figure 9: OpenProj Logo

The team will be using Open Proj tool as a Project management tool which helps in creating the Gantt charts, Work breakdown structures and many more network, activity structures Budget which we will be using for the project planning.

Apart from that, the manager is also planning use Open Project tool as it's also very efficient and useful in terms of assigning tasks, milestones etc.

The Project metrics is useful for planning:

1. Work Breakdown Structure

2. Resource Breakdown Structure
3. Project timeline using Gantt Chart
4. Milestones

## 3.4 Risk Management Plan

### 3.4.1 Risk Identification

Even the most carefully planned project can run into trouble. Problems are likely to occur even after a lot of planning, like Team members get sick or quit, resources that you were depending on turn out to be unavailable, bugs, even the weather conditions etc.

So, to deal with such issues, we will always try to depict the possible risks from the start of the project so that our team would be able to find the solution for these risks.

Risk Identification will be a constant topic throughout the project. Risk identification consists of determining which risks are likely to affect the project and documenting the characteristics of each. Risk communication brings risk factors or events to the attention of the project manager and project team.

### 3.4.2 Risk Mitigation

Risk mitigation has two major steps:

- Identifying various activities to reduce the probability and/or impact of a risk.
- A Plan to deal with the risks.

The table depicts the possible risks with their mitigation techniques.

Risk	Consequence	Probability of Occurrence	Impact	Mitigation Methods
Bugs	Code not working properly	1	5	To understand the code first before writing it. Moreover, to check it after completion of every phase.
Miscommunication and Objectives	Requirements not met	1	5	Communication amongst team members during meetings. Also, by organizing meet ups at regular intervals.
System Crash	Rework	2	4	Taking backup of the work side by side. Using version control systems to save different versions of the code.
Training	Extra time to train employees	2	4	To involve under skilled employees from the start so that they would learn from the experienced developers. Also, so that they would know the flow from the starting.

Employee Health	Extra time to complete that particular phase or else over time	3	4	Work will be divided amongst employees so that in worst situation other developer could continue the work.
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Table 9: Risk Mitigation

### 3.5 Project Closeout Plan

This Food Logging Application Project will end on 15<sup>th</sup> February 2020.  
The team will provide following deliverables as part of project closeout:

1. Providing the customer, a copy of all the documents in electronic format.
2. Archive all the project's artifacts (documents, source code, project plans, user documentation etc.).

## 4. Technical Process Plan

### 4.1 Process Model

The development of this project will be divided into different phases and each phase will display a complete development cycle and along with the various functionalities of the system which will be delivered at the end of each phase. The phased approach will be an advantage for our project as this approach will provide flexibility in what the team will deliver, it will give our team an opportunity to reassess the effort for every phase and the content of each phase can be changed at any stage of the project by the client as well as the team.

