Medical Prescription Detection and Health Guidance System Using Machine Learning

22_23-J 73

Project Proposal Report

D.H.K.C Jayangika

BSc (Hons) in Information Technology Specializing

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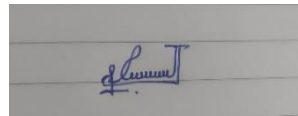
Department of in Information Technology

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Sri Lanka

October 2022

DECLARATION

I declare that this is my 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 my 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.

Name	Student ID	Signature
D.H.K.C Jayangika	IT19146270	

The above candidate is carrying out research for the undergraduate Dissertation under my supervision.

Signature of the supervisor   Date

....
(Supervisor Name)

Signature of the Co-supervisor   Date

....
(Co-supervisor Name)

ABSTRACT

A disease is a condition that affects a human physically and mentally. In the modern world, there are numerous different diseases. A disease that has both physical and mental effects among those is arthritis. There are different types of arthritis. According to those types, the types of medicines given to patients by doctors are also different. According to the patient's health, any of these drugs could have side effects. Many people are unaware of the potential side effects of the drugs they are taking. A person who takes drugs for a variety of diseases may sometimes have a lot of side effects as a result of the medications. Also, the patient does not have a correct understanding of the laboratory report data that the doctors tell the patient to obtain during the diagnosis of arthritis. As a result, a patient's family member cannot obtain correct info about the medical situation from the patient. We were able to conclude from our analysis that it is useful to establish an app for arthritis because of this. Our analysis showed that while several apps have been developed for various diseases, none have been developed for diseases such as arthritis. Our analysis revealed that many disease-specific applications are not being actively used. We discovered via discussions with patients and doctors that the proper applications are not being created to precisely identify the side effects of arthritis patients taking their drugs and the information available in laboratory tests.

As the basic plan of this research part, through a mobile application, we will introduce the side effects of the drugs prescribed for each type of arthritis diagnosed by the doctor and provide an accurate description of them and health advice to avoid side effects. Furthermore, the information is correctly identified through the application and provided to the patient by accurately analyzing the data of the laboratory reports after uploading the laboratory reports related to Arthritis disease in the form of images on the doctor's recommendation through our mobile application.

Keywords – Side effect, Laboratory report, mobile application, Arthritis disease

Table of Contents

LIST OF FIGURES

List of Tables

LIST OF ABBREVIATIONS

Abbreviation	Description
ML	Machine Learning
NPL	Natural Language Processing
ANN	Artificial Neural Network
CNN	Conventional Neural Network
PCR	Printed Character Recognition

1. INTRODUCTION

1.1. Background

In the modern world, there are many different diseases. A disease is a particular abnormal condition that negatively impacts an organism's structure or function on the whole or on a specific part of it. One disease that negatively impacts an organism's ability to perform in modern society is arthritis. Arthritis describes a group of conditions in which inflammation or disease affects one or more joints. There are several different types of arthritis. Rheumatoid arthritis, osteoarthritis, and psoriatic arthritis are three major kinds of arthritis among them. [1] For each of these types of arthritis, there are specific drugs. The drugs may induce favorable or unfavorable changes in the human body. The unfavorable changes that are elicited by the drugs in the human body are known as drug side effects. These side effects range from minor reactions like headaches to serious ones. [2] Due to these reasons, it is crucial that patients are aware of the possible side effects of the drugs they are taking. Additionally, there are different laboratory reports for various types of arthritis. Though the patient is informed of the information in each of these laboratory results by the doctor, the patient's mental condition prevents a patient from having a proper understanding of the information. There is a risk that the disease will get worse because the data in the laboratory reports weren't properly understood. It is crucial to have a thorough understanding of laboratory reports for these reasons.

The side effects and laboratory reports of the drugs used for arthritis differ depending on the arthritis type. Laboratory test results based on the kind of arthritis are used to analyze the patient's disease level. To identify arthritis and check out other disorders, more tests may be performed. The choice of testing is based on the patient's symptoms and the type of arthritis that doctors suspect the patient may have. [3] There are different types of laboratory tests. For example, Rheumatoid Arthritis reports are Blood count reports, ESR or CRP, Serology, X-ray, Aspiration of the joint, etc. [4] Each of these laboratory reports has a different set of information. It is very important to properly understand the data in these reports. Despite the fact that the doctors explained to the patient the data from this report, the patient's mentality made it impossible for the patient to comprehend the precise level of the condition. These factors also make it impossible for even a member of the patient's family to know the patient's precise status.

The side effects of the drugs might be very different depending on the patient's age, gender, disease stage, and other factors. There are many circumstances that can lead to these negative effects. They may be elicited when a drug is first used, when the dosage is changed, or even when the drug is being stopped. If a medication causes severe adverse effects, the dosage may be changed, or a different medication may be prescribed. In some cases, changing one's diet or way of life can help lessen the negative effects. [5]

Technology is used nowadays to solve a wide range of problems. However, it is clear that no successful application has yet been created to allow a person to precisely read the laboratory data for all diseases, regardless of how cutting-edge the technology may be.There aren't any specific applications for diseases such as arthritis. Some apps only mention the causes of arthritis and types of exercise. These applications do not currently have any functionality. Furthermore, the use of mobile application-based applications to comprehend the adverse effects of drugs prescribed to patients by doctors is still in its infancy, and because it is not properly localized the side effects of medicines can only be identified in a few types of diseases. Many patients are not aware of the side effects of arthritic drugs and the details included in laboratory reports. They have knowledge of only a limited amount of disease information. As a result, both patients and doctors agree with mobile app-based solutions.

