

IOT DEVICE TO DETECT ANEMIA

Project ID: 19-129

Project Proposal Report

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Systems and Network Engineering

Department of Information Systems Engineering

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Declaration of the Candidates & Supervisor

We declare that this is our own work and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

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Abstract

Anemia is a disease that is caused due to the lack of iron in the blood which eventually reduces the blood hemoglobin level. This causes lack of oxygen in the body. The ability to detect the disease at an early stage would lead to an early cure. If a person diagnosed with anemia cannot detect the disease at the early stage, then the potential of organ failures is vital thus could result in heart attack. In order to prevent this detecting, the disease at an early stage is vitally important. In order to achieve this, the team will be designing a device which has the ability to detect anemia with a high accuracy rate and giving the output to the patient so that the treatments can be taken an early stage. The device is built in a non-invasive method so that blood should not be taken and then data is sent to the server for processing and the user has to fill details in the app as well then would be able to get the results to the app.

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Chapter 01

1.0 Introduction

1.1 Research Problem

Anaemia, a disease that is mainly caused due to the reduction of iron in blood, which is a common blood disorder. If someone is carrying this disease, then the production of red blood cells in the body is low, which causes the protein known as haemoglobin to reduce. Reduction of haemoglobin would cause a major issue in the body, where it would reduce the amount of oxygen that would be carried in the blood would reduce. The reduction of this is a major issue because if the required amount of oxygen is not transferred to the organs then the organs would start to malfunction and sometimes organ failure could even be a possible outcome. This is like your body is starting to suffocate from within the body due to the lack of oxygen. This disease can be identified at the initial stage when a full blood count is taken if the amount of red blood cells is less than 12 grams per decilitre for women and 15 grams per decilitre the doctor would direct you for further testing because normally this reduction is caused due to anaemic conditions in the body. But to narrow down into the root cause the medical officer would direct those patients for further testing. Some of the identification symptoms that can be seen in an anaemic patient is that the patient would be having trouble in breathing. This is mainly caused due to the lack of red blood cells to carry oxygen, so the patient would develop heavily breathing conditions [1].

There are mainly 3 causes of Anaemia. The first is blood loss. When a person suffers from greater blood loss then a large amount of red blood cells is lost. During that time the production is not enough to cater the amount of red blood cells the body needs. The probability of women getting anaemia is high due to the blood loss during the menstrual cycle. Heavy menstrual cycle periods would cause larger blood loss making women more likely to carry this disease. Other types of blood loss could be caused due to the amount of blood that is lost during accidents and external bleeding due to surgery or due internal bleeding that is very hard to identify. The second cause of anaemia is due to the reduction in the production of red blood cells.

This condition can be caused by an iron lacking diet, medical condition such as cancer, AIDS or women who are pregnant also would be also anemic due lower production of red blood cells, children also can be anemic due to genetic disorders of not producing enough red blood cells. The last cause of anaemia is the increased amount of red blood cells destruction by the spleen. This can be caused due to certain diseases that would cause our own body to destroy more red blood cells from our body. The second reason for this to happen would be an enlarged spleen that is causing the destruction of red blood cells that would cause anemic conditions in the patients [2]. But there could also be other reasons like inability to absorb iron which a vital disorder that could last in anaemia soon, but this is a rare cause but the above mentioned three are the main causes of this disorder. So, identifying the disease early is the best solution for the patients suffering from this problem.

According to statistics obtained from the WHO, globally, anaemia affects 1.62 billion people (95% CI: 1.50–1.74 billion), which corresponds to 24.8% of the population (95% CI: 22.9–26.7%). This is a large amount of anaemia patients that has been recorded. The highest amount is seen in children, mainly in pre-school children. The statistics of WHO is mentioned below [3].

Table 1.1.1: Worldwide prevalence of anaemia [3]

Population group	Prevalence of anaemia		Population affected	
	Percent	95% CI	Number (millions)	95% CI
Preschool-age children	47.4	45.7-49.1	293	283-303
School-age children	25.4	19.9-30.9	305	238-371
Pregnant women	41.8	39.9-43.8	56	54-59
Non-pregnant women	30.2	28.7-31.6	468	446-491
Men	12.7	8.6-16.9	260	175-345
Elderly	23.9	18.3-29.4	164	126-202
Total population	24.8	22.9-26.7	1620	1500-1740

In Sri Lanka anaemia can also be detected in high amounts. In Sri Lanka the prevalence of anaemia is high among women. This can be seen from various surveys that was carried out in Sri Lanka. According to indexmundi, “Prevalence of anaemia among women of reproductive age (% of women ages 15-49) in Sri Lanka was 32.60 as of 2016. Its highest value over the past 26 years was 48.70 in 1990, while its lowest value was 30.10 in 2010” [4]. According to a report by the government of Sri Lanka, which was published in the year 2006/07 it shows a report where the anemic condition in school children also shows a caelestropic rate. Mild anemic conditions can be seen in many children which goes undetected. The statistics are shown below.

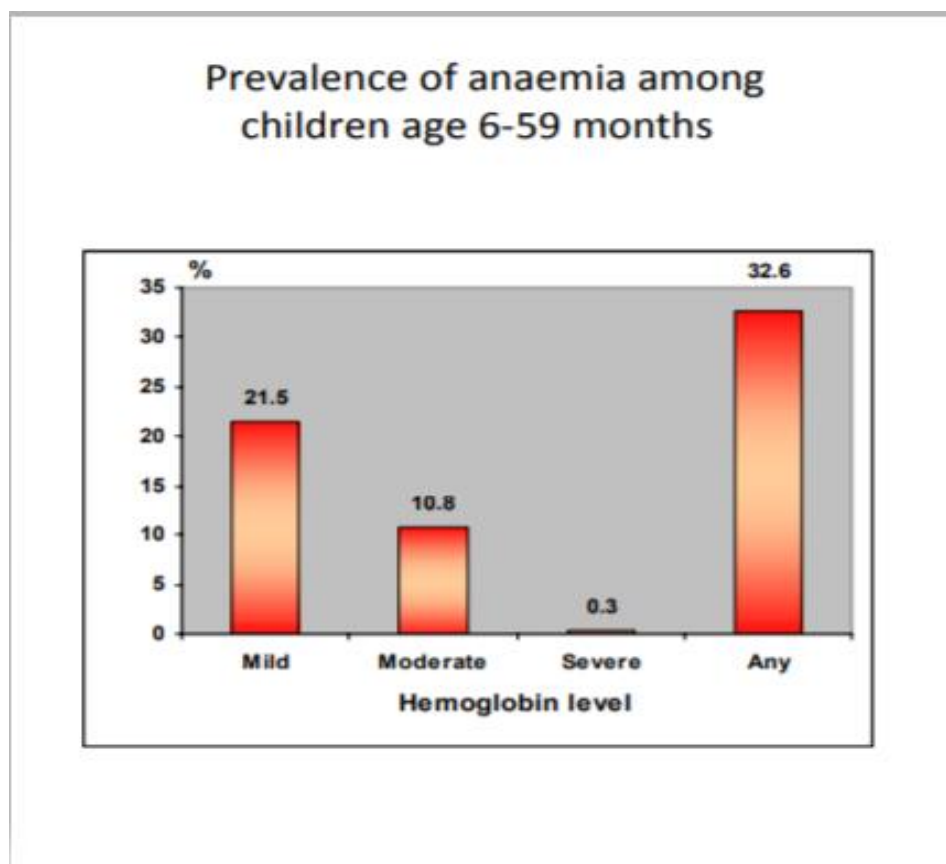


Figure 1.1.1: Anaemia among children [4]

Anaemia is a disease mainly caused due to loss of blood or sickle cell, should be treated as soon as possible. For treatment to happen early detection should be possible before it reaches severe conditions which may turn catastrophic for the patient. Some of the symptoms that can be observed in the patient are fatigue and is

vital to shortness of breath, or chest pain. So, to detect anaemia, the haemoglobin levels are accessed, and certain blood tests are carried out.