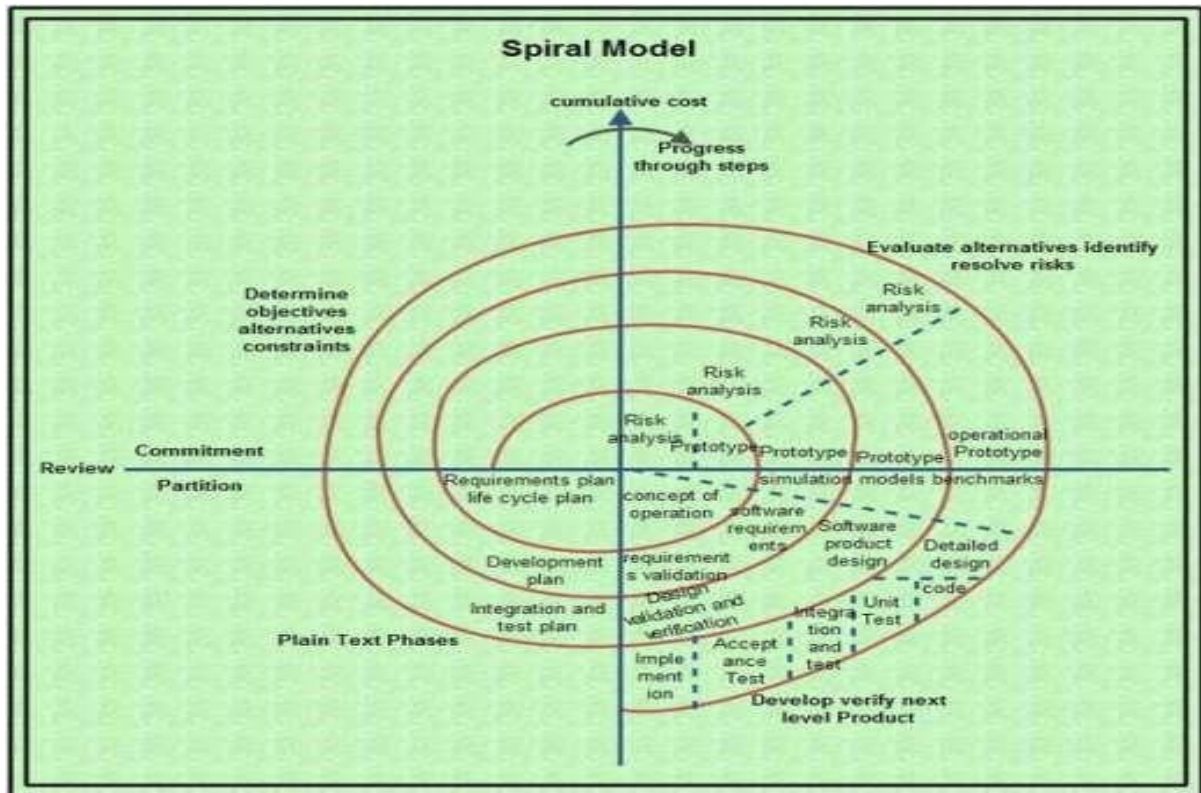


Figure 10: Spiral Model

We will be using spiral model as a process model in this project. Spiral model will be very beneficial for our development team as all the activities in this model are organized in a spiral and has many cycles. It will analyze all the requirement problems while the development team will work on the prototype. Spiral model will also guide and measures the need of risk management in every cycle of each model. Until the application development is finished, model will include activities such as typical requirements of the project, design and coding of the application.

Our team will follow the spiral model in the following steps:

- Each cycle of the first quadrant of the plan will begin with identifying the goals for the respected cycle. It will also analyze the alternatives which can be possible in completing the goals.
- The second step will evaluate the alternatives based on the objectives as well as the constraints of the project. This will identify the uncertainty so that the technical team can ready themselves and will work on them.
- The third quadrant of the project will include the final software development while considering the possible risks at that stage of project. These risks will be regarding planning, configuration management, quality assurance, verification and testing.
- At last, the last quadrant will plan the next step and will include planning for the next prototype which will include requirement plan, development plan, integration plan and test plan.

The key feature of spiral model is that each cycle will be completed by the reviews conducted by the individual or users of our project. These reviews will be related to intermediate products which will be developed during the cycles. In addition, spiral model will also include the plan for the next cycle.

## 4.2 Methods, Tools, and Techniques

### 4.2.1 Image Recognition and Calorie Estimation

In this, an algorithm is proposed which detects combinations of food items. Each of the training images contains only a single food item, while the testing images may contain multiple food items. The labels of food items will be predicted, and estimated number of calories will be displayed.

#### 4.2.1.1 Bounding Circle

In this the background is removed from the main objects by drawing a circle around the food place. There will be single boundary for multiple food items and there is no requirement for rounding each food items separately.

#### 4.2.1.2 Data Sending to Cloud

We will do our processing and storage in the cloud in order to reduce the processing time and battery usage for the mobile device. To distribute the data and process it across Amazon EC2 instances Hadoop will be used.