16. If there is a mobile application system for identifying drug side effects without meeting a doctor.it helps identify drug side effects Do you agree with those mentioned above?
48 responses

- Stongly Agreed
- Agreed
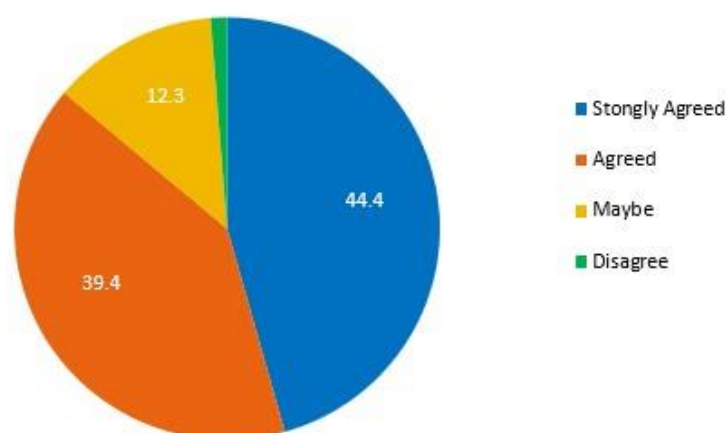- Maybe
- Disagree

44.4
39.4
12.3

Figure 1.1 Summary of responses for mobile application for identifying drug side effect

In this research, machine learning is mostly used. Using a natural language processing (NLP) model trained to predict the side effects of the specified drugs, we are using an Artificial Neural Network (ANN) in this component to detect prescriptions. Also, We must upload an image of the lab report using a Conventional Neural Network (CNN) in order to evaluate the lab results. The data in the report is then analyzed using PCR (Printed Character Recognition).

Therefore, the main objective of this research is to develop a mobile app that will be simple for arthritis patients and their family members to use. The current level of the disease (high or low) will be clearly displayed on the laboratory reports that the patient acquired through this application once the patient or a family member uploaded the report as an image through the application. Additionally, this app will deliver month-to-month predictions and details regarding the patient's disease level based on the data analyzed and measured by it. Additionally, through this application, correct information about the adverse effects of the doctor-prescribed drugs for arthritis as well as health tips to avoid adverse effects are provide

1.2. Literature Review

The main objective of this study is to create an application to accurately assess the data of the laboratory reports obtained according to the type of arthritis on the recommendation of the doctor and to accurately display the disease level of the patient. And also, accurately identify the side effects of the prescription drugs prescribed by the doctor and provides health advice to arthritis patients.

In the analysis of data available in laboratory records, It was discovered that several researchers had analyzed laboratory report data using methods based on image uploading. One of the research papers presents a deep-learning-based approach for textual information extraction from images of medical laboratory reports, which may help physicians solve the data-sharing problem. The deep learning method for text detection and recognition from images of medical laboratory reports is presented in this study. First, a patch-based training technique is applied to a detector that generates a collection of bounding boxes with texts using an image of a medical laboratory report as input. Then a recognizer, which uses the areas of the source image's bounding boxes as inputs and produces recognized texts, has a concatenation structure added to it. [6]
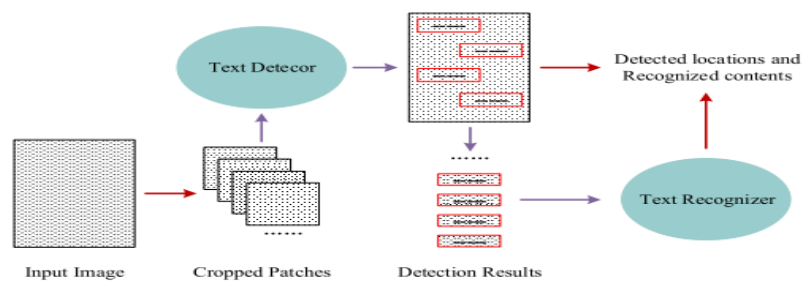
Figure 2 Medical laboratory report detection

In this picture displayed A medical laboratory report input image is first divided into smaller patches. The text detector then looks for text-based items on each patch and outputs where they are. The text recognizer uses each text area as input and guesses its contents based on detection results. [6]

- On documental images with high resolution, a patch-based method is used for text detection, and this strategy provides high recall and precision
- A concatenation structure is suggested that significantly enhances a multilingual scene by combining the information from two adjacent convolutional layers.

- For text detection and recognition from images of medical laboratory reports, a deep learning method is given.

As a result of this study, a deep learning-based approach for extracting textual information from images of medical laboratory records is presented.

As another study related to the above-mentioned background, The focus of this study was to develop a new, improved ensemble model for disease prediction using laboratory test data by combining a DNN (deep neural network) model with two ML models. In this research, 39 different diseases were investigated.

This study mainly focuses on three methodologies

- Evaluation of the neural network's performance. A new neural network (DL model) was created, and it was trained using 88 different parameters. Utilizing stratified five-fold cross-validations, they tested this deep learning system.

- ML results (XGBoost, LightGBM). We developed two ML algorithms using LightGBM and XGBoost. These algorithms were trained using 88 different parameters in the same dataset used with the DL model.

- To enhance AI performance, we combined our DL model with our two ML models to create a new ensemble model. For model optimization, we utilized the validation loss. [7]

The new ML model achieved high efficiency of disease prediction through the classification of diseases. This study will be useful in the prediction and diagnosis of diseases

Additionally, research has focused on identifying drug side effects. The objective of this review is to evaluate the computational tools that have been created for the prediction of drug side effects. The metrics for evaluating the drug side effect prediction techniques have been explained, and the significant data sets that are provided for drug side effect prediction have been mentioned. [8]

Four categories of techniques are used to predict drug side effects

- Docking-based approaches
- Network-based approaches
- Machine learning-based approaches
- Miscellaneous approaches.

