Faculty of Computers &
Artificial Intelligence

Benha University

Early prediction of Atrial Fibrillation & Congestive Heart Failure

Medical Informatics program

Project Team

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Although it was a challenging journey, we are here standing and discussing this project that helped us to be patient and hardworking.

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for their efforts and patience with us.

DECLARATION

We hereby certify that this material, which we now submit for assessment on the program of study leading to the award of Bachelor of Computers and Artificial Intelligence in *Bachelor degree (Graduation project)* is entirely our own work, that we have exercised reasonable care to ensure that the work is original, and does not to the best of our knowledge breach any law of copyright, and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of our work.

Signed:

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‘

Abstract

According to data published by the World Health Organization in 2019 - on top of more than 23 million patients globally - heart disease was the primary cause of death for more than 32 percent of 17.9 million deaths, and in the deaths of 17 million patients (under the age of seventy), heart diseases accounted for 38 percent of deaths. Therefore, the goal of this research is to identify cardiac problems early, especially those that are frequently diagnosed in their advanced stages, such as atrial fibrillation and Congestive heart failure .

(AF) is a heart condition that causes an irregular and often abnormally fast heart rate it can be considerably higher than 100 beats a minute. Sometimes AF does not cause any symptoms and a person who has it is completely unaware that their heart rate is irregular.

(CHF) is a chronic progressive condition that affects the pumping power of heart muscle. It specifically refers to the stage in which fluid builds up within the heart and causes it to pump inefficiently. By using ML model we could predict early stages of both AF & CHF with accuracy 99.67%. & 98.87%

We tested the model by using our hardware device that we built to capture real time ECG signals from AF & CHF patients. The device will be existed and available in hospital and sports fields. Then the results will be displayed in our Mobile Application which is connected to the model that analyze the ECG signals.

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List of Abbreviations

CHF	Congestive Heart Failure
AF	Atrial Fibrillation
ML	Machine Learning
DL	Deep Learning
LV	Left Ventricle
ECG	Electrocardiogram
UML	Unified Modelling Language
PCB	Printed circuit Board
CNN	Convolutional Neural Network
SVM	Support Vector Machine
KNN	K-Nearest Neighborhood
ANN	Artificial Neural Network
PTB	Physikalisch-Technische Bundesanstalt
DT	Decision Tree
RF	Random Forest

CHAPTER ONE

INRODUCTION

Worldwide, more than 23 million patients are affected by heart diseases, which makes it a major public health problem and huge economic burden.

heart disease is considered one of the most dangerous and life snatching chronic diseases all over the world. In heart disease, normally the heart fails to supply sufficient blood to other parts of the body to accomplish their normal functionality

In this project, we will focus on two main diseases of the heart:

1. Atrial fibrillation (AF):

It is a heart condition that causes an irregular and often abnormally fast heart rate.
The heart rate is irregular and can sometimes be very fast. In some cases, it can be considerably higher than 100 beats a minute. A normal heart rate should be regular and between 60 and 100 beats a minute when you're resting. Sometimes atrial fibrillation does not cause any symptoms and a person who has it is completely unaware that their heart rate is irregular.

2. Congestive Heart Failure (CHF):

CHF is a chronic illness that affects the heart chambers. It occurs when the heart is unable to pump blood adequately throughout the body without an increase in intracardiac pressure. The kidneys respond by retaining body fluid, which results in lung congestion and swelling in the arms and legs. CHF is caused by functional impairment of the left ventricle, which is the dominant contractile chamber that pumps blood systemically. The systolic contractile function of the LV is conventionally quantitated using the LV ejection fraction (EF), defined as the ratio of LV stroke and end-diastolic volumes, with normal LVEF being 50% or more. CHF can be stratified into two main types: heart failure with reduced (HFrEF) and preserved EF (HFpEF) ejection fraction, characterized by predominance of either inadequate LV systolic contraction (EF less than 50% typically) or inability of the LV to expand or fill efficiently during diastole, respectively. While classification of HFrEF and HFpEF is arbitrarily based on the level of EF, elements of LV, both systolic contractile and diastolic filling pathophysiological changes, can co-exist in the same patient. This project aims at early detection of patients in emergency rooms in hospitals, clinics, medical institutions, and Sports Field.

Problem Statement:

The importance of early detection of cardiovascular disease is what makes the difference between life and death, by being aware of the early signs of heart disease such as atrial fibrillation and congestive heart failure.

With the help of our project, we aim to early detection of these diseases in order to help both the doctor and the patient, and thus you will have a better chance of treatment, improving the condition and avoiding serious complications, resulting in a reduction in the number of deaths resulting from these cardiovascular diseases (AF) & (CHF).

Solution:

Nowadays, many heart’s patients suffer from chronic diseases. Heart diseases that can kill a person fast, although there are many solutions to solve this problem. Among these solutions, which require a quick test on the patient's future condition as a result of the signals coming from the heart. We have to add a web application or desktop application to do a comprehensive examination for 2 diseases including (Atrial fibrillation and Congestive Heart Failure). We look forward to continuing the path of researchers who have been busy with this technology and development on it to show more accurate results to help the doctor in the examination and give the appropriate medication before this process occurs.

- Artificial intelligence will play a vital role in deducing many impressive results to discover these diseases before they occur in the heart. Although a lot of heart signals are captured in vectors, we created an application that is connected with a Model & Hardware Device. By the use of or Hardware / Device the doctor and patient will be able to record patient’s heartbeat signals and send it to the Model Which will analyze those signals and show the result if the patient has any of the 2 diseases (Congestive Heart Failure or Atrial Fibrillation) or the patient is well then, the result will be shown on our application.

That will help us to rescue our patient on early stages and reduce death cases which happen because of Congestive Heart Failure or Atrial Fibrillation.

Motivation:

Nowadays, many heart’s patients suffer from chronic diseases:
•CHF and AF are growing all over the world it is a major cause of death for millions of people around the world. As a result, accurate diagnosis, monitoring, and management are critical.
•Although there are many methods of diagnosis, but these methods are expensive and time-consuming, so we decided, with the help of new technologies, to find an easy-to-use and low-cost method to help patients faster and provide a high-level medical service. Because the patient's comfort is always our priority.

Project Scope:

With the help of our project, we aim to early detection of these diseases in order to help both the doctor and the patient (in Hospital Reception & Emergency Room and Sports Field), and thus you will have a better chance of treatment, improving the condition and avoiding serious complications, resulting in a reduction in the number of deaths resulting from these diseases and emergency rooms in hospitals that can be followed up quickly for operations if necessary. As well as Sports Field, then direct transfer to the hospital for treatment.

Project advantages:

• There are numerous advantages of the usage of our project:

1-Build a Low Coasted Device
2-Build a Portable Device with approximately no weight
3-Easy to Use Device, not working with specialist
4-Rapid response. Results are shown in our application
5-Easy to use Application with no complexity

6-Ability to Maintain & develop the model to detect more disease

7-Help many patients in many places and save their lives.

Project disadvantages:

•According to short time that causes some disadvantages that we need to handle:

1_Detect only 2 diseases of many of heart disease.