The above-mentioned process to detect anaemia is a time taking process so many people although they are infected by Anaemia goes undetected specially because there are no proper methods of measuring anaemia. In medicine it is well known fact that early detection leads for early cures. Therefore, the team is designing a device in order to detect anaemia without extracting blood.

1.2 Research Gap

Prevention is better than cure, but early detection can get the patient suffering to the best cure. Therefore, identifying anaemia at the initial stage and taking necessary treatments would make the condition reduce and stop from reaching severe conditions. Anaemia can be identified from specific symptoms that are mentioned below;

1. General Fatigue
2. Dizziness
3. Pale Skin
4. Difficulty in concentration
5. Leg cramps
6. Insomnia
7. Shortness in breathing and headache, when exercising
8. Unusually rapid heartbeat
9. Cold feet and hands
10. Tongue swelling or soreness
11. Feeling faintish and blackout

So, based on the above-mentioned symptoms [5], identifying the disease that the patient is having is either anaemia or not is the key part of this research. Although there are many methods of identifying this disease most of them are done by laboratory tests and are more invasive methods, by taking blood and testing those. Which would take more time and needs complex systems to function to identify whether the patient is either diagnosed with this disease or not. Therefore,

identifying the disease with a more portable machine is the best way to detect the disease. But the device would only be eligible of detecting one symptom but in the mentioned method the research group shall be using plenty of input to decide whether the person is diagnosed with this disease or not.

In order to do this, the team shall be using a non-inversive method. For this the team shall be developing a device and an app so that the team can get many inputs so that our accuracy increases when the team can state whether the patient is diagnosed with this disease or not. For that the team shall also come up with a device so that it can detect a certain symptom from the above-mentioned symptoms and finalize on a certain symptom so that the patient can have a double check with a blood check if needed and it would also show the same result.

This is a problem faced by women at large and the solution would also be helpful for many pregnant women for them to detect if they are diagnosed with this disease or not especially because the disease would be infecting the baby that they are carrying. Which would literally cause malnutrition for the child as the mother would be having lower oxygen levels. Therefore, if a solution is developed so that this can be detected at an early stage the patient can go the necessary treatments and the life of the patient and the child can be saved. Therefore, developing this device is important and the research group shall be implementing the device so that not only it will be portable but also transferring all necessary information through the cloud to the phone, which is the research gap and could be further improved if the historical data can be stored and be viewed later by the patient. This is the main gap that would be needed to be fulfilled. Although some attempts were made to make a portable device to detect anaemia there is no device to detect anaemia using the cloud and through multiple symptoms.

1.3 Research Proceeding and Objectives

The part of this research is the implementation but before the implementation of this project the team need to collect necessary data to implement this device. From the above-mentioned symptoms under the topic 1.2, one of the key symptoms is skin going pale. So, the researchers shall be developing a device to detect if the skin is

pale and oxygenated blood flow is less so that, the skin is pale would indicate a major factor that anaemia and depending on the input from the questionnaire on the app we can detect whether the patient is suffering from anaemia or not. The questions in the questionnaire would mostly be related to the symptoms of anaemia which a major factor in the detection anaemia is. So, in order to implement the hardware device, we need the image of the finger tip of the patient when it is squeezed as well as released. The time gap between the release after the squeezing should also be calculated.

The main reason to do this is when squeezing the finger tip of a person the fingertip turns yellow in colour, so we need a camera module configured in the respective module used which is raspberry pi where the camera module will be configured. Then the image during the squeezing of the fingertip will be taken as the first shot, then the image would be taken after the squeeze is released. Then using image processing we shall be checking the time taken and the comparison. Then we would need to gather data from an anaemia diagnosed patient in order to get the data when the finger is squeezed and released the time taken. So, comparatively we will be running an algorithm of an infected patient and a normal person's data to check if the patient using the device has anaemia or not then the information is sent to the server. The server would detect the input and we would request the patient to use the app to register before doing the above functions in the app so that the relevant information is taken, and an account is created in the app. Then the app would contain a questionnaire where the questions related to the disease is needed to be answered by the patient in order to get a proper accurate result, so based on that we can get the input into the server from the questionnaire as well as the device.

After getting the input from both, the device and the questionnaire we shall be running a machine learning algorithm in order to detect whether the patient has been diagnosed with anaemia or not. After the algorithm is run the results will be pushed to the app where the final user would be able to see if he/she is diagnosed with anaemia or not. The main objective of this research is to make sure the patients would be able detect anaemia at an early stage and take necessary treatments so that they can be cured at an early stage.

Chapter 02

2.0 Literature Survey

Due to the increment in different types of diseases we need better technologies for the identification of these diseases which the patient is diagnosed from. There was a research conducted by Jamie Punter and five other members. In this research they obtain 50 μ L whole blood sample to test for anaemia. The main aim of the project is to get a portable device so that it can be used for instantaneous detection of anaemia. The developed device contains electronic instrumentalization, post processing software and plug and play disposable sensor. The disposable sensor is based on a three-gold electrode commercial sensor which is of low cost and 50 μ L of blood is required for the device to use in this test. In order to achieve a success with this device they had used 48 blood samples for testing of this device. These samples were collected from different clinics and hospitals for the task. Blood samples were distributed in two main groups as one for system calibration and the other 38 samples for system validation. The calibration of the device was done using a complete EIS experiment in this project to get accuracy in the detection of anaemia, defining the working range of haematocrit detection. So, in this project the specialty they had used an instant impedance detection in order to make sure they achieve accuracy, sensitivity and co-efficient of variation in this project. After the proper testing has been carried out only 2% accuracy error had been seen [6]. Therefore, this is a more successful device that is portable.

But the main difference between the project that we are developing, and this project is that we will be also developing a portable device, but our project is non-invasive where we will not be getting any blood samples to carry on any tests but rather make sure that the required input is taken from the symptoms. For this we shall be building a device with the necessary features with image processing integrated into it. The next most important difference between the device that we are to develop, is that the device would be containing a connection to server as a cloud, which we shall be connecting to send the relevant data and

those would be connected to the mobile device of the patient. The patient should also answer a questionnaire that is designed in the app and the accuracy in ours would also increase because we shall be accessing many symptoms and mainly using the device we shall be taking a main input which to determine whether the patient is diagnosed with this disease or not. We are going to detect the whether the blood flow in the patient is low by using image processing and relevant technologies. Using these the team can detect the blood flow and determine the severity of anaemia in the body. This would be the idlest method to detect anaemia in a non-inversive methodology.