The image below shows the categorization and numerous methods under each of these categories. The image describes each of these categories as well as some of the outstanding research that has been done in the area of drug side effect prediction within each of these categories.
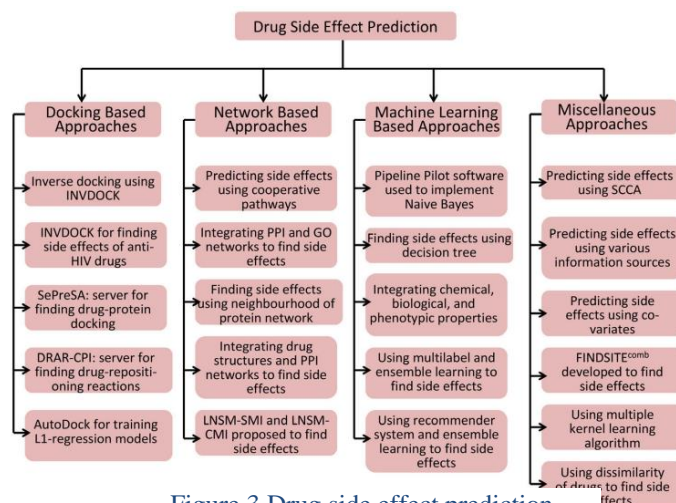

Figure 3 Drug side effect prediction

The drugs and proteins are connected in a network using network-based methods to predict side effects. To determine the side effects of drugs, machine learning approaches use a variety of machine learning tools and classifiers. The methods that do not fit into one of these three groups have been collected under the miscellaneous approaches heading. [8]

The various methods for predicting drug side effects are compiled in this study. There has been a critical evaluation of the many categories of drug side effect prediction and the numerous methodologies falling under each of these categories. The disadvantages of the different strategies as well as their benefits have been described.

Drugs can have either positive or negative effects on the body. Drug side effects are the adverse effects that drugs have on the body. The same medication given for one disease may have side effects in a person who is taking drugs for two diseases. These reasons emphasize the necessity of patients being informed of any potential side effects of the drugs they are taking. There are different laboratory reports for different types of arthritis as well. The patient's mental state prevents a proper understanding of the information, even after the doctor explains to the patient the information contained in each of these laboratory results. Due to improper interpretation of the data in the laboratory reports, there is a risk that the disease will worsen. For these reasons, it is essential to have a good understanding of laboratory reports.

Taking into consideration all of the issues mentioned, this research aims to make it simpler for arthritis patients to comprehend laboratory results correctly, recognize the adverse effects of the drugs that doctors have given, and provide them with the appropriate health tips.

1.3.   Research Gap

During the literature review, I found several ways to detect the lab report data and analyze the drug side effect. To analyze laboratory results and identify drug side effects, the specifics of the relevant research systems are compared. For that, the following table is used.

Table 1 Comparison of Existing Solutions

	Features	Research A	Research B	Research C	Research D	Research E	Proposed system
Laboratory Report Data Identify and Analysis	1. **Lab report image uploading**	✓	✓	✓	✓	✓	✓
	2. **Lab report data extract and display the disease level**	✓	✗	✗	✓	✗	✓
	3. **Display the disease level using graph**	✓	✗	✗	✗	✗	✓
	4. **Display the difference in disease levels from month to month.**	✗	✗	✗	✗	✗	✓
Monitoring the side effects of heavy drugs	5. **Display the drug side effect**	✓	✓	✓	✓	✓	✓
	6. **Display The Health Tips avoid the drug side effect**	✗	✗	✗	✗	✗	✓

The table above shows that five research papers identified data analysis by image upload in the laboratory report analysis. In that research, they had made use of various technologies. To identify the laboratory reports for various diseases, machine learning and deep neural networks were used. [7] Only arthritis patients can provide information about laboratory results, according to our research. Different laboratory reports can be added to the system depending on the type of arthritis. The patient can accurately understand the current disease

level due to this application. The current level of the disease (high or low) will be clearly displayed on the laboratory reports that the patient acquired through this application once the patient or a family member uploaded the report as an image through the application. Additionally, this app will deliver month-to-month predictions and details regarding the patient's disease level based on the data analyzed and measured by it. Also, a person who has lost laboratory reports can be available in an emergency by keeping them safely through the app. In the research papers I studied, the laboratory records of several diseases were analyzed.

In studying the side effects of drugs, a patient can upload the arthritis prescription given by the doctor through our system as an image through our app. There, using our application, the drugs related to arthritis are identified, and their associated side effects are displayed. Our app provides health advice to prevent drug side effects and steps to take if they do occur. The research papers that I have read only detailed the drug's side effects. These research papers do not provide any health advice.

In the study of side effects research, different techniques have been used to identify the adverse effects of medications in all five types of research A, B, C, D, and E. Machine learning has been used in research b, c, d, and e. Techniques such as network-based, machine learning-based, and docking based have been used in research. Deep learning and machine learning have been used to the analysis of lab reports. Image processing was used in research papers A, B, C, and D to upload laboratory reports. Based on the information above, our test has a considerable test gap when compared to several research.