2 – Less of integration between our ECG system & Medical record system

Deliverables:

- Hardware device: able to capture ECG signal.
- Software:

1- A Model that can detect the AF and CHF.

2- An android application for display result

3 – A website for display result if Application is not downloaded

That contain all the sources which make the project available for diagnoses.

Project challenges:

• We face many challenges while working with our system. We can find many setbacks with the ECG signals because of:

- In the near future there will be a drawback of models
- How to secure Database of ECG signals while transfer it from the Hardware to the Model
- How to control Any development of ECG signals to any one of disease
- Increasing cost according to big size of Signals & Model Development
- How to keep response Fast & don’t Increase Time
- How to manage Maintenance of the project

CHAPTER TWO

LITERATURE REVIEW

Related Work

After searching and reading of papers related to our project, we found that

Deep convolutional neural network for the automated diagnosis of congestive heart failure using ECG signals [1].

In this paper, they develop an 11-layer deep convolutional neural network (CNN) model for detecting CHF. This suggested CNN model requires very little pre-processing of ECG signals and does not require any engineered features or classification. The suggested CNN model was trained and tested using four different sets of data (A, B, C, and D). Set B had the best accuracy of 98.97 percent, as well as the highest specificity and sensitivity of 99.01 percent and 98.87 percent, respectively, among the four sets. By providing more objective and faster interpretation of ECG signals, the suggested CNN model can be put into practice and serve as a diagnostic assistance for cardiologists.

Congestive heart failure waveform classification based on short time-step analysis with recurrent network.[2]

They develop 15 models using a data base consisting of 10 recordings, divide them into 80 percent for training and 20 percent for testing and validation, and then choose the best model with accuracy 99.36 percent by using deep learning techniques and recurrent neural networks and LSTM.

Machine learning based congestive heart failure detection using feature importance ranking of multimodal features.[3]

Empirical Receiver Operating Characteristics (EROC) values were used to classify patients into five groups. They determine the highest performance and accuracy classifier among (Decision tree-Nave Bayes –SVM) which was SVM with accuracy 88.79 percent.

Regularized HessELM and Inclined Entropy Measurement for Congestive Heart Failure Prediction [4]

The research focuses on the automated prediction of congestive heart failure using ECG signals

Regularized hessenberg decomposition based extreme learning machine (R-HessELM) and feature models; squared, circular, inclined, and grid entropy measurement were introduced and applied for CHF prediction. This study demonstrated that aspects of inclined entropy measurements accurately depict ECG signal properties, and that when combined with the R-HessELM technique, overall accuracy of 98.49 percent was attained.

Use of Accumulated Entropies for Automated Detection of Congestive Heart Failure in Flexible AnalyticWavelet Transform Framework Based on Short-Term HRV Signals [5]

The Flexible AnalyticWavelet Transform, which decomposes HRV signals into distinct sub-band signals, is used in this technique. Furthermore, the cumulative sums of these sub-band signals are used to construct Accumulated Fuzzy Entropy and Accumulated Permutation Entropy. This gives complexity analysis at various frequency scales utilizing fuzzy and permutation entropies. From the signals acquired at different frequency ranges of HRV signals, we identified 20 characteristics. The collected features from three distinct lengths of HRV signals are ranked using the Bhattacharyya ranking algorithm (500,1000 and 2000 samples). The Least Squares Support Vector

Machine (LS-SVM) classifier is fed these rated features. For the 500-sample duration of HRV signals, our suggested method achieved a sensitivity of 98.07 percent, specificity of 98.33 percent, and accuracy of 98.21 percent. For HRV signals with a length of 1000 samples, our system had a sensitivity of 97.95 percent, specificity of 98.07 percent, and accuracy of 98.01 percent, and for signals with a length of 2000 samples, our system had a sensitivity of 97.76 percent, specificity of 97.67 percent, and accuracy of 97.71 percent.

Detection of Atrial Fibrillation Using a Machine Learning Approach[6]

They built six models based on deep learning methodologies (SVM-LSTM-CNN) after researching heart rate variability, and then tested them on 13 patients with overall accuracy 87.5 percent.

Early Detection of Atrial Fibrillation Based on ECG Signals [7]

The aim is to develop an intelligent wireless system with a built-in abnormal ECG detection mechanism and an alert expert system for the early detection of cardiac disorders. The first part of the Arduino algorithm was developed to extract and plot the raw ECG signal and to convert the signal using transfer function and process it with digital filtering method. The second part of the algorithm determined the heart beats per minute of the healthy ECG signal, followed by the RR interval of the ECG signal. The third part of the algorithm was developed to compare the result acquired from second part with the normal values which was included in the algorithm as the threshold value to show the alert for any potential cardiac events. The accuracy was about 96%–98.5%.

Machine learning detection of Atrial Fibrillation using wearable technology [8]

An inexpensive wearable heart rate monitor and machine learning algorithm can be used to detect AF with very high accuracy and has the capability to transmit ECG data which could be used to confirm AF. It could potentially be used for intermittent screening or continuously for prolonged periods to detect paroxysmal AF. Further work could lead to cost-effective and accurate estimation of AF burden and improved risk stratification in AF. The SVM algorithm demonstrated excellent discrimination with sensitivity and specificity both exceeding 99 percent for the training data set. This compares favorably with other algorithms results using the same databases in the literature.

Deep Neural Networks Can Predict New-Onset Atrial Fibrillation From the 12-Lead ECG and Help Identify Those at Risk of Atrial Fibrillation [9]

Deep neural networks were trained to predict new-onset AF in patients without a history of AF. Performance was evaluated using areas under the receiver operating characteristic curve and precision-recall curve. For all experiments, data were divided into training, internal validation, and test sets. The composition of the training and test sets varied by experiment, as described in Study Design; however, the internal validation set in all cases was defined as a 20 percent subset of the training data to track validation area under the receiver operating characteristic curve (AUROC) during training to avoid overfitting. Accuracy was about 95 percent.

Detection of Atrial Fibrillation Using 1D Convolutional Neural Network [10]

To improve detection accuracy and reduce network complexity, this research offers an AF detection approach based on an end-to-end 1D CNN architecture. We create a simple, yet effective 1D CNN (10-layers) by analyzing the effects of key components of a convolutional block on detection accuracy and using grid search to acquire optimal hyperparameters of the CNN. Because the PhysioNet Challenge 2017 dataset contains ECG recordings of varying durations, we propose a length normalization approach to generate equal-length records in order to meet the CNN criterion. Our method of 1D CNN obtains an average F1 score of 78.2 percent, according to experimental findings and analyses

CHAPTER THREE

PLANNING & SELECTION

Assess scope and complexity of project then establish procedures to support activities. Here we define. Clear, discrete activities and the work needed to complete each activity (Table 3,1)