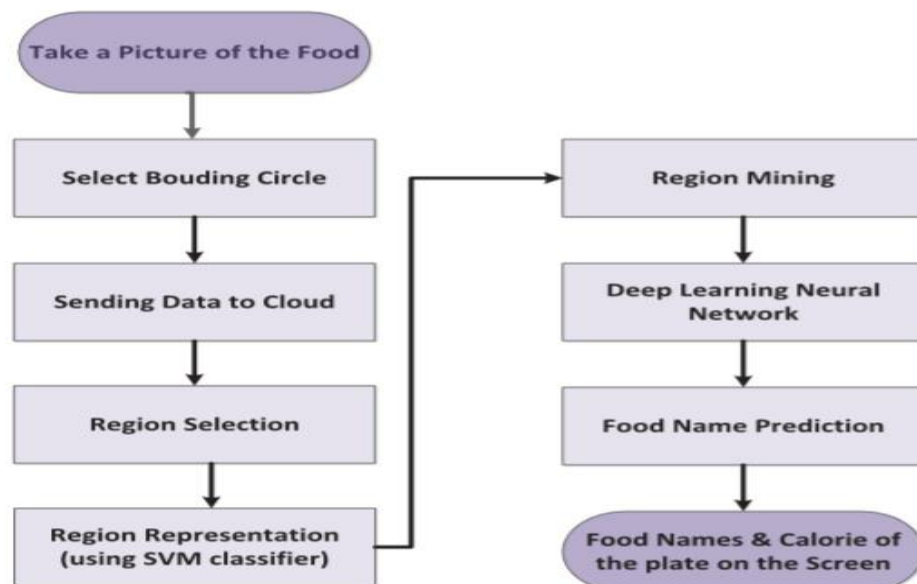


Figure 11: Block Diagram

#### 4.2.1.3 Region Collection

Selective Search is used to generate region proposals for multiple food detection. Super-pixels are grouped to generate a hierarchy of small to large regions. Usually, more than 1,000 regions

are generated for a single image. Further candidate regions are filtered based on their size and aspect ratio. Because of this simple, logical filtering process, the number of proposed regions per image are decreased from about 1,000 to about 150. This decrease significantly improved the speed and accuracy of the subsequent procedures.

#### **4.2.1.4 Region Description**

To represent the regions in the featured space, extracting features is an important component of object detection. We will use Deep-learning framework to enumerate the feature vectors of the proposed regions. Later, a feature matrix of  $150 \times 4,096$  is computed for each image which is used as the input data.

#### **4.2.1.5 Region Mining**

It finds two types of regions from all the proposed regions of training images. For positive regions, as different proposed regions have different kinds of differences toward the target object class, a region mining procedure evaluates the discrimination to discover the positive regions that would best differentiate the target object class from the backgrounds. Hard-negative regions consist of two parts: the background regions from positive images belong to the same class, and the regions from negative images belong to other classes.

#### **4.2.1.6 Deep Learning**

In order to recognize the food object and measuring its calorie content we will use deep learning which gives us high accuracy. This approach will give the estimated distance from the food object and later calibrate the image size to measure calorie content.

Deep learning methodology which is specific to food images enable the system to recognize the features of food based on color, contour, size and texture in order to classify the food object with full accuracy. This method will train the deep learning network with different food classes image sets and generating food image specific trained model files and using it further to classify the food images.

The most efficient algorithms when the training set is large and redundant is Stochastic gradient descent which uses the support vector machine. There are two techniques used in classification of food object. After training our food images, the modal file will be generated later segmentation is performed and the features are extracted that were further written in hidden layers in the deep network. We will generate the results of the classification after customizing the top-level feature layer.