1.4. Research Problem

One of the research study's main problems is targeting identifying Lab reports data analysis and identifying drug side effects. The relationship between the doctor and the patient has become distant because of numerous issues today. Due to various diseases, patients visit doctors once a month or every few weeks. But these chances have decreased for several reasons. By studying all these issues, this research provides an analysis of the decrease and growth of the disease in the laboratory report according to the different types of arthritis, displays the adverse effects of the drugs, and provides insight into the healthy behaviors that should be adopted.

Many patients sometimes don't properly understand the information in the laboratory reports they get. Even if the doctor correctly analyzes the patient's level of disease, the patient's sick mentality prevents them from understanding the doctor's instructions. Therefore, a patient's family member is also unable to accurately recognize the patient's level of disease.

As shown in Figure 4, more than 50% of survey respondents say They do not have a proper understanding of the laboratory report data.

13. Do you properly understand the information in the laboratory reports that relate to diseases?
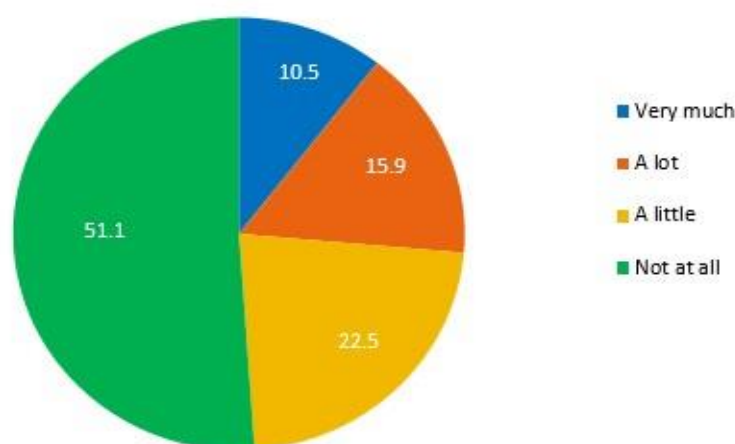48 responses

Figure 4 Summary of responses regarding lab report understand

Also, laboratory results differ according on the type of arthritis. The patient or a family member of the patient should see a doctor monthly to know about the progress of the disease according to the laboratory reports. Due to difficulty in visiting doctors, patients are not able to understand the disease level correctly.

As shown in Figure 5, more than 80% of respondents to the survey say that without seeing a doctor, it is impossible to understand the decrease and increase of the disease monthly.

14. Is it possible for you to get an understanding of your disease progression on a monthly basis without seeing a doctor?
48 responses

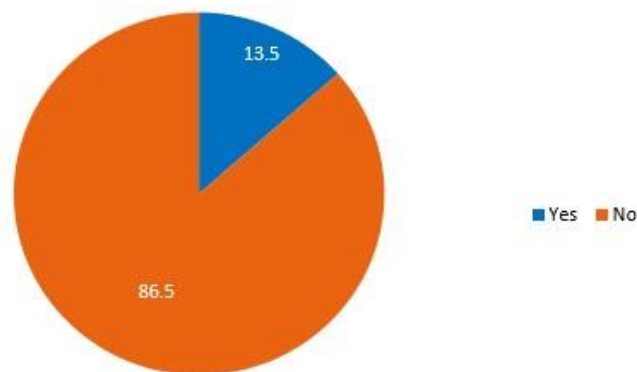Figure 5 Summary of responses regarding monthly lab report progression

Additionally, patients do not fully understand the side effects of the drugs they take for their diseases. Doctors don't always inform patients about drug side effects.

15. How much are you aware of the side effects of the drugs you are taking?
48 responses
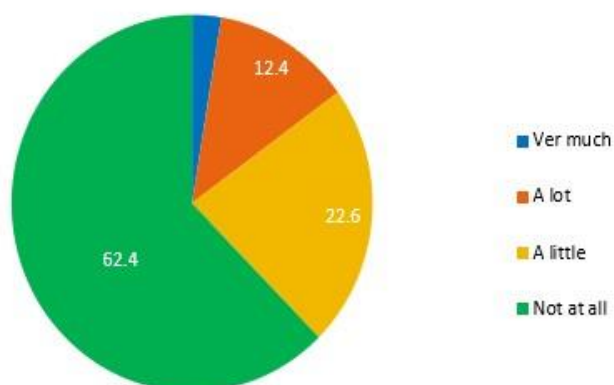
Figure 6   Summary of responses regarding drugs Side effect

16

As shown in Figure 6, more than 50% of survey respondents say do not have a clear understanding of the side effects of the drugs they are taking.

Considering all the above facts, they are looking for a method to accurately interpret the data in the laboratory reports provided for conditions like arthritis and to properly identify the side effects of the drugs. Because there is an app for almost anything now. More than 50% of survey respondents say that a mobile app is essential to analyze laboratory data and detect the side effects of medications for diseases such as arthritis.

2. OBJECTIVES

2.1. Main Objectives

The proposed mobile app will primarily focus on the relevant areas that are supposed to be covered to fulfill the needs of arthritis patients by providing the necessary services such as detecting prescriptions and visualizing drugs in the bottles according to the arthritis disease, identifying the best available pharmacy, voice recognition, and e-prescription generation, lab report reviewing and monitoring the side effects. The team's top priorities are to recognize essential services that must be offered through the mobile application and to deliver exceptional service with minimal interruptions. This app helps arthritis patients to get a better diagnosis.

2.2. Specific Objectives

The following specific aims can be obtained in the research study to gain disclosure of the Arthritis disease increase or decrease.