Table 3.1: Project plan

Task	Start time	End time
Improve Team skills	15 – Sep	15 – Oct
Do surveys	16 _ Oct	25 _ Oct
Select paper	26 _ Oct	31 _ Oct
Do Analysis	1 – Nov	7 _ Nov
Download dataset	8 _ Nov	11 _ Nov
Work on Hardware	12 _ Nov	17 _ Nov
Build Mobil App	18 _ Nov	5 _ Dec
Exams		
Start to work on data set	2 _ Feb	12 _ Feb
Build the model	13 – Feb	5 _ march
Connect the model with the Application	6 _ March	15 _ March
Connect Hardware with Software	16 _ March	26 _ March
Test	27 _ March	2 _ April
Modify & maintain	3 _ April	17 _ April
Final Release	18 _ April	

As a completing step we used Gantt chart which is a diagram that represent our tasks and duration and dependency of each on other (Figure 3.1)

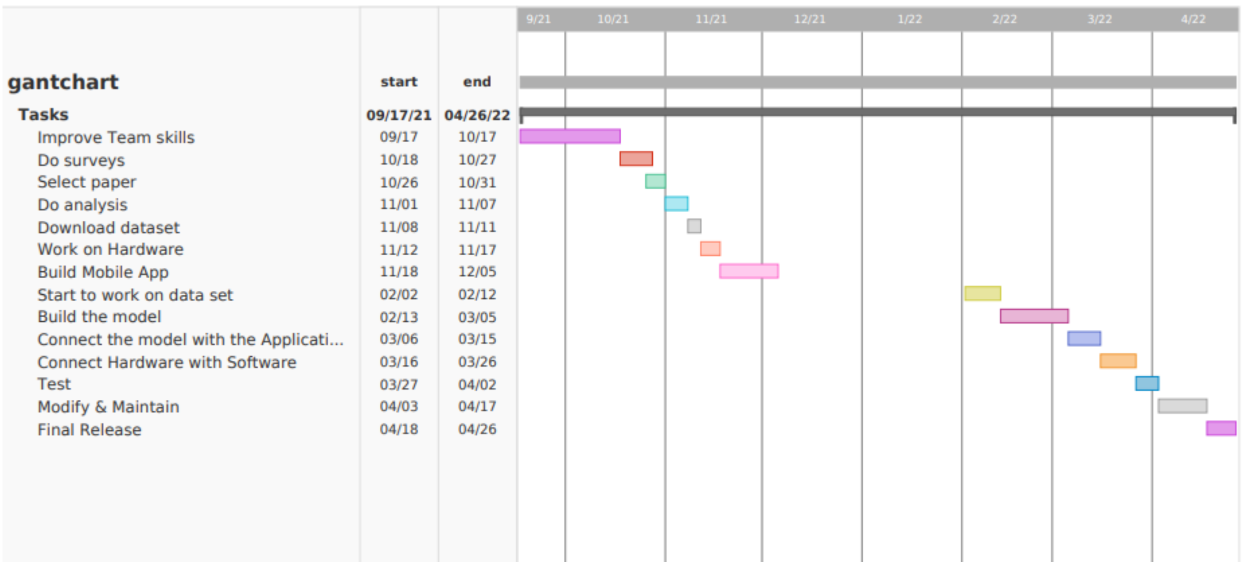


Figure 3.1: Gantt Chart for Project Plan

CHAPTER FOUR

SYSTEM ANALYSIS & DESIGN

Assumptions

The following assumptions are made in order to simplify the overall architecture of the system:

There are only these assumptions how hardware read & capture the ECG signals and the ease of carrying the device for diagnosis, whether it is in sports field or emergency departments in hospitals or any other health care and then move the patient to Cardio Department if the patient has atrial fibrillation or congestive heart failure

System Requirements [11]

Functional Requirements:

1 - Build Model that train on dataset to be able to detect AF & CHF & Normal Heartbeat

2 – Build Hardware Device that capture ECG signals

3 - Create Application that display results of ECG if it contains AF or CHF

4 - Sensors attached to Right Arm & left Arm & left leg to get ECG signals

5 – Use Integrated development environment Software (Programs) to build our project such as

- 5.1 Anaconda (Jupyter Notebook / Spyder) To build the Model
- 5.2 Android studio to build the Application
- 5.3 Arduino IDE to Capture signal from our Arduino microcontroller Hardware

Non-Functional Requirements:

1 - **Security**: All operators of administrative and data entry have separate logins. Should understand who is actually logging in to the network, no intruders allowed Nobody can change records and valuable data excluding administrative system

2 - **Safety**: If a significant portion of the database is destroyed due to catastrophe Failure, such as a disk crash, returns a past copy of the recovery process Database backed up to archival storage and restoration of a more Present status by reapplying or rescheduling the transactions committed from the log backed up, right up to the failure time.

3 - **Performance**: Answer time-The device will provide answers within 1 second after the search, Capacity-The system must support 1000 people at a time

4 - **Usability**: the quality of the user experience when using a website, software the goal of usability is to satisfy the end user effectively and efficiently

5 - **Speed or responds**: The most important attribute of good customer service, according to clients' themselves, is a fast response time. How quickly do you respond to your own clients So the device will provide answers within 1 second after the search.

6 - **Controls**: It helps us to prevent or eliminate degradation of any part of the system, initiate immediate response to demands that are placed on the system, respond to changes in the system to meet long range requirements, and may include various sub functions, such as continuous control of quality, continuous control of performance

7 - **Error detection**: Error can occur anytime and anywhere. So, the major activities of system with respect to error handling. So, system should constantly remain aware of possible errors. The system must take the appropriate action to ensure correct

8 - **Maintainability**: It is the modification of a software product after delivery to correct faults, to improve performance or other attributes and it involves fixing defects.

9 **- Stability and Testes**: tests increase confidence in a couple of ways. As launch time approaches, the customers are confident that the software works. They have seen the results of the functional tests and know that they are correct. Tests also make developers more confident. The code release process includes running all the tests. If a test fails, no code can be released

UML Diagrams

Context Diagram

It represents all entities that may interact with the system and all inputs and outputs of the system (Figure 4.1).