According to the above-mentioned project by Jamie Punter the structure of the internal systems is as follows;

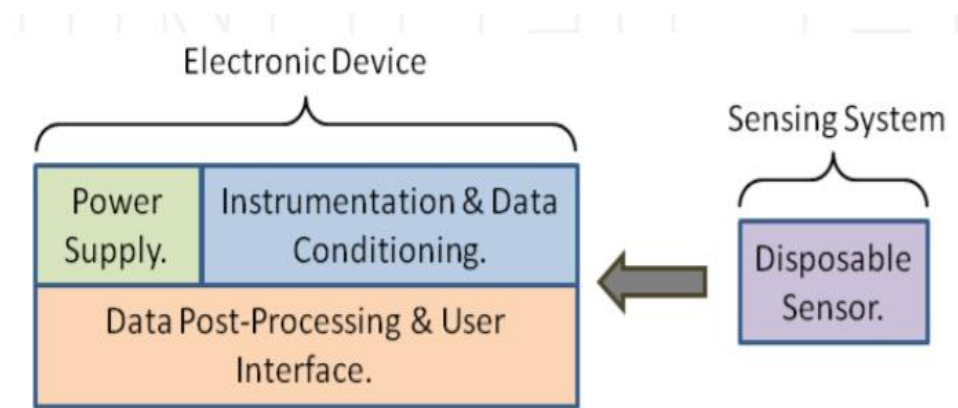


Figure 2.1: Schematic development view [6]

But the expanded view of the electrode sensor is shown below.

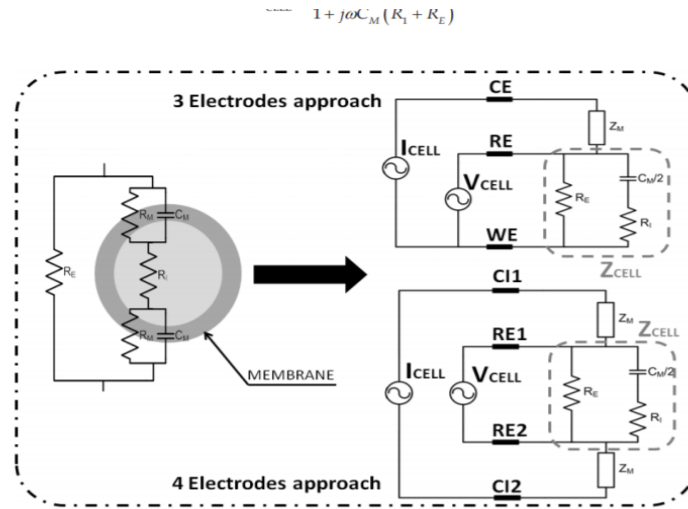
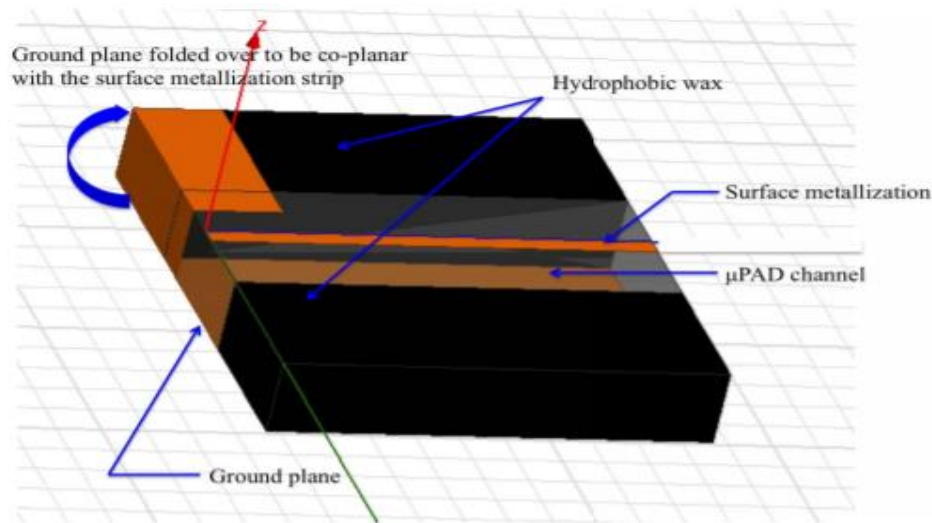


Figure 2.2: System based on 3 electrodes [6]

So, based on the figure 2.2 above figure the blood is dropped on the electrode and then the specific information that is gathered is transferred to that unit where it can detect the relevant changes and the testing happens.

The next project that is done by R. Bhattacharyya which is using RFID the ability to test for anaemia. In their project which is titled, “Towards low-cost, wireless blood anomaly sensing: An RFID-based anaemia detection sensor” they use a method there they would be able to send a certain frequency to detect if there are ample amount of red blood cells in a given quantity of blood inside the body. Therefore, in order to detect that they have been shall be using a frequency and send it back and retrieve the relevant data and analyse whether there is a difference between the normal person’s blood and an anaemia infected patient. In an anaemia infected patient anyways there will be lower red blood cell count. Therefore in there project they have used a sensor which is capable of reliably differencing between blood having 20, 30, 40 and 50% red blood cells concentration by volume. In the RFID equipment that is used by this team has the ability of allowing for automated screening of blood specimens at large scale is also available. Therefore, according to this project the Red Blood count

is taken by volume and is checked for anaemia. The structure of the frequency



transferring device is shown below;

Figure 2.3: Micro strip designed with μ -PAD channel [7]

In the design there is a layer of wax so that the wave is not transferred to the required destination rather than making it to flow in a specific direction so that would facilitate the process of getting the inputs as well as the outputs in an effective manner [7].

Image processing is also used in this project. Image processing is used in order to detect many kind of changes, so in anaemia image processing can also be used to detect the exact symptoms and those changes. In a project done by Sachin D. Khirade to detect diseases in plants he has used image processing. In this scenario the researcher has been using steps like image acquisition, image pre-processing, feature extraction and classification to detect the changes in the plants by continually monitoring the changes in those plants by the means of image processing.

So, in this project the image is captured initially, so at the capturing stage the image would be at RGB format so then the transformation for the leaf image

captured would be changed according to the RGB colour transformations. Then image pre-processing step takes place so at that stage the noise that is there in the image is removed using different image pre-processing techniques like image clipping and etc. Then a histogram equalization is used in order to enhance plant image diseases. Then the image segmentation step takes place where the image would be portioned into various parts. So, in this step the segments would be portioned into different similar segments or having similar features. So, this could be done using different methods like otsu' method, K-means clustering a different method. Then this image is subjected to feature extraction. The feature extraction method plays an important role in identification of the object. This stage is used in image processing to detect colour, texture, morphology and edges. So, in this project the texture is detected in order to make sure the there are certain changes that could be detected. For this there are two methods that can be used. The first method is colour co-occurrence method and the other is leaf colour extraction using H and B components. Each of these methods can be used for getting a proper feature extraction. The next and the final step that is used is the classification step in this project for image processing. This is done using two methods, out the two one is using the ANN method and the other is back propagation.