Arthritis Laboratory Report Analysis

Arthritis patients can provide information about laboratory results, according to our research. Many patients sometimes don't properly understand the information in the laboratory reports they get. Even if the doctor correctly analyzes the patient's level of disease, the patient's sick mentality prevents them from understanding the doctor's instructions. Therefore, a patient's family member is also unable to accurately recognize the patient's level of disease. different laboratory reports can be added to the system depending on the type of arthritis. This objective will help arthritis disease level to identify,

- The current level of the disease (high or low) will be clearly displayed on the laboratory reports that the patient acquired through this application once the patient or a family member uploaded the report as an image through the application.

- This app will deliver month-to-month predictions and details regarding the patient's disease level based on the data analyzed and measured by it.

- Also, a person who has lost laboratory reports can be available in an emergency by keeping them safely through the app.

Monitoring the side effects of heavy drugs and giving the health guidance

In studying the side effects of drugs, a patient can upload the arthritis prescription given by the doctor through our system as an image through our app. There, using our application, the drugs related to arthritis are identified, and their associated side effects are displayed. Our app provides health advice to prevent drug side effects and steps to take if they do occur.

3. METHODOLOGY

I propose a system to develop a mobile application feature to act as analyze arthritis laboratory reports and identify drug side effects. In this research, the patient needs to upload a lab report image. The uploaded image is matched, by using image processing techniques to get the best image matches possible. Using a Conventional Neural Network (CNN) to evaluate the lab results. The data in the report is then analyzed using PCR (Printed Character Recognition). Using a natural language processing (NLP) model trained to predict the side effects of the specified drugs

As there are numerous aspects that need to be covered in order to deliver an ideal solution, feasibility studies and user research were undertaken as the first task.

3.1. User Research

The initial phase of the product development process is requirement gathering. Hereabouts, we created a questionnaire on Arthritis patients' knowledge of Arthritis and gathered information. In order to determine user wants and needs that have not been met, the domain literature was also reviewed.

12. Have you ever used a mobile app to identify your Arthritis disease level?
48 responses

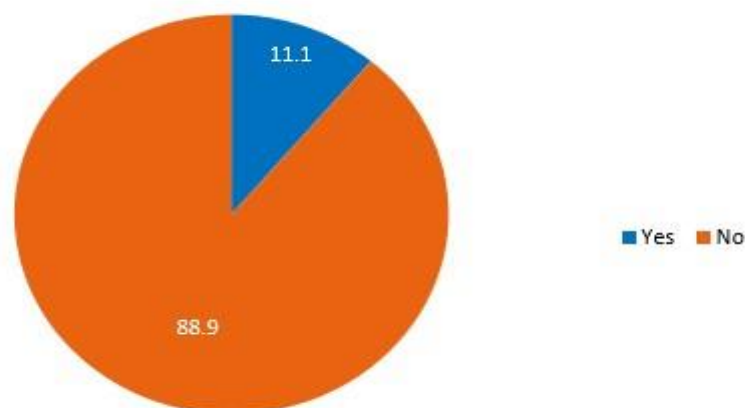Figure 7 Summary of responses regarding identify arthritis disease level

As shown in Figure 7, more than 89% of the survey respondents said they had never used a localized mobile app to identify Arthritis disease levels. Since there no proper localized method for identifying Arthritis disease levels, we compared our proposed system with other Disease detection systems, designed a case scenario, and examined user needs.

3.2. Feasibility Study

> ➢ Technical Feasibility

We analyzed the most recent technology methods while assessing earlier research reports, and we talked about the technical viability of this project. The newest technological method and the suggested framework make it possible. However, as it is essential to the entire process of product creation, we need to expand our knowledge of component development.

> ➢ Economic Feasibility

The application's components are distributed among the team members for us to complete the application with all the functions integrated effectively. Identifying the data analysis of the Arthritis laboratory report, and identifying drug side effects will be very useful for the successful development of the system and will reduce the cost of free access using a mobile phone without consulting a doctor

> ➢ Scheduling Feasibility

- Implementation Stage

The proposed system should also be completed before the deadline. We examine the Scheduling Feasibility and establish our tasks by the deadlines. Furthermore, present for delivering the final product on schedule.

The implementation phase is consistent with the following functional development,

1) Upload laboratory report and Analyze arthritis laboratory report data.

2)Implement a level of Arthritis high or low-level identification

3) Implement level of Arthritis diseases monthly level

4) Implement the Arthritis drug side effect identification

5) Implement health tips to protect against side effects

These activities include Mobile User Interfaces will be built for these functions.

- Testing Stage

As appropriate, attention should be taken when examining components for Arthritis disease issues in Arthritis patients. Therefore, the first testing phase should be performed with the Arthritis doctor's permission.

➢ Operation Feasibility

Analyzing arthritis laboratory reports and identifying drug side effects. The current level of the disease (high or low) will be clearly displayed on the laboratory reports that the patient acquired through this application once the patient or a family member uploaded the report as an image through the application. This app will deliver month-to-month predictions and details regarding the patient's disease level based on the data analyzed and measured by it. Also, a person who has lost laboratory reports can be available in an emergency by keeping them safely through the app. And also using our application, the drugs related to arthritis are identified, and their associated side effects are displayed. Our app provides health advice to prevent drug side effects and steps to take if they do occur. The patient benefits from this feasible solution. The mobile app will help users to avoid the problem of arthritis patients

3.3.   System Overview

According to my component, Arthritis Lab reports data analysis and identifying drug side effects. Even if the doctor correctly analyzes the patient's level of disease, the patient's sick mentality prevents them from understanding the doctor's instructions. Therefore, a patient's family member is also unable to accurately recognize the patient's level of disease. To analyze lab results and identify drug side effects, machine learning algorithms are used.