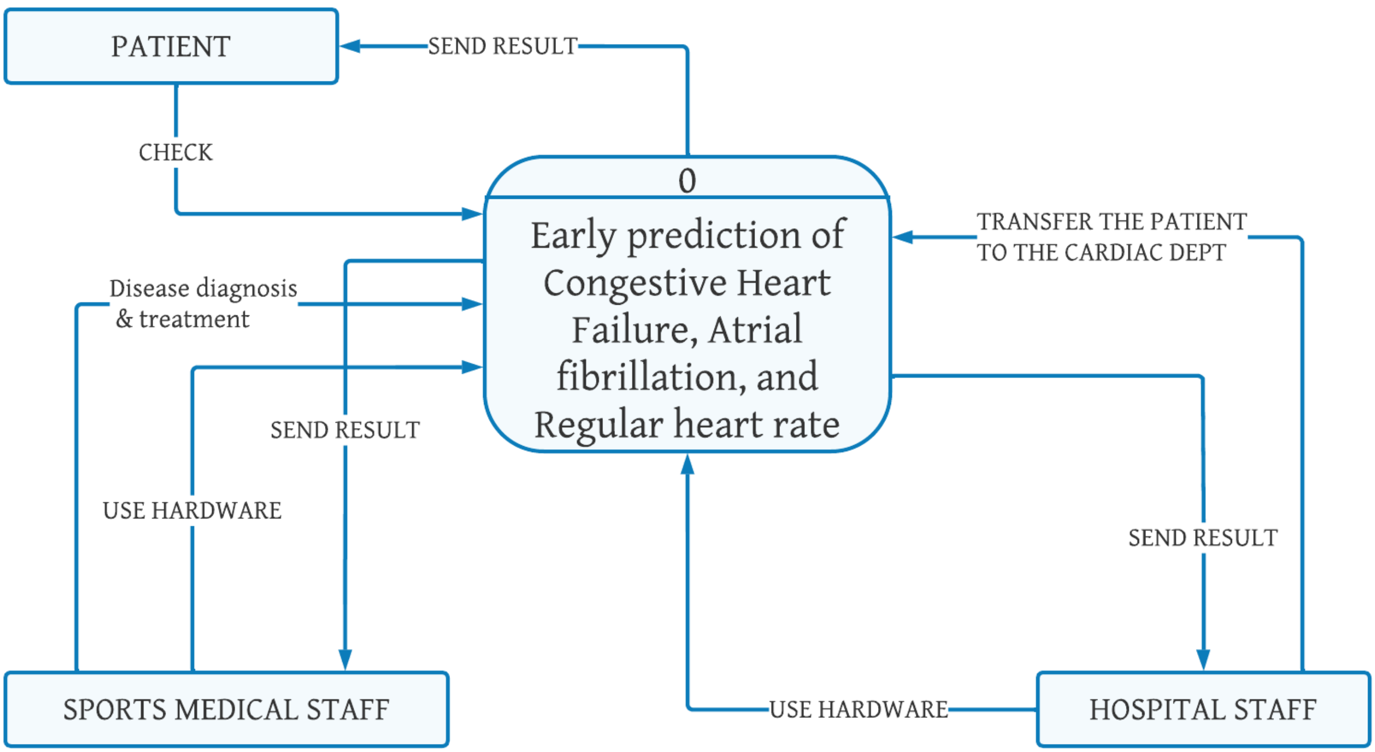


Figure 4.1: Context Diagram

Use Case Diagram

Use case diagram represents the relation between users and different use cases in the system. It determines the different users of the system and operations (Figure 4.2).

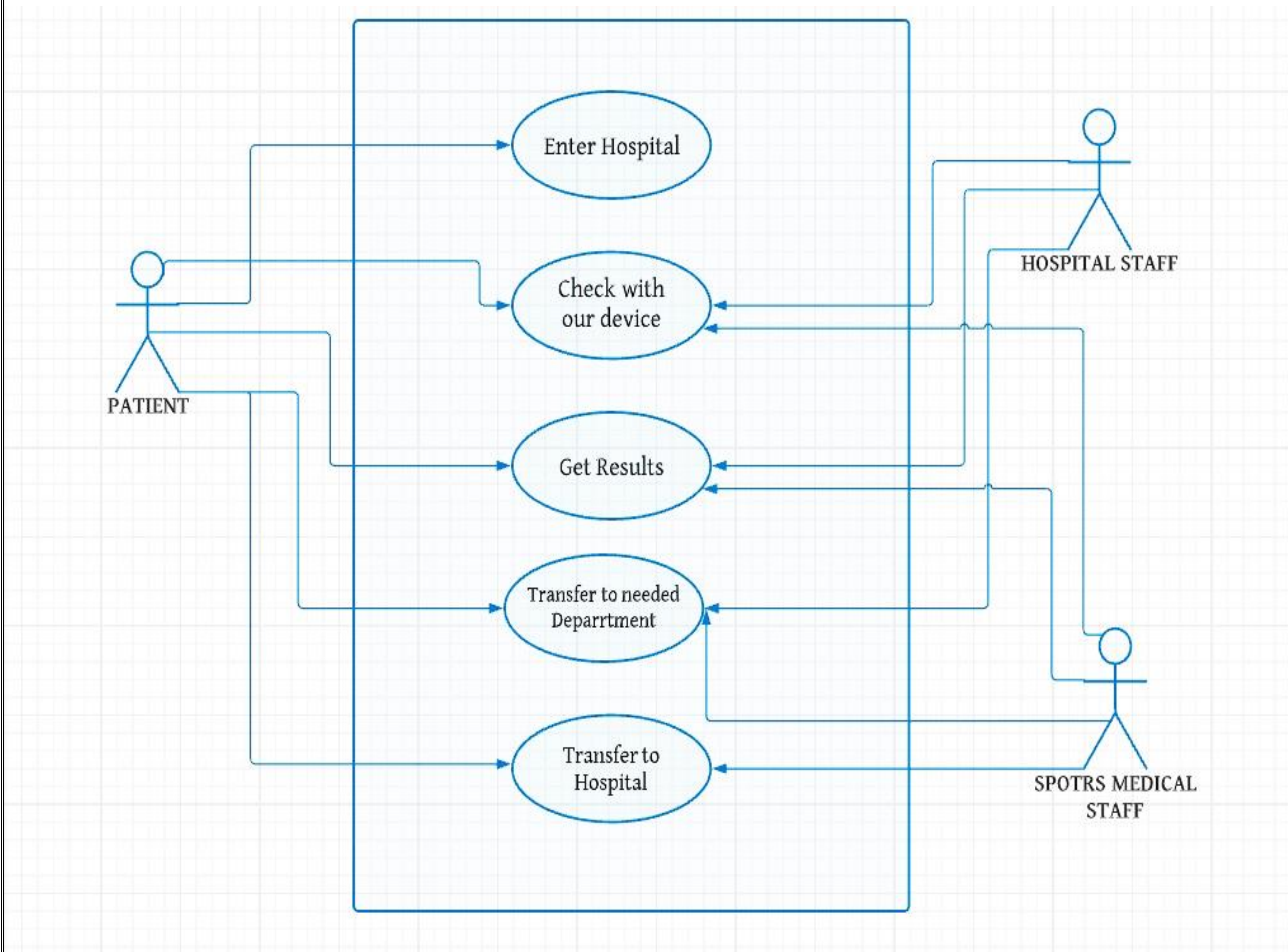


Figure 4.2: Use Case Diagram

DFD Diagram

A data-flow diagram is a way of representing a flow of data through a process or a system. The DFD also provides information about the outputs and inputs of each entity and the process itself (Figure 4.3).