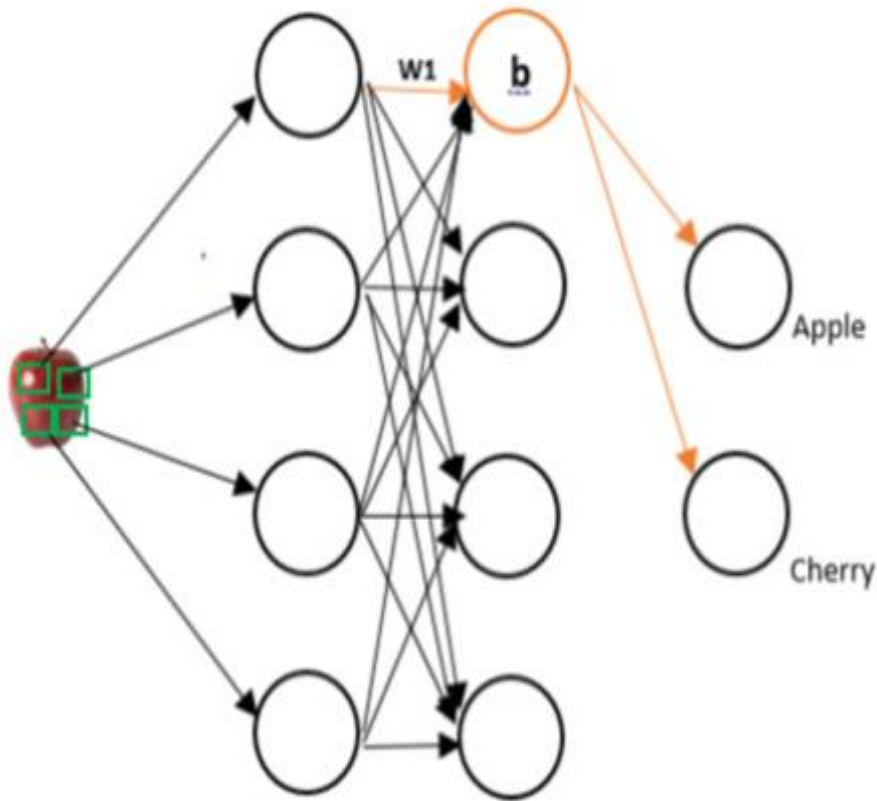


Figure 12: Implementation of Stochastic Gradient Descent

#### 4.2.1.7 Calorie Estimation

According to recent study, deep learning is one of the proficient and power methods that will be used in our project for image recognition. Image recognition is used in this project for food calorie measurement system. Deep learning will use CNN known as convolution neural network, it will be basically used to recognize food portions more precisely and with more ease. As we know, food items are widely classified, due to this huge variety of food items, it became difficult to distinguish between these different food items. But CNN solves our problem as it detects and recognizes food images through parameter optimization. In our application, it will construct a dataset of the most frequent food in an independent available food logging system and utilized it with the convolution neural network which will recognize and able to distinguish between different food items and therefore will measure their calories.