Different laboratory reports can be added to the system depending on the type of arthritis. Uploads lab report using image processing. Using a Conventional Neural Network algorithm (CNN) in order to evaluate the lab results. The data in the report is then analyzed using PCR (Printed Character Recognition). Using a machine learning approach to show monthly disease level change. The system will identify, analyze, and evaluate the laboratory results in accordance with the type of arthritis and show the disease level with the best degree of prediction accuracy. It can show as below.
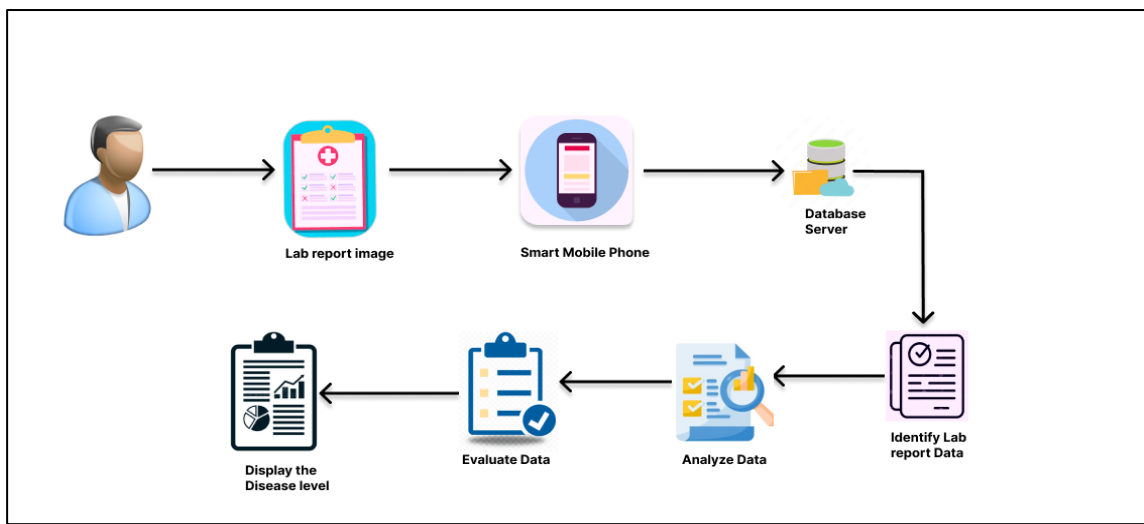
Figure 8 Laboratory report system overview

Additionally, this system provides health guidance to identify and prevent drug side effects. Using a natural language processing (NLP) model trained to predict side effects of specific drugs. Using API to provide health advice for drug side effects and displayed according to doctor's instructions. It can show as below