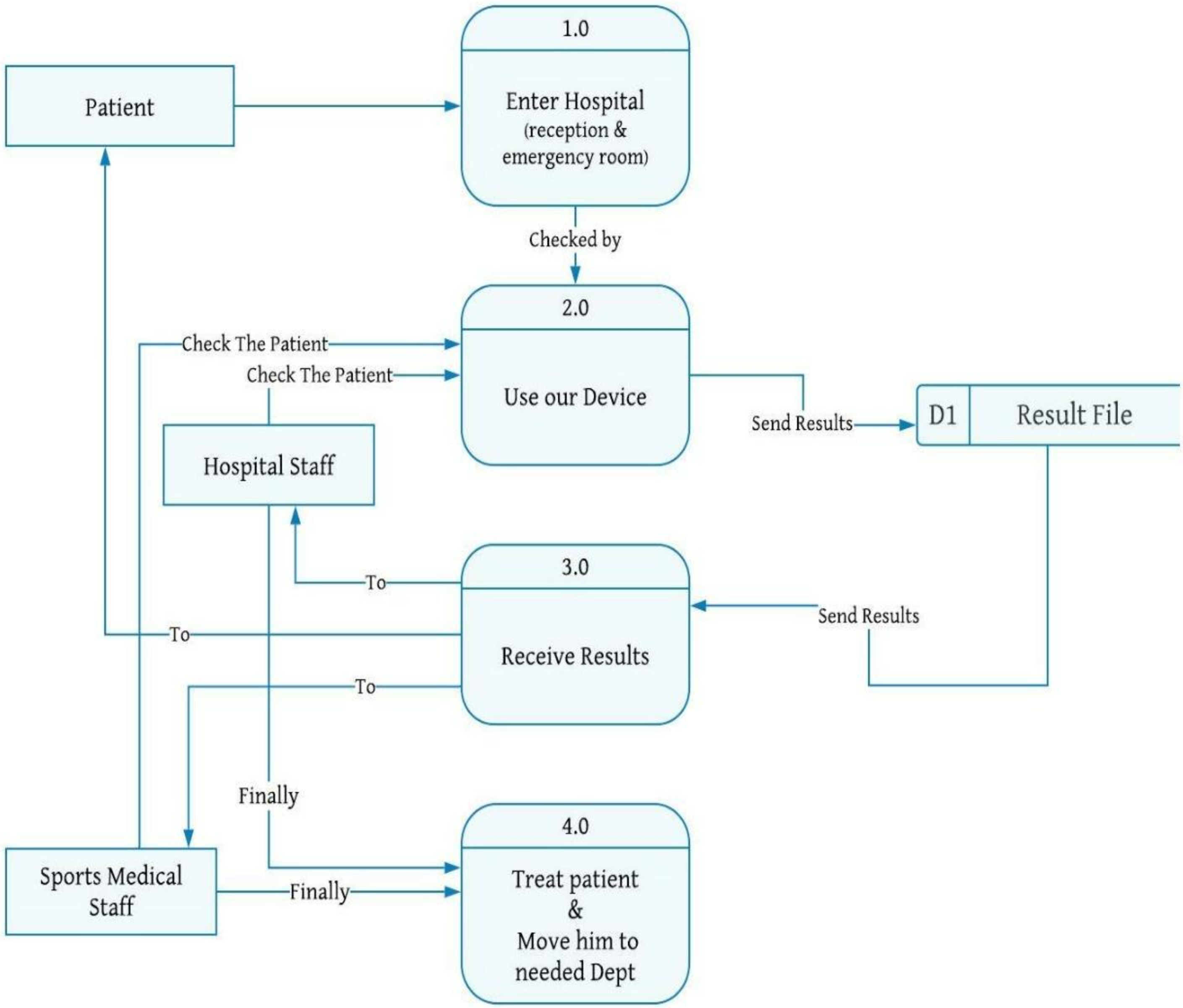


Figure 4.3 : DFD Diagram

Sequence Diagram

A sequence diagram is a type of interaction diagram, it describes how—and in what order—a group of objects works together. it is used by software developers and business professionals to understand requirements. (Figures 4.4.a, 4.4.b).