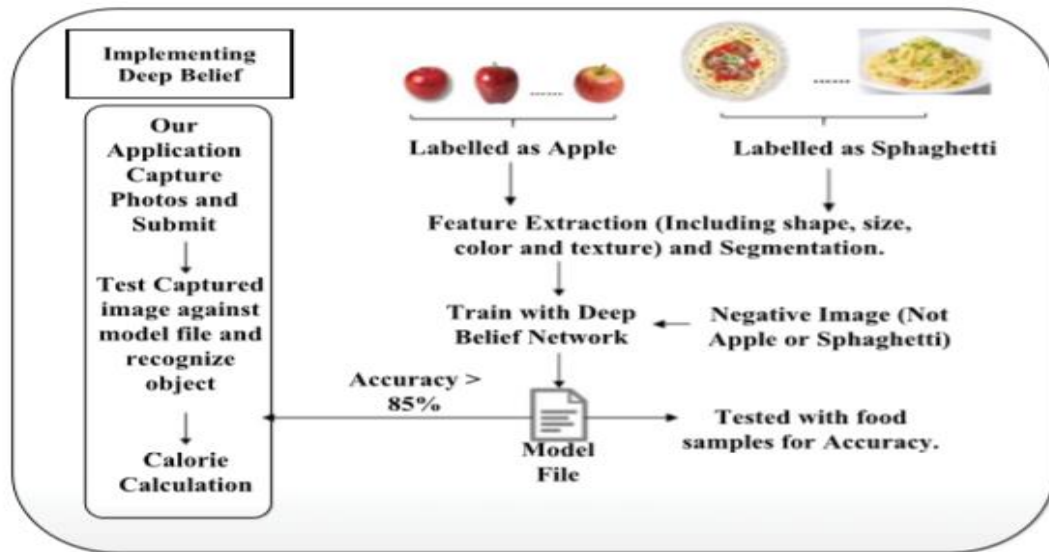


Figure 13: Calorie Estimation

## Programming Languages

As this is a mobile application that will utilize the cloud computing and databases, there is a need to draw from a wealth of technologies before finalizing which will be used in the project. As our main aim is to build an android and IOS application as well as many machine learning frameworks that utilizes object-oriented programming named as Python.

- **Android:** It is a well-known open source cellphone operating system which is known for its easy utilization and development. It is designed for touch screen mobile phones such as smartphones and tablets. Android's default UI is based on the direct manipulation which means utilizing touch points inputs that loosely correspond to real-world action that are similar to swiping, pinching, tapping to manipulate on-screen objects. It will be easier for them to develop an application on android because it provides a lot of libraries and resources. It is also used all over the world which makes it easier to find people willing to test the application in the future.
- **Java:** It is an object-oriented programming language and is also considered as the official language used in the application development of android. Since the application is developed on the android, Java is the best option for application development as it is considered as the primary language for the android. In addition, several members of our team are experienced with the language because of its syntactic similarity to C++.
- **Objective C:** It is a powerful, intuitive and object-oriented programming language that is widely used for an IOS application development. Our Special IOS developers will use this language for IOS application development.
- **Python:** It is a kind of high-level scripting language widely utilized in the data science applications. Python will be used in this project because of its greatly used in the data science applications, as well as it has an easy syntax which makes it easier to read and

write. Along with java, it has also extensive libraries for machine learning and image recognition. These both are instrumental in the project.

- **TensorFlow:** It is an open-source software library that is used for dataflow programming and machine learning. It is considered as machine learning python libraries which uses very concise language in comparative to other libraries. It has the ability to make use of computer's graphics processing unit to speed up the model training. It's ability of image recognition API is the primary category of library that will be used in the project.
- **Google Compute Engine (GCE):** It is a kind of on demand cloud computing platform provider. The basic need of the application is to be reasonably fast and low weight. To achieve this, we need machine learning computations to be completed outside of the phone. Therefore, the team is using a cloud server to determine images and send results back to the client while maintaining 100% uptime and scalability.
- **JSON:** It is a type of data format that is mostly used while dealing with the databases and machine learning. JSON files will be the preferred format for data packets that are sent back from GCE, because it is readable across various programming languages. The feature of "dictionary" style formatting of JSON makes easier for sending unordered coordinate and image classification data.
- **Firebase:** It provides a platform for mobile application development and testing software. It is mainly utilized for authentication of integrating google accounts in our application. Due to its help, we do not have to store or develop the authentication services by our self. It is also utilized in the project to store every client's food journal activities, uploaded images and also it keeps a track of information connected with each food item so that our model will be able to recognize it.

## Architecture

The system will be using a client-server architecture because the functionalities of the client program and the server database must be separated as per the request by the programmers. The user will take the picture on the client side and sends them to the server for processing. Once the server will receive the information, it will examine the image by image recognition model and returns the suite of data related to the recognize food and calories so that it can be displayed back on the client side. The machine learning model itself developed and trained on our personal systems which are totally separated from these working systems. The server uses this machine learning model to determine the image sent to it. In addition, the data of user will be stored on the Google Firebase data instance tied with each individual account.

### 4.3 Infrastructure

In this section we have focused on the hardware, operating system, network and software.

- **Storage:** Amazon Web Services (AWS) is used to store the image data set. AWS basically provides on-demand cloud computing platforms and APIs to individuals, companies, and governments, on a pay rate.