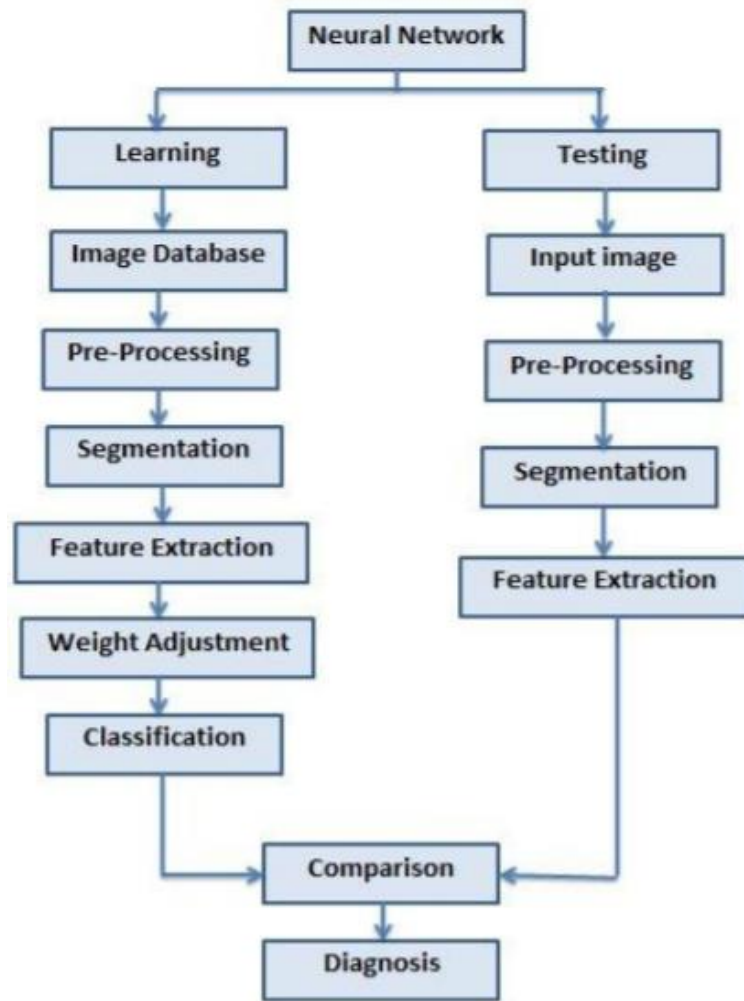


Figure 2.4: Working principle of ANN [8]

In the above-mentioned step-in figure 2.4 initially the image is captured and step by step learning process is run because there should be an image database that is created and then linked run through each process that can be seen on the steps indicated in the left hand side. While, when the device is implemented and is used the device would capture an image and that would be used and has to go through the testing stage, input image, pre-processing stage, segmentation and feature extraction, then the image that is produced would be compared with the images that was taken when the plant was at a healthy state would be compared to the whether there is a disease it has carried or not [8].

In the proposed project for the image processing the team would also be following some of the above steps to build the project. In the detection where would be taking images of anaemia infected patient and a normal person would be compared at the last stage after going through certain processes that are to be built. So, the images when the finger is pressed would be taken and processed using some of the method under image processing and then the image after relaxing the finger would also be taken and fed into the image database that is to be built. Then the image would be used for comparison afterwards.

CAD or also known as computer aided diagnosis is major field that is growing in the current world. In order to achieve this machine learning techniques shall be used based on the systems that is to be introduced. In those devices the main feature would be collecting plenty of data in order to process them and determine the diagnosis for the disease-based on the symptoms that the patient carries. This can be done through analysing each symptom or through input from the relevant patient.

According the project by Meherwar Fatima on the topic, “Survey of Machine Learning Algorithms for Disease Diagnostic” has discussed on the types of machine learning algorithms that are available such as;

- Supervised learning
- Unsupervised leaning
- Semi-supervised learning
- Reinforcement learning
- Evolutionary learning
- Deep learning

Therefore, these above-mentioned methods can be used in machine learning to detect the diseases. Pattern recognition and data classification methodology should be used to detect the exact cause and could be designed easily to detect the disease and make sure the patients would be able to diagnose the disease through these systems. Using different algorithms heart diseases, diabetics, liver diseases, dengue and hepatitis can be identified. For these proper

algorithms should be used [9]. In our project the team shall be using machine learning algorithms in order to detect anaemia and increase the accuracy, which is crucial.

Chapter 03

3.0 Objectives

Objectives are the key factors or outcomes that the team expect out of this project. So, the main objectives that is expected out of this project are as follows;

- Early stage anaemia detection and identification and guidance for proper treatments.
- Use of non-invasive method in disease identification
- Data aggregation, mining and extraction with the inclusive of past data.
- Accurate decision-making algorithm with intelligent decision making agent.
- Cloud based wireless information exchange architecture.

These are the main objectives of this project while there are some specific objectives;

- To get a better understanding on image processing and implement it
- Gain knowledge in machine learning and its implementation
- To gain more knowledge on anaemia and proper treatments
- Configuring IoT and setting up hardware device to gain necessary input to be sent to image processing

Chapter 04

4.0 Methodology

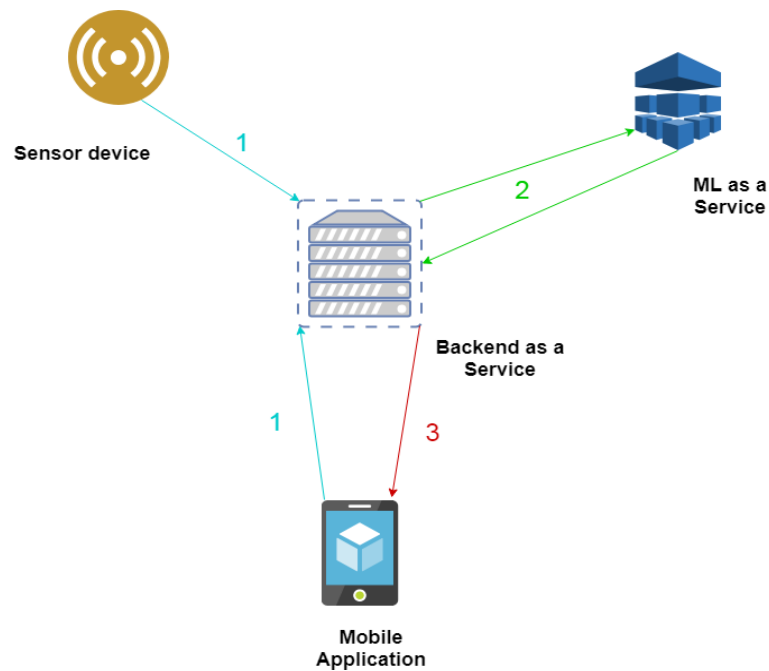


Figure 4.0.1: System Architecture Diagram

4.1 Procedures

The main procedures that is involved in the designing of this project is to build a simple device that has accuracy and give the user the ability to trust the results of the device. In order to achieve the above-mentioned objectives, the team have designed the project on 4 major steps.