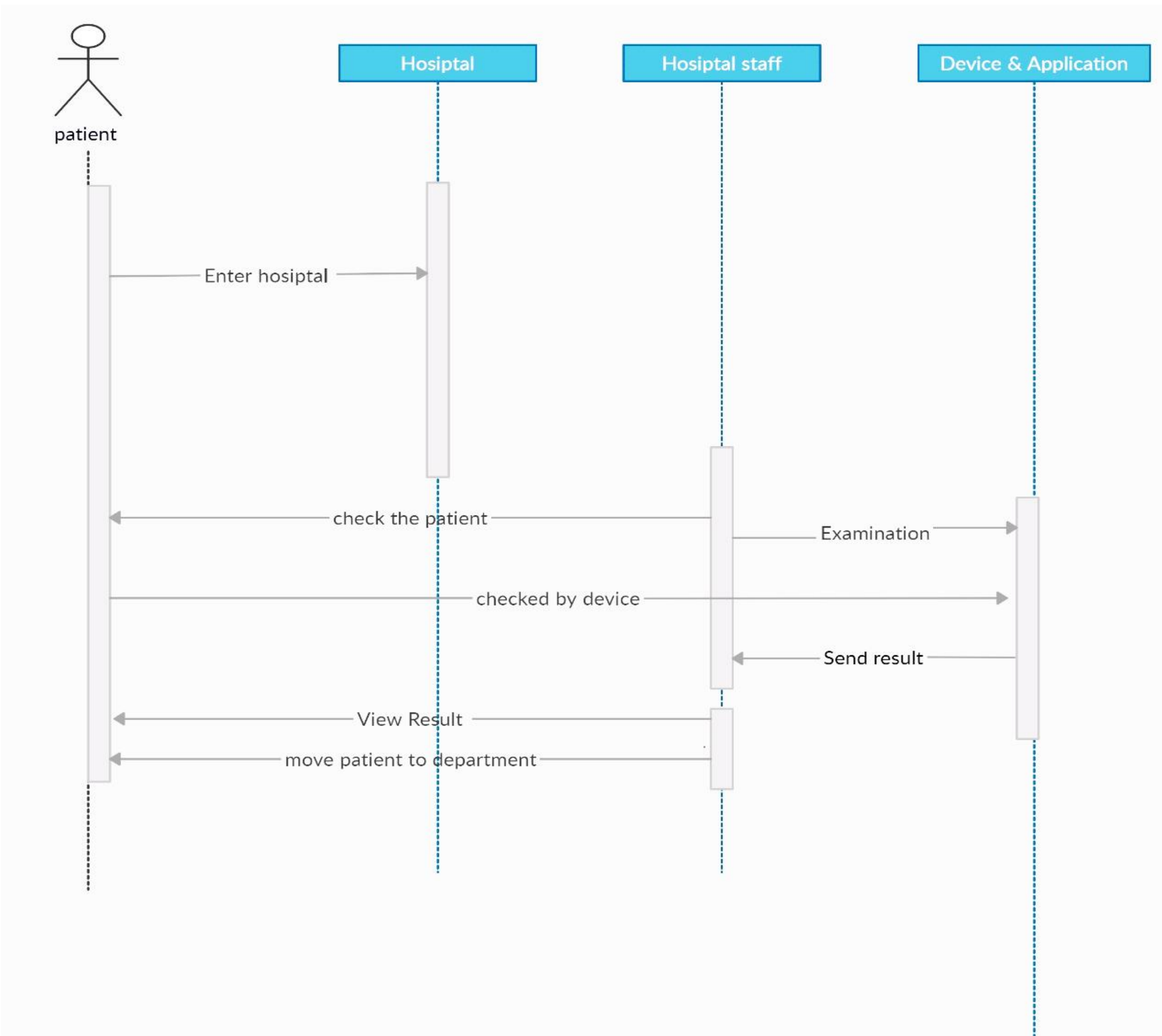


Figure 4.4.a : Sequence Diagram

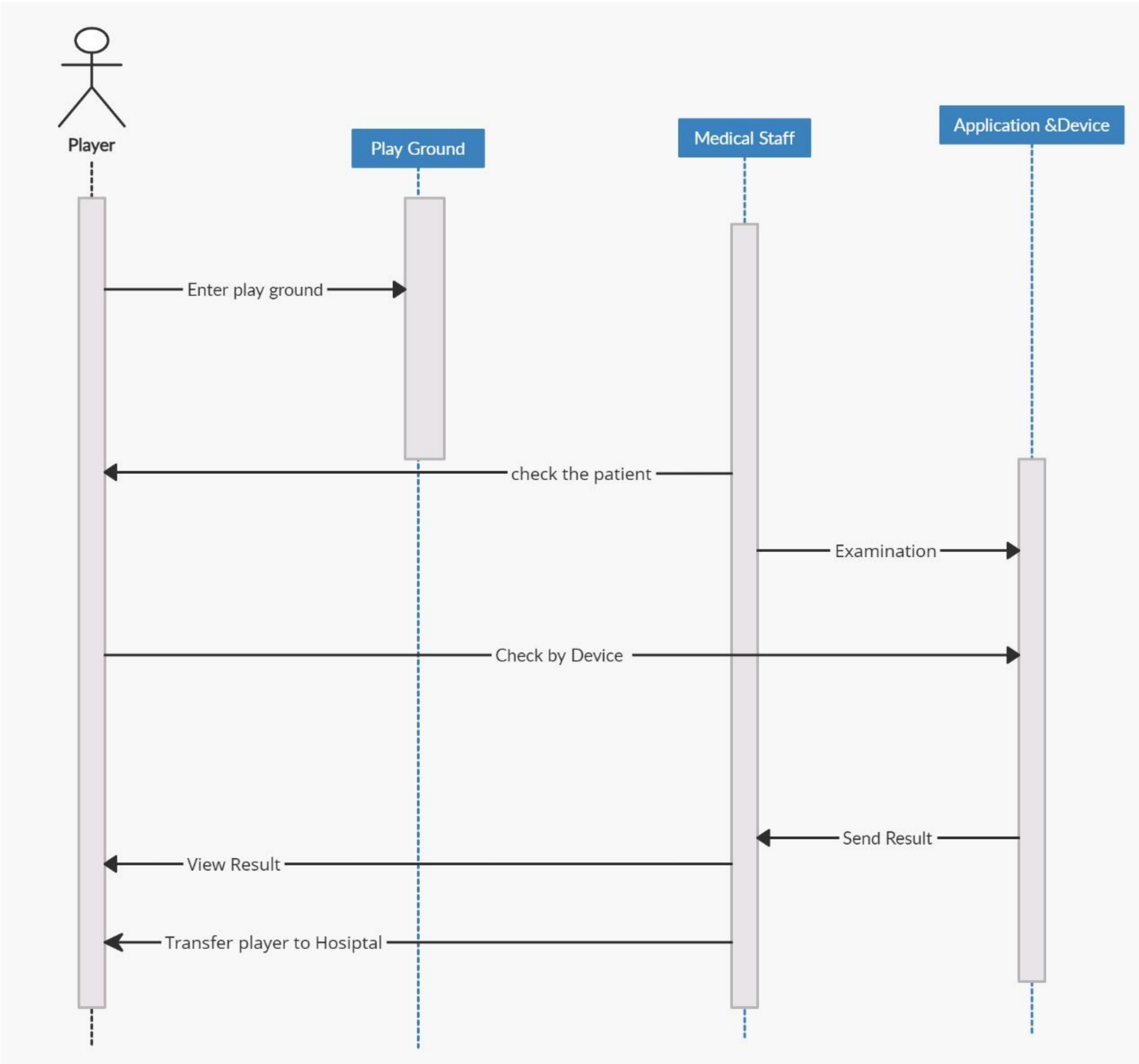


Figure 4.4.b: Sequence Diagram

Class Diagram

A class diagram in the Unified Modeling Language (UML) describes the structure of a system by showing the system's classes, attributes, operations, and the relationships among objects.

(Figure 4.5)