- **GUI:** The GUI of the application will be programmed by using cross platform Layout editor. It is a built-in feature for Android Studio and provides various of useful tools for the creation of dynamic activities
- **Application Testing Tools:** The testing team will be working upon the following testing tools to create a nearly bug free project. Some of the tools are as below.
  - a. **Appium Studio:** It is an open source automation testing tool used for testing android mobile application and IOS application. It will allow our testers to test variety of applications such as hybrid, native and mobile web. Using Appium, our testers can test our application on mobile, tablets, etc. It makes mobile application regression testing easy. It is widely used in the world which makes easier for us to test anywhere in the world.[8]
  - b. **ExperiTest:** It will be used in the project as a testing tool because it creates and execute more than hundreds of manuals as well as automated tests on one thousand plus real IOS and android devices in the cloud. Our testers will utilize its real-time interaction and debugging with the application. Its biggest advantage is that it speeds up the mobile testing cycles and increase the quality of our releases. It will provide our team visual testing report and advanced analytics.[8]
  - c. **Selendroid:** It is proficient testing tool which will provide our developers an automation framework that will drive off the UI of android native as well as hybrid applications and the mobile app. It will play a vital role in testing as it is highly compatible with JSON wire protocol. Another advantage is that it will interact with multiple android phones and tablets.[8]

#### 4.4 Product Acceptance

Deliverables after each phase	Acceptance criteria
Front-end Design	Front end (User Interface Design) including menu and changes can be made in accordance with the demand of the client
Camera Functionality	Must click the picture
Image Recognition	It should at least recognize the food items individually
Weight & Calorie Estimation	External objects (like user thumb or coin) are unacceptable
Backend User and Image Dataset	It should be fast and scalable so that it can handle large amount of data
Final product	It must work on android and iOS system. In addition, if it is working on desktop then it is also acceptable.

Table 10: Product Acceptance

Above is the table shown for the acceptance criteria for different stages of the project

## 5. Supporting Project Plans

### 5.1 Configuration Management

The team will manage release management and saving different configurations i.e different versions of a system using a version control system like GIT.

On GIT, we can easily manage project versions.

#### Change Control Tools

In order to provide a central repository from which to manage the change control process, a collaborative tool such as the ProjectSolve<sup>2</sup> website is recommended.

The Project Solve shall be used for the following purposes:

- Provide a platform in which participating Centers may access developed software, interface definitions, and interface control documents;
- CCB agendas and minutes which document decisions and policy;
- Any policy or procedural documents;
- Test plans, procedures, and results;
- Submit change requests, repose approved and declined requests and changes pending CCB approval and implemented changes.

### 5.2 Verification and Validation

This section will include the tools, techniques and responsibilities for the verification and validation work activities.

#### 5.2.1 Verification

Verification includes static testing which does not include execution of code. So, our team will be verifying the progress and the deliverable after each phase using following methods:

##### 1. Walkthroughs

The code walkthrough will be done on regular intervals and also after completion of every phase.

##### 2. Inspection

Code Inspection will be beneficial at times. The team will be doing inspections which will help in avoiding the defects at a later stage.

##### 3. Desk Checking

Though desk checking is an informal way or can say a manual process for verifying the logic and algorithm before writing the exact code, but it's very helpful in Verification. As it leads to very less bugs in the logic.

#### 5.2.2 Validation

Validation includes the dynamic testing which covers execution of code. It is mainly the documented process which checks whether the process meets defined set of requirements.

For Validation purpose our team will work on following strategies:

1. As it means that the output should be accepted by the customer, so the deliverable after every milestone will be checked and compared with the requirements and the output expected from this phase.

2. Various kind of Validation process will be used by the team as such:

- **Prospective Validation**

This section will include the division of project into several steps, and then carefully analyzing the critical points.

- **Concurrent Validation**

It includes very close monitoring of all the steps in the project at times.

- **Re-Validation**

Periodic revalidation offers the chance to recheck the perfect functionality of system after any change. It checks the end result which should not be affected by an intended or unintended change.

## 5.3 Documentation

There are a number of documents that will be prepared during the lifetime of the project. All documents are made by the team members.