- Building the hardware device
- Configuring Image processing
- Configuring connection between server and device
- Configuring the server and creating necessary channels to intake data from app
- Building the app
- Designing an algorithm in the server to process the data using machine learning algorithms

So, the above-mentioned steps are the key steps in building up this device and establishing connectivity in order to make the users able detect whether they are diagnosed with anaemia or not.

4.2 Building the Hardware Device

Initially the device should be built so that the input can be sent from the device to the servers. Therefore, the team have decided in using a raspberry pi in order to configure the device. The raspberry pi would be connected to the camera module that will be used. The camera module would be designed in manner attached to a clipping device, where the device would be clipped on to the hand of the user and a picture of the squeezed finger would be taken. In order to take that the camera should be configured so that it is able to take the pictures in a more focused manner so that the level of identification is high. After the pictures are taken then they should be sent to the raspberry pi where the team shall implement image processing. So, when designing the device, the clipping should be done so that the finger is tightly held and then released upon the release during a specific period another snapshot of the finger should be taken. In this device a strong light would also be fixed so that it passes through the finger where it would make the blood visible for the camera and when the finger is tightened then the blood moves back and that also can be noticed. This would also include a snapshot when released and the time taken. Depending on that the images would be loaded in image database for image processing. The pictures would be eventually configured.

When the device is configured an OS will be used in the raspberry pi for the programs to run so that it would also facilitate image processing to happen in the same device where it would make it easy to configure image processing as well. The device shall be connected to the server using node ESP or a similar device. Then the results that is processed in the device will be transferred to the server via the node ESP8266 that would be connected to do the server. The TCP protocol will be configured, and it would be safe to transfer those details via this protocol because it is much safer than the other protocols.

4.3 Configuring Image Processing

After the images are taken it would be sent to image processing at the same device. As the team have configured the raspberry pi with an OS the team would be able to make the necessary image processing settings in the device itself. So, when the images are sent there would be two streams created. One for the healthy patient and the other for anaemia infected person. So, when configuring image processing the following steps should be considered;

- The input added to the processes
- Run pre-processing
- Segmentation
- Classification

Initially the images taken as samples should be inserted into the system. Then the images should be cleaned from noise to avoid it interfering in the decisions the device would arrive at the latter stage. Then at the pre-processing stage the images would be used for detection of the intensity of the images. The main aim of this step is to make sure an improvement in the image data and the unwanted information would be suppressed from unwanted distortions or enhances so that in the further processing part it would be giving the correct amount of data for the decision making and the device needs to use two of the sample data for processing where this would apply for both the patient's image as well as the healthy person's fingertip image. In order to achieve this, the team can use many techniques.

The third step in image processing is to do segmentation. In segmentation the image is set to the process of portioning where the image is portioned into multiple segments such as set of pixels. The main aim of this step to make sure that the image is represented in a more meaningful manner so that it could be easier to analyze. This mostly used in order to determine the boundaries and objects that are in the image. This would help to clarify the exact shape of the image that is needed. The image processing steps are shown in the below diagram;

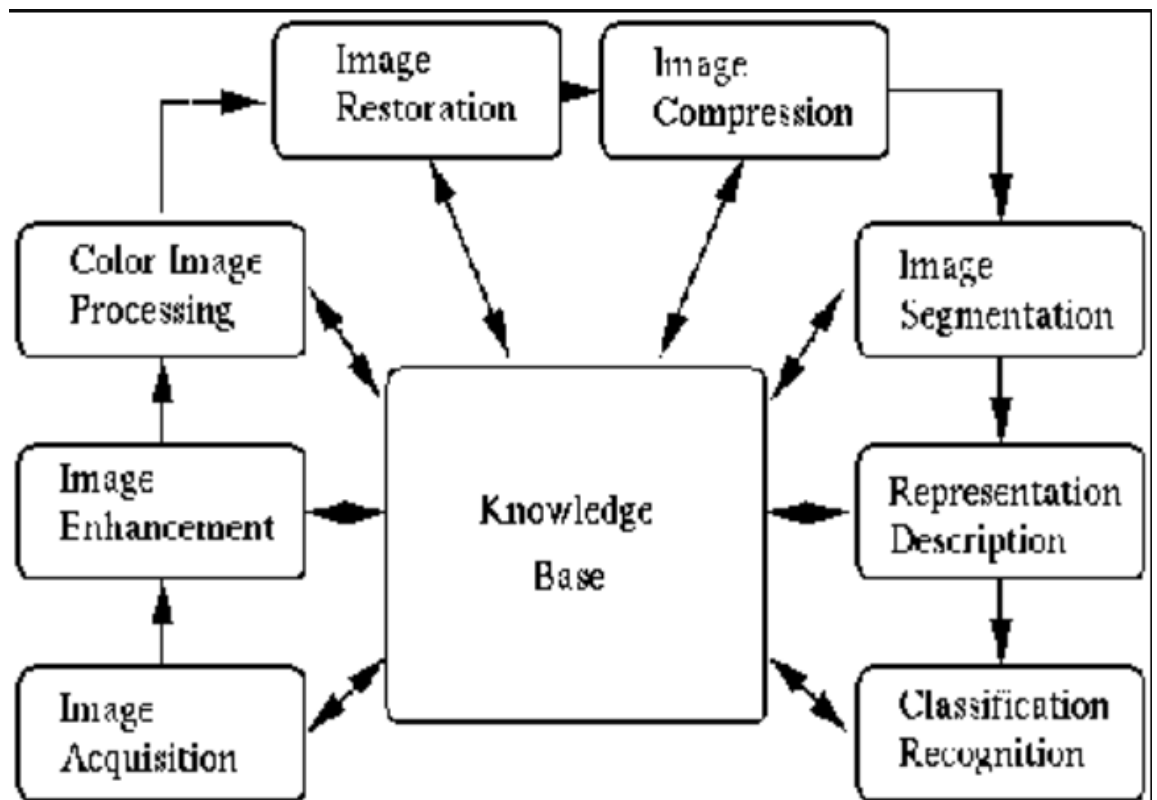


Figure 4.3.1: Basic steps of image processing [10]

The above flow of diagrams shows how the image processing steps work and each level has certain set of algorithms that is run to achieve the desired output. The next step after segmentation of the image is the step of classification. Although in figure it depicts representation description, the team shall be looking at the main steps that would be involved in the process of identification of the image. So, as the next main step, classification of the image, where the step categorizes detected objects into defined classes so that the image patterns can be compared with the target patterns. Although

classification of objects by humans is simple task it's a complex task when it comes to computing. Because a quality image should be needed from the device a low-price high-quality camera and with automatic focusing capabilities should be used [11].