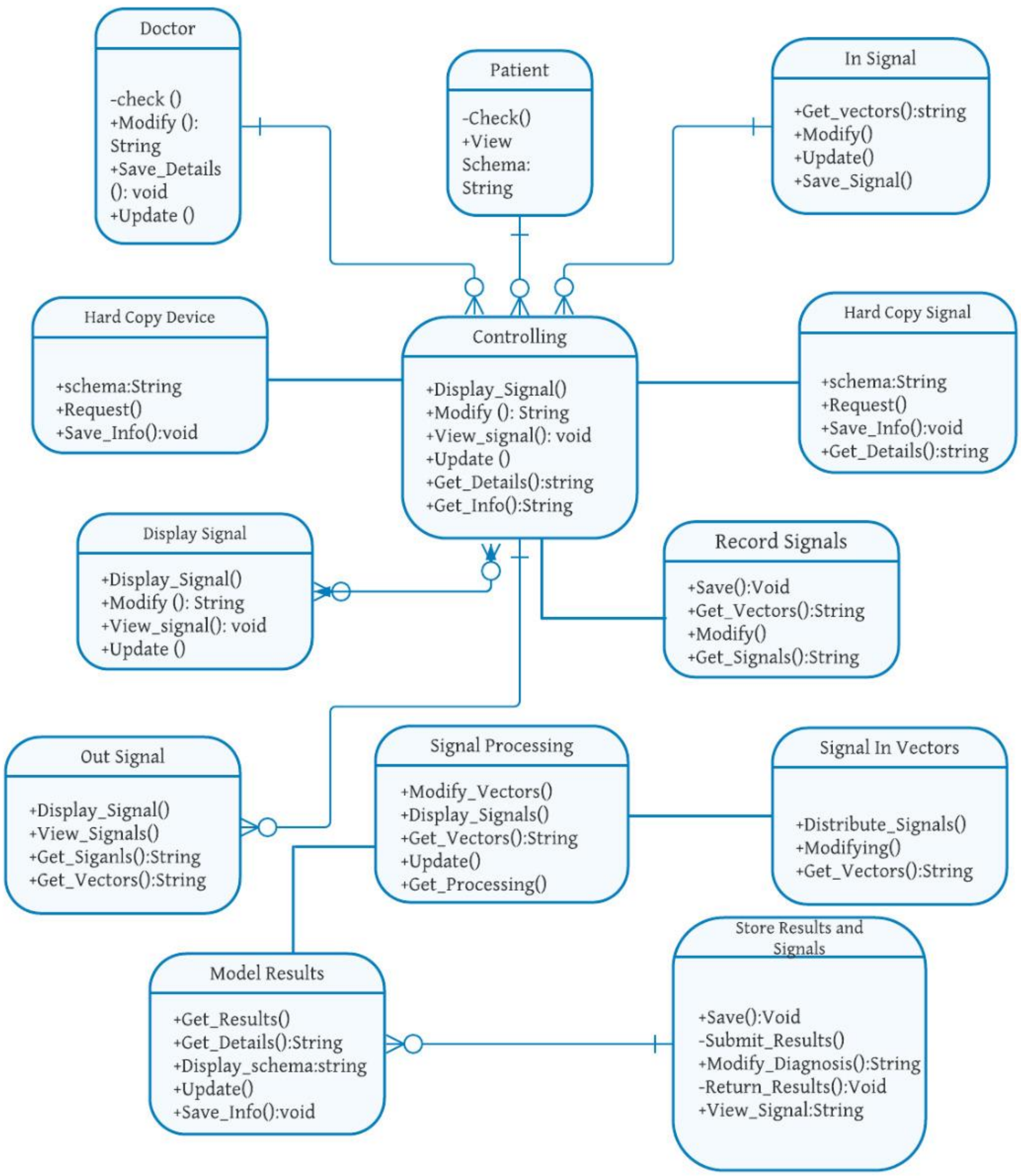


Figure 4.5: Class Diagram

CHAPTER FIVE

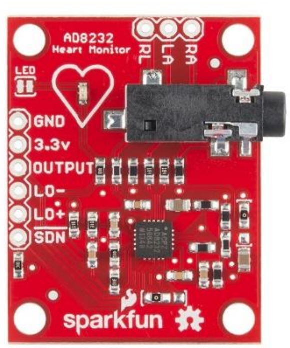
HARDWARE

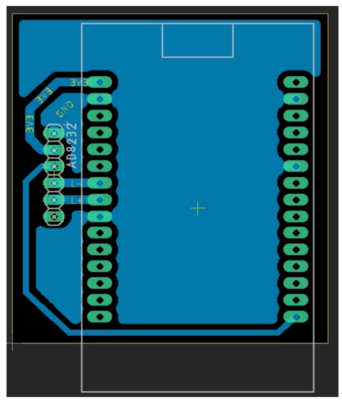
Hardware component:

We created a device which can monitor ECG signals from patients by connecting electrodes or needles to patients' left arm and right arm and right leg [12] by using Components (Table 5.1) and connected them together (Figure 5.1) [13] then the device will be able to send signals to our application to be predicted.

The device has a size of 5 cm x 6 cm with light weight which help users to carry and use our application together easily with no suffering.

Table 5.1: Hardware Components

Component	Image	Usage
Electrodes		Used to capture ECG signals from patient right arm , left arm, and right leg Then Move ECG to AD8232 Sensor
AD8232 Sensor		Captures ECG signals from patient by help of electrodes and give signals to ESP8266

ESP8266 – Wi-Fi		Wi-Fi sends real time ECG signals of the patient to the application firebase to be predicted
PCB		It is a flat plate used to electrically connect electronic components by soldering them in conductive passages, etched from flakes of copper plates on a non-conductive substrate.

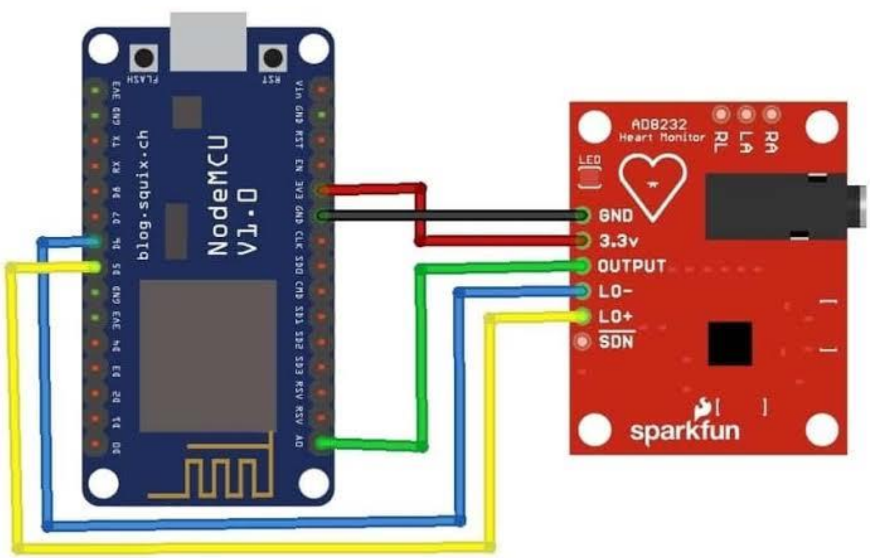


Figure 5.1: Device Circuit Diagram

CHAPTER SIX

MATERIALS AND METHODS

Datasets:

The ECG signals used in this study were from public databases (PhysioBank & PhysioNet), and they were as follows: (Table 6.1)

Table 6.1: Datasets Resources & Details

Data Set	Disease	Source	
MIT-BIH Atrial Fibrillation Database	AF	PhysioNet	[14]
Predicting Paroxysmal Atrial Fibrillation/Flutter: The PhysioNet/Computing in Cardiology Challenge 2001	AF	PhysioNet	[15]
MIT-BIH Arrhythmia Database	Normal	PhysioNet	[16]
BIDMC Congestive Heart Failure Database	CHF	PhysioNet	[17]
PTB Diagnostic ECG Database	CHF	PhysioNet	[18]

Methodology

- CHF –Machine learning:
  Reading the data set first, then using some feature extractions to extract labels based on time and sample frequency.

Then, using machine learning, classify data using various algorithms and compare them to choose the best one. DT resulted 95.38% accuracy, KNN resulted in 96.33% accuracy, ANN resulted in 98.21% accuracy, SVM resulted in 98.29 % accuracy, and RF resulted in 98.87 % accuracy. (Figure 6.1)