Figure 9 Predict Side effect system diagram

3.4. Work Breakdown Structure
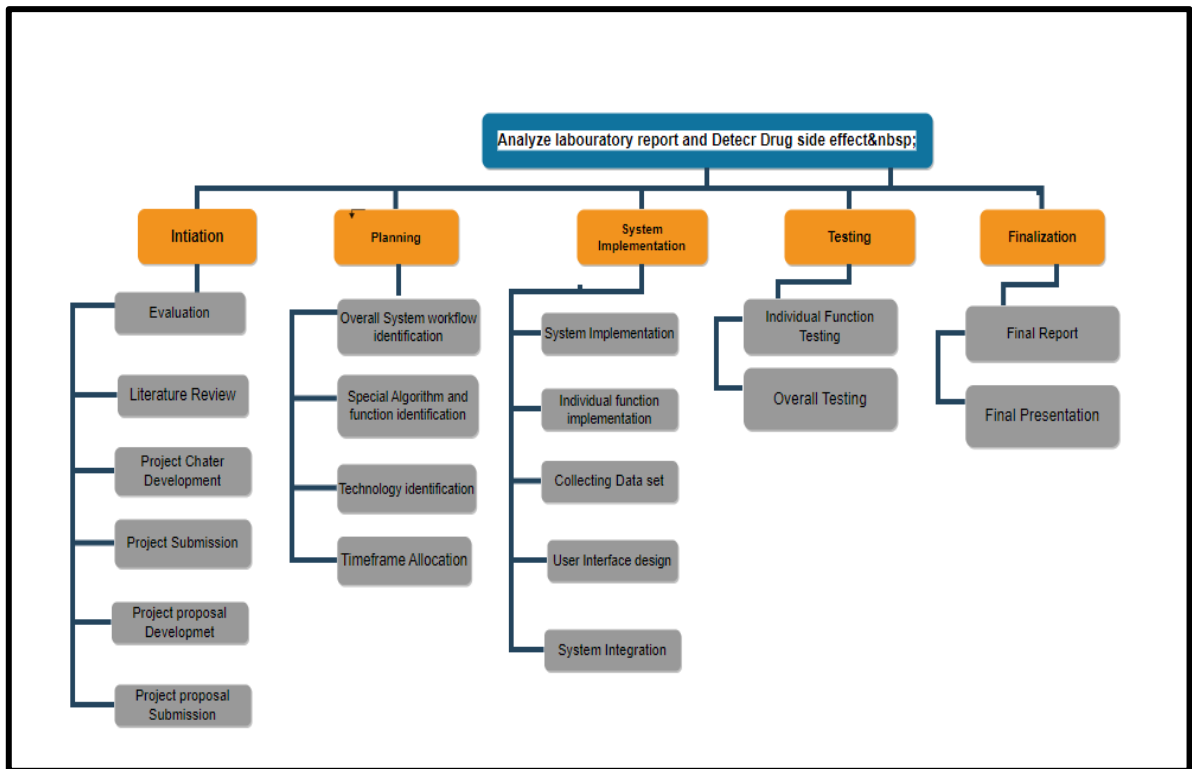
Figure 10 Work breakdown

3.5. Gantt Chart

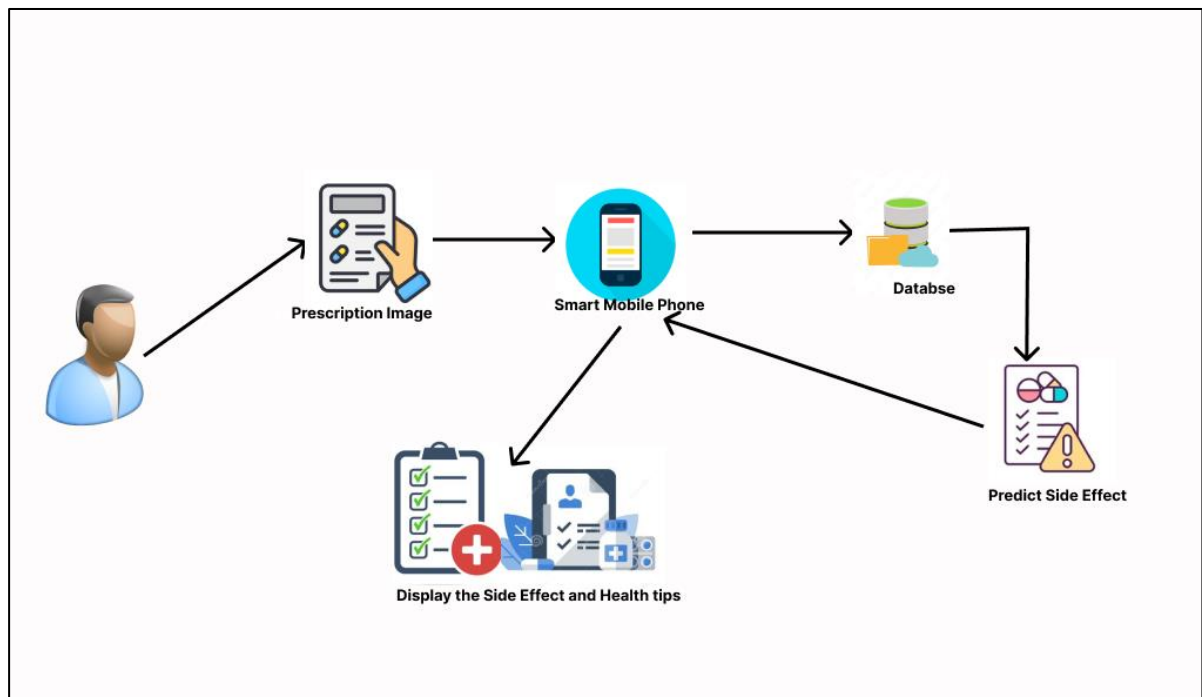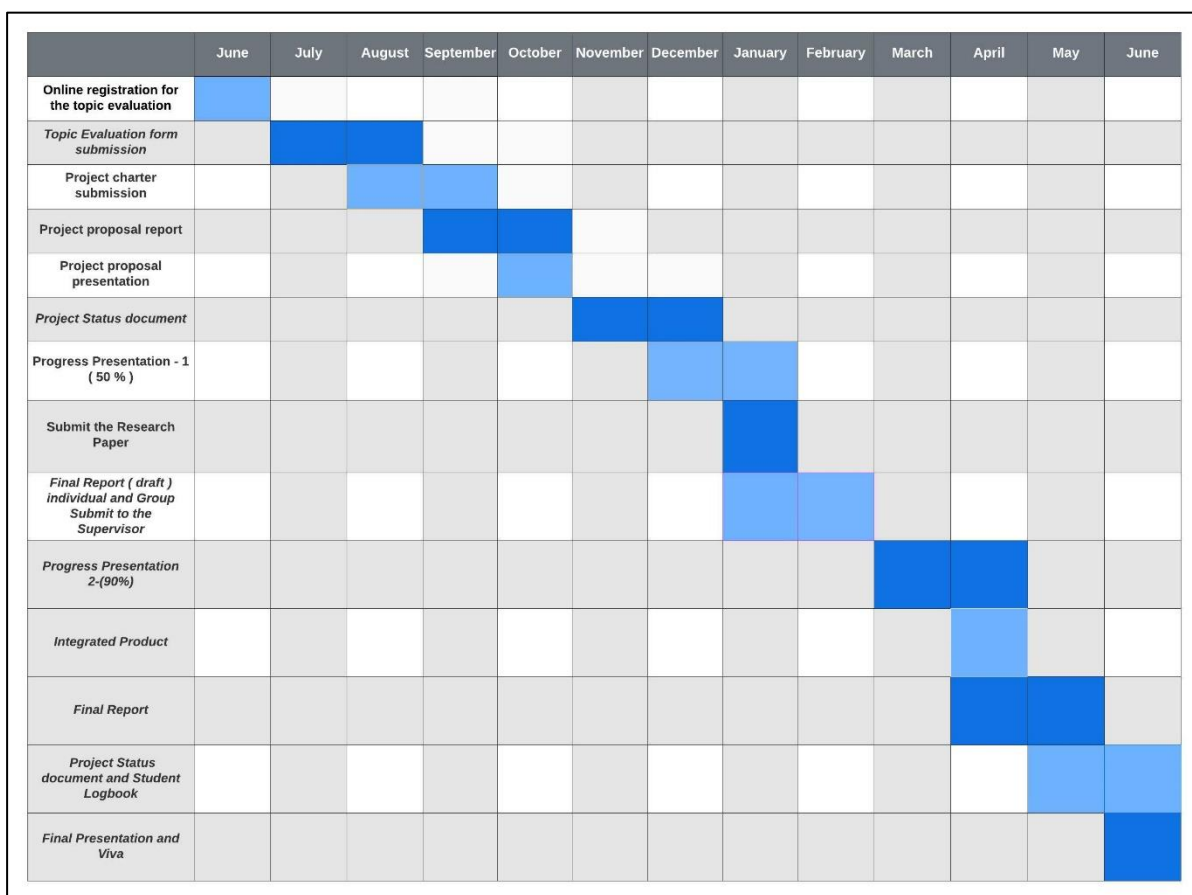|	June	July	August	September	October	November	December	January	February	March	April	May	June
Online registration for the topic evaluation	■												
Topic Evaluation form submission		■	■										
Project charter submission			■	■									
Project proposal report				■	■								
Project proposal presentation					■								
Project Status document						■	■						
Progress Presentation - 1 (50 %)							■	■					
Submit the Research Paper								■					
Final Report (draft) individual and Group Submit to the Supervisor								■	■				
Progress Presentation 2-(90%)										■	■		
Integrated Product											■		
Final Report											■	■	
Project Status document and Student Logbook												■	■
Final Presentation and Viva													■