So, after this the recognition of the image would happen and then the data will be sent to the server in order for further processing. This would help to detect whether the user has anemic conditions or not and the data which would be sent to the server would again subjected to machine learning depending on the input given by the app as well as the device after image processing.

4.4 Configuring connection between Server and Device

In this step the connection between the server and the device should be established. In order to achieve this, the team need a WIFI – module or a module that would connect with the internet for transferring data to the server. In order to do that the team shall be using the node ESP8266 for the purpose. The device shall be connected to the WIFI by configuring the module using AT commands this would establish the connection between the server and device via API key that is given for each.

The server provides two keys for the communication purpose, to send in data as well as send the data out. The two API keys that are provided by the server is the read API and the write API key. This should configure to the device to establish the connection to transfer the details from the device to the server. The server, which shall be used also needs to be configured to receive data and those can be analysed in a manner so that it can be subjected to machine learning after the input from the app is also taken into the device. This would make it possible for the device to transfer the required data to the server whenever an input is taken and after image processing has been configured.

4.5 Configuring the Server and creating necessary Channels to intake data from the Application

After the device is configured with server then the app should also be connected to the server and for that configuration too the team shall be using the keys that are given by the server to transfer the details accordingly. In order to do that the team shall have to configure the app to a certain socket so that whenever the data is input into the app the details would be transferred to the app and the required. The transfer of information is vital because it is required so that communication channel between the server, device and app is important to generate more accurate and relevant output.

4.6 Building the Mobile Application

After the device the next main mode of input is the app. The app would be designed so that there will be a user login so that the user will have to register before logging into the system. The user will have to use the email address to register to the system. Then according to the database, the system will be designed so that there are the users can use their username and passwords to access the accounts. When accessed the app using the proper credentials the user will have to two platforms, where in one the user will have to answer the questions that are designed in the questionnaire. In the app the questionnaire should be designed according to the symptoms of the disease. The symptoms as mentioned early would be;

- General Fatigue
- Dizziness
- Pale Skin
- Difficulty in concentration
- Leg cramps
- Insomnia
- Shortness in breathing and headache, when exercising
- Unusually rapid heartbeat
- Cold feet and hands

- Tongue swelling or soreness
- Feeling faintish and blackout [5]

So, during the design of the questions, it would be mainly addressing the above-mentioned symptoms and also some symptoms that would be taken by consulting a doctor as well as an anaemia infected patient. During this the question should also be designed so that each symptom would indicate the how severe level of anaemia the patient is diagnosed with. So, this would be the main factor in determining the amount severity of anaemia the patient is diagnosed with.

The next main part of the app would be design be the part where the result of the entire process can be seen. In order to achieve a successful output, the team shall be using an algorithm in the server so that both the input from the server and the input from the client is processed and the result is achieved. Then the output would be sent to the app where the user would be able to see the results. That would make the user to simply the output and get them for later medical purposes. This is the main tasks that shall be performed by the app. The app will also be designed with a good User Interface where the user would also be able to arrange the data that the user gets when testing. Then the proper ordering of the results would also be done in the app.

4.7 Designing an Algorithm in the Server to process the data using Machine Learning Algorithms

According to the inputs given by the app and the device, the device that will be designed so that it directs the input to the server and the app will also be configured with the server in order to fulfil the required changes that would be committed as input for the server. The server then processes the information that is taken from both inputs. In order to achieve this, the team shall be implementing supervised machine learning. In this step the team shall be using a methodology where a set of training data shall be used to achieve this. This training data for the algorithm to run should be taken as a faithful information to be collected and run in these algorithms. In these algorithms the server

would play a major role so that the inputs taken would be from data that has already been collected from patients diagnosed with anaemia as well as a test from a normal healthy person, so that the processing machine learning algorithm can be trained to each data set, which would expand the chances of getting more accurate results is high. This would help in identification of the disease at an early stage.

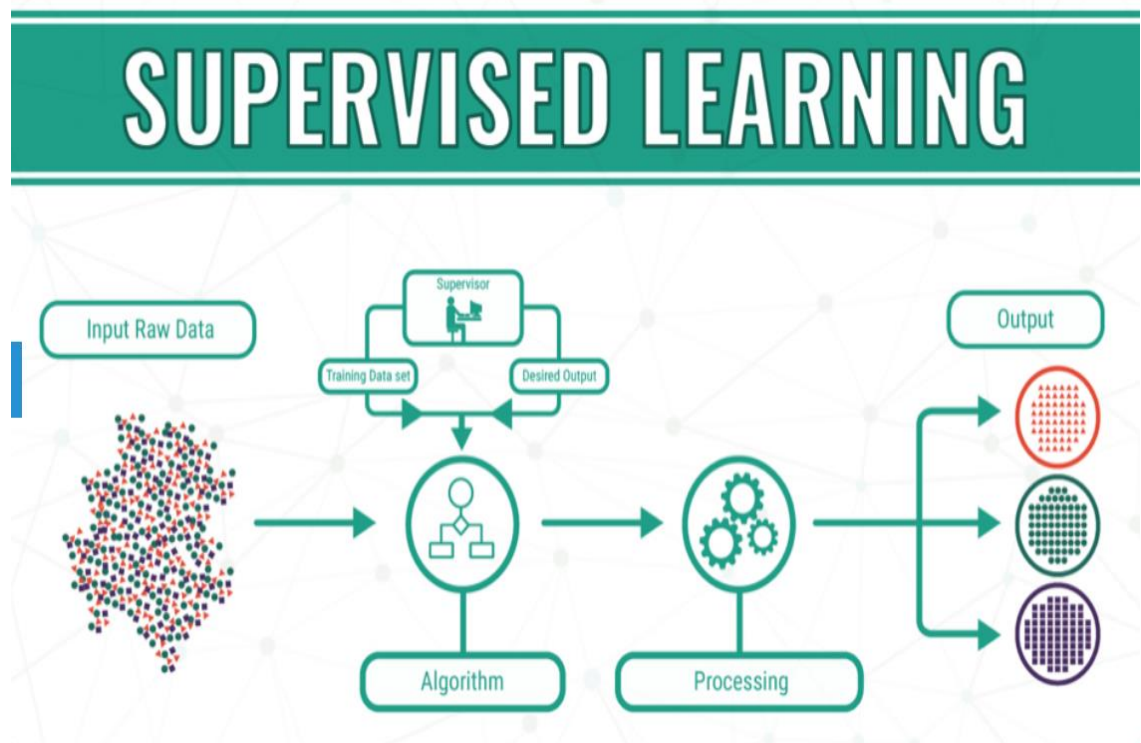


Figure 4.7.1: Steps in supervised machine learning [12]

In supervised machine learning initially the output is fed into the algorithm through the system. This would mean that the machine knows what the output would already be depending in the criteria that would be used to run in the algorithm [12]. Although the system doesn't know the ultimate result is it would know how to achieve to the desired output. This design would be implemented in the project. The output would be fed with relevant data sets so that the algorithm is trained so that it would be able decide what would be the possible outcomes from the inputs that are fed. This would be running in the server fulfilling the requirements and coming up with the final output.