Below are the various documents prepared:

- Software Requirements specification (SRS) - defines the functionality that is required by the client.
- Design specifications – defines the structure of the system.
- Test scripts & results – tests that are executed have to be recorded.
- Risk analysis reports – involves risk handling issues.
- Defect log – log of all the defects and their current status.
- Change log – log of all requested changes.
- Metrics log – log of collected metrics data.
- Reviews – review documents of all phases of the project.

## 5.4 Quality Assurance

The quality assurance plan quality assurance plan is meant to ensure that the final deliverable will be of utmost quality.

The team will work on following activities to assure quality of this project:

1. **Policies and Procedures**

Proper standard and guidelines will be set for the team members and everything in the project will be done by following the set procedures.

2. **Regular Meetups and Feedbacks**

Meetings will be schedules at regular intervals to check the output after every phase and to check whether the quality standards are being followed.

3. **Measure Results**

Results will be measured after every phase to check the efficiency of method applied.

## 5.5 Reviews and Audits

### 5.5.1 Reviews

Reviews are kind of an external work which would be done by other individuals apart from the team which has been involved in the project from the start as they might be having a particular mindset regarding the functionalities and interface.

Therefore, periodic reviews will be conducted in form of paper or online survey to get feedback.

### 5.5.2 Audits

Project Audit comes under a formal review of project. Through Audits we will ensure the standards are being followed. The Audit department will be responsible for doing this.

Moreover, during meetings, the company employees who are not the part of this project could be included to give feedback and reviews for the betterment of the project.

## 5.6 Process Improvement



Figure 14: Process Improvement

Improving our work progress will not result in a huge operation if our team will start the project with small and incremental problems. It is not necessary for our team to read a textbook about any new methodologies to implement these process improvement techniques. These are a kind of improvement methods that can be implemented in a very quick and easy by the team. These methods will be implemented by our team in following steps:

- **Create a workflow:** In general terms, a workflow is the process that our team will use to get the tasks done. The status of the task is sometimes more complex than simply done or not done. Generally, the tasks of our projects will go through various stages before being completed. In addition, there will be phases in software development such as planning, doing, reviewing and deployment. The team will create a workflow explicit so that the developers can keep an eye on the inefficiencies and bottlenecks of the process. Taking the process through loops various times will reveal insights that will help the team to improve the workflow of the process.
- **Clean up backlog:** The team will be using Trello for managing backlogs in the project. The team don't want low priority work to keep them distracted, therefore it will be better to keep them on separate board altogether. The team will be deleting the tasks periodically that will no longer needed and if any case they are needed they will pop up again so that the team can work on it.
- **Have a clear definition of 'done':** Following are the things that will ensure that the tasks are completed:
  - All features are implemented.
  - Unit test are passing.
  - Documentations are up to date.
  - Features are reviewed by QA team.
  - Code is in master branch.
  - Code is deployed to production.
- **Control work in progress (WIP):** To increase the efficiency of the tasks, the team will be using Kanban board to limit multi-tasking. Kanban board will allow to specify the maximum number of tasks allowed on each column. Due to this, each developer will have a limitation on tasks and will restrict them to do more than specified tasks in each column of Kanban board. The advantage of WIP limits is that it will never stop the team to start a new task before completing the ongoing tasks. The team will follow them as warning signs rather than absolute rules.
- **Make progress visible:** Transparency is a very factor while working in a project. The tool named as Kanban will be used in our project to make the things clear and transparent not only to the team members but also to the team managers as well as the stake holders. Kanban will use a physical board on the wall or can be any other information radiator. The members of the project can just walk into the room and will see what current status of the tasks without disturbing other members of the project. As the human brain is literally designed to process visual information rapidly at a high bandwidth and Kanban takes the advantage of this and will always show information radiator to know our status of work just by glancing up. This process will limit spark conversation in our project which means fewer unpleasant surprises further down the road.

## 6. Conclusion

This report introduces the process of food data acquisition and includes the improvement process of the faster R-CNN algorithm, the network model, and the whole process of network



configuration, testing and training. In this report, the related algorithms are differentiated and determined by the AP and mAP of each type of food item. This shows how p-Faster R-Convolution Neural Network have dominance in a full range.

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