Figure 11 Gantt Chart

4. PROJECT REQUIREMENTS

4.1. Functional Requirements

- Depending on the type of arthritis, patients taking drugs for it should be able to view the drug's side effects in the prescription.

- To prevent the drug's side effects, the patient should be able to see the necessary health instructions.

- Depending on the type of arthritis, it should be possible to upload images of the results of the laboratory tests.

- The decrease and increase of arthritis should be accurately displayed to the patient depending on the type of arthritis.

- Increases and decreases in arthritis should be shown month by month

- If the laboratory record has been entered into the system, someone who has lost them should be able to retrieve them.

4.2. Non-Functional Requirements

- Availability

The arthritis patient or a family member of the patient should be able to retrieve laboratory reports at any time after they are entered.

- Usability

The aim of this study is to develop a mobile application on the Android platform to be used by arthritis patients and to analyze the laboratory reports given according to the types of arthritis to tell the level of the disease and to point out the side effects of the drugs given for arthritis and to give the necessary advice to avoid those side effects.

- Capacity

Since this system is installed and used as a mobile application, the device's storage capacity should be taken into consideration.

- Readability

The data in the laboratory report should be easy to understand and be able to correctly identify drug side effects

- Performance

There are open-source libraries of pre-made components that can further speed up the process of React Native applications.

5. DESCRIPTION OF PERSONNEL AND FACILITIES

5.1. Tasks assigned to the component

Table 2 The tasks allocated to the development of the component

Member	Component	Task
D.H.K Chathurani Jayangika IT19146270	Mobile application feature to act as a system to identify Arthritis laboratory reports and identify drug side effect diseases.	1. Developing a mobile platform to upload the images Laboratory report using image processing 2. Using a Conventional Neural Network (CNN) in order to evaluate the lab results. 3. The data in the report is then analyzed using PCR (Printed Character Recognition). 4. Using a machine learning approach to show monthly disease level change. 5. Using a natural language processing (NLP) model trained to predict the side effects of the specified drugs. 6. Using API to Provide Health tips for relevant drug side effect.

5.2. Resource Personnel for development

The table shows the resource personnel who assist in providing the database for the Arthritis laboratory report and drugs side effect identification process.

Table 3 Resource Personnel

Name	Designation	Company
Charuni Pinnaduwa	Doctor	District Base Hospital Theldeniya
Namal Pathirana	Doctor	Badulla General Hospital

5.3. System and Software Requirements for development

The proposed solution must be implemented properly, which will involve certain hardware and software requirements. Below is a description of every element of the system and software specifications.

✓ System Requirements

Android Phone/tab
- Android Version: Below 10.0
- Memory: 1GB
- Free Space: 256MB
- Back Camera: Minimum 5MP
- X86 64-bit CPU (Intel / AMD architecture)

✓ Software Requirements

- Android Emulator
- NPM
- NodeJS

6. COMMERCIALIZATION PLAN

6.1. Targeted Audience

Patients with arthritis will be the primary focus of the suggested remedy. End users of this system will be doctors, patients, and assistants.

6.2. Benefits to the end-users

- The user can get a solution to Arthritis diseases in a short period
- Without going to a doctor, identify the Laboratory report and Drug side effects.
- Providing health tips to protect against drug side effects.
- Gaining a better understanding of the level of the arthritis disease
- Get service from the mobile app anytime

6.3. Advertising and Communication

Commercializing an all-purpose tool would be extra valuable for users in the target domain and can be considered a simple however rewarding innovative venture.

- Social media is used to market the app mainly.
- We'll create a Facebook page and a YouTube channel to promote the mobile app in-depth.

7. BUDGET AND BUDGET JUSTIFICATION

Table 4 Development cost

Description	Amount
Server Cost	2000.00
Internet Usage Charges	2000.00
Travelling cost	2000.00
AWS S3 Cloud Service	4000.00
Hosting	2000.00
Documentation and Printing Cost	1000.00
Total	13000.00

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