Chapter 05

5.0 Personal and Facilities

Table 5.1: Work progress of each member

Person	Roles
M.H.M.Akmal	<p>In this part the team shall be using image processing to identify anaemia. After the image is captured the image processing steps would be applied. Initially the noise would be cleared in the image. Then it will be subjected to certain process and stored in the image database. In order for this the team shall be taking images of the finger where the patient is suffering of anaemia and a healthy person. This would be used when the device takes an image to compare and decide whether infected with that particular symptom or not. Then it would be transferred to the server.</p>
M.Pravienth	<p>At the user level the most important content is the device as well as the app. The app would contain a questionnaire where the user must answer. Those questions in the questionnaire would be most relevant to the symptoms and features that an anaemia patient would contain. So, the main research</p>

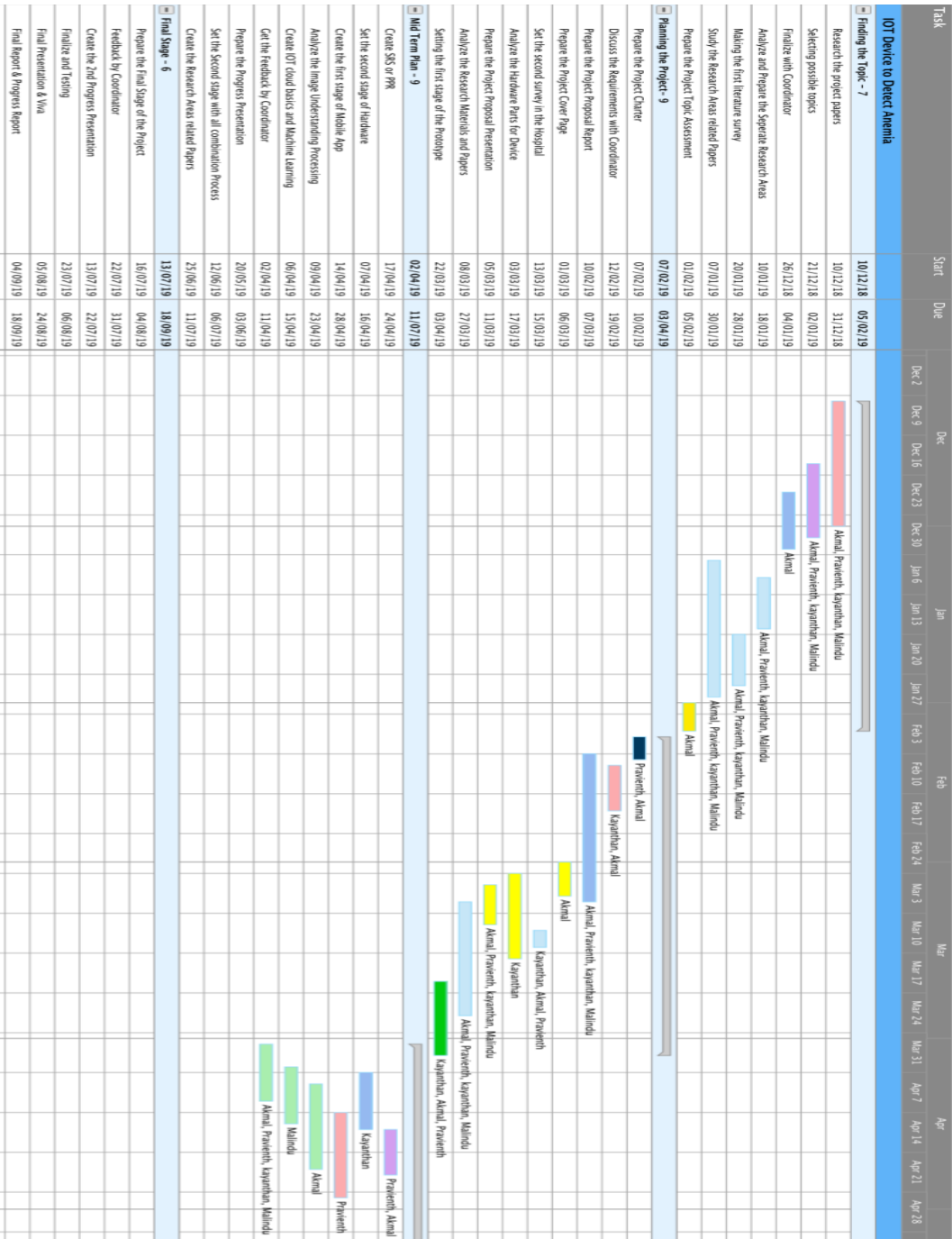
	<p>component is finding the information about the disease and designing those questions and how to send those data to the server and get the final output to the app to be displayed to the user.</p>
N.Kayanthan	<p>Specific systems should be used to build the device and interconnect them with each other so that it also has the ability of transferring the required data to the server. So when building these hardware components the team need a camera and a module to transfer the required data to for image processing and to be sent to the server. The team would be using a strong light in order to pass through the fingertip so the changes when squeezed and released can be detected.</p>
H.S.M.H. Fernando	<p>The cloud service that would be used in this project is the web related cloud services so that the team can create a server like structure and the data sent from the app and the device would be collected and the required machine learning algorithm would run so that it can decide whether the user is diagnosed with anaemia or not. In machine learning the team shall be</p>

	<p>using a specific pattern so that it would be able to decide on the disease. For that the team shall have to feed prior data to make the mechanism to run as usual. This would be a key component of the project as at this stage the vital decision is taken, whether the patient is diagnosed or not.</p>
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Chapter 06

6.0 Testing and Evaluation

6.1 Gantt Chart



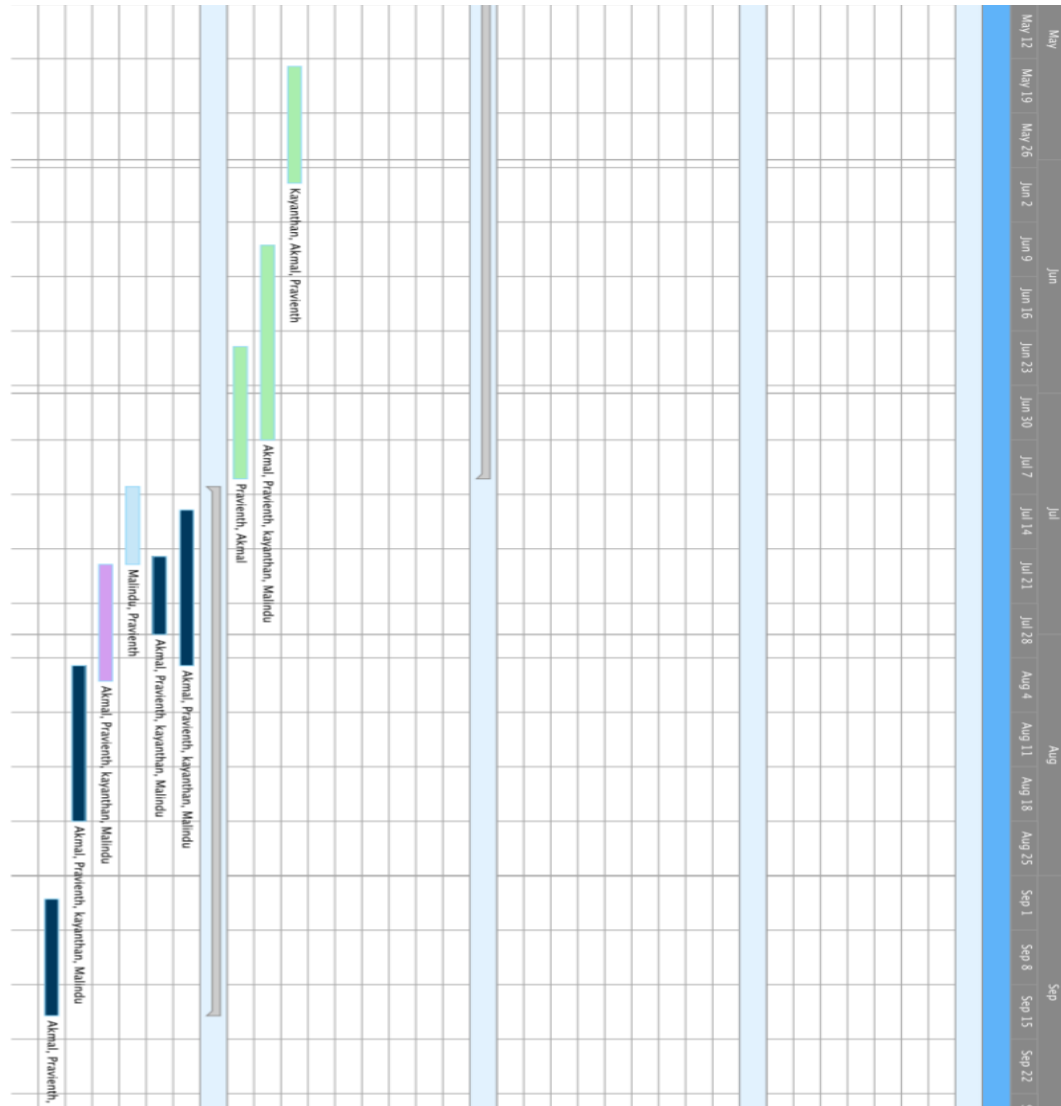


Figure 6.1.1: Gantt chart

The above figure demonstrates the rest of the Gannt chart that has been shown in the page above. This explains the work that would be done throughout the period of the project by the team members.

After the device has been built, the testing of the device should be done to know whether the device is functioning in accurate manner. In order to do that the team shall be testing the device on the patients whom we collected the data and come to a conclusion whether the device is generating accurate results or not.

6.2 Work Breakdown Structure

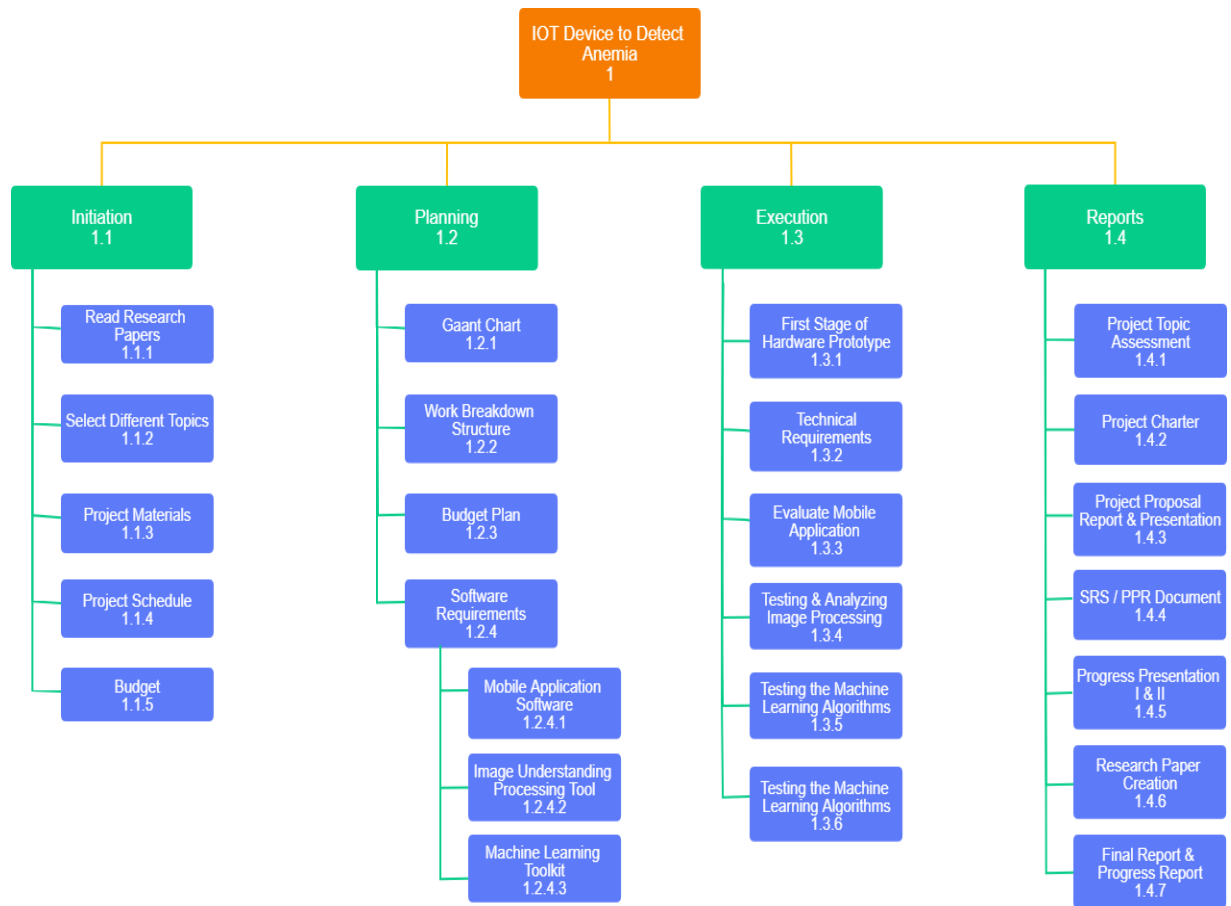


Figure 6.2.1: Work Break down structure

The Work Breakdown Structure explains four stages the project.

1. Initialization
2. Planning
3. Execution
4. Reports

The picture shows the project's overview and structures of the characters. It conveys the basic system of the project.

Chapter 07

7.0 Budget

Description Equipment	Estimated Cost	Actual Cost	Difference
Raspberry Pi B	9000	8550	-450
Camera Module	6000	6000	0
3-D printing	5000	6500	1500
Cloud Server Service charge	1000	900	-100
32GB Memory Card	2000	1500	-500
Ring LED Panel	300	200	-100
3.5” LED Display	4000	4000	0
Jumper Wires	140	140	0
Power Pack	500	600	100
Total	27940	28390	450

Table 7.1: Budget Plan

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