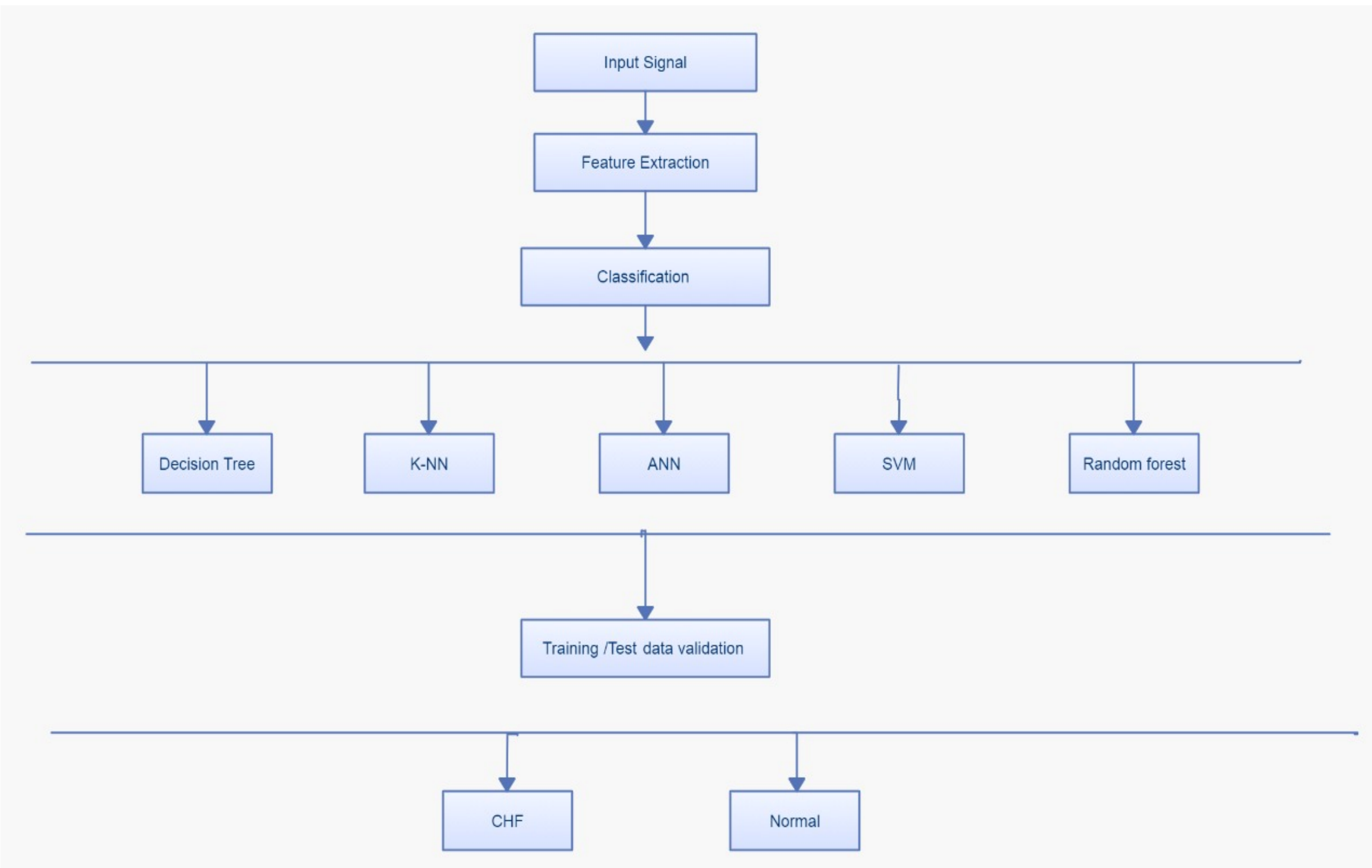


Figure 6.1 : CHF ML Flowchart

- CHF-Deep Learning:

  Reading the data set and input signals was the first step, followed by feature extraction based on time and sample frequency, and label extraction. Then, using three layers of deep learning CNN model and classify data into normal beats, which indicate a healthy patient, and abnormal beats, which indicate a CHF patient.

  The data was then splitting into training and test resulted 97.86% accuracy. (Figure 6.2)

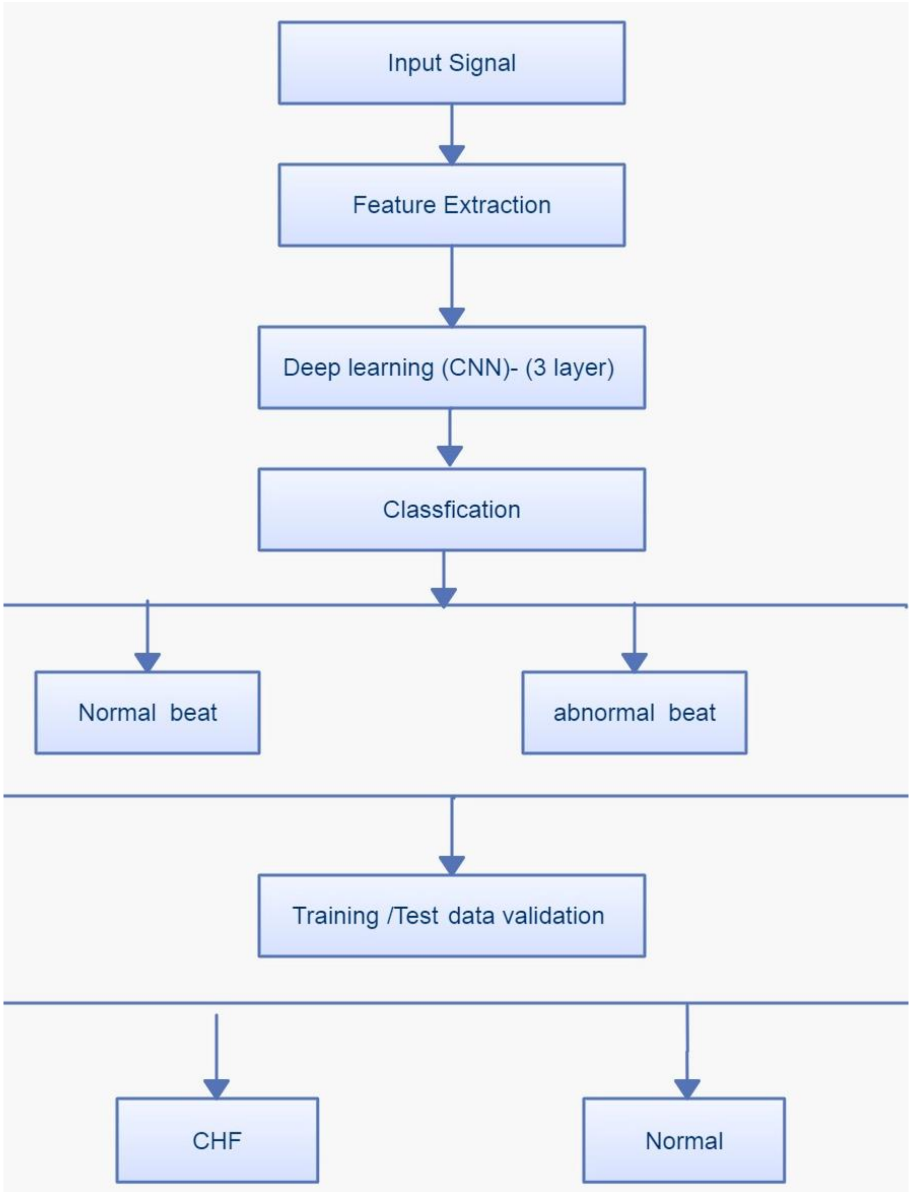


Figure 6.2 : CHF DL Flowchart

- AF-machine learning:

Initially, we used three different data sets: one for atrial fibrillation, one for atrial flatter, and one for a normal rhythm. We read the data, then apply some feature extraction to extract labels and save them in a csv file. We then classify the input into two labels, (A) for atrial and (O) for ordinary and do some preprocessing to remove num values. Split data into training and validation groups, then used machine learning's K-fold algorithm to test the data, resulting 99.31% accuracy (Figure 6.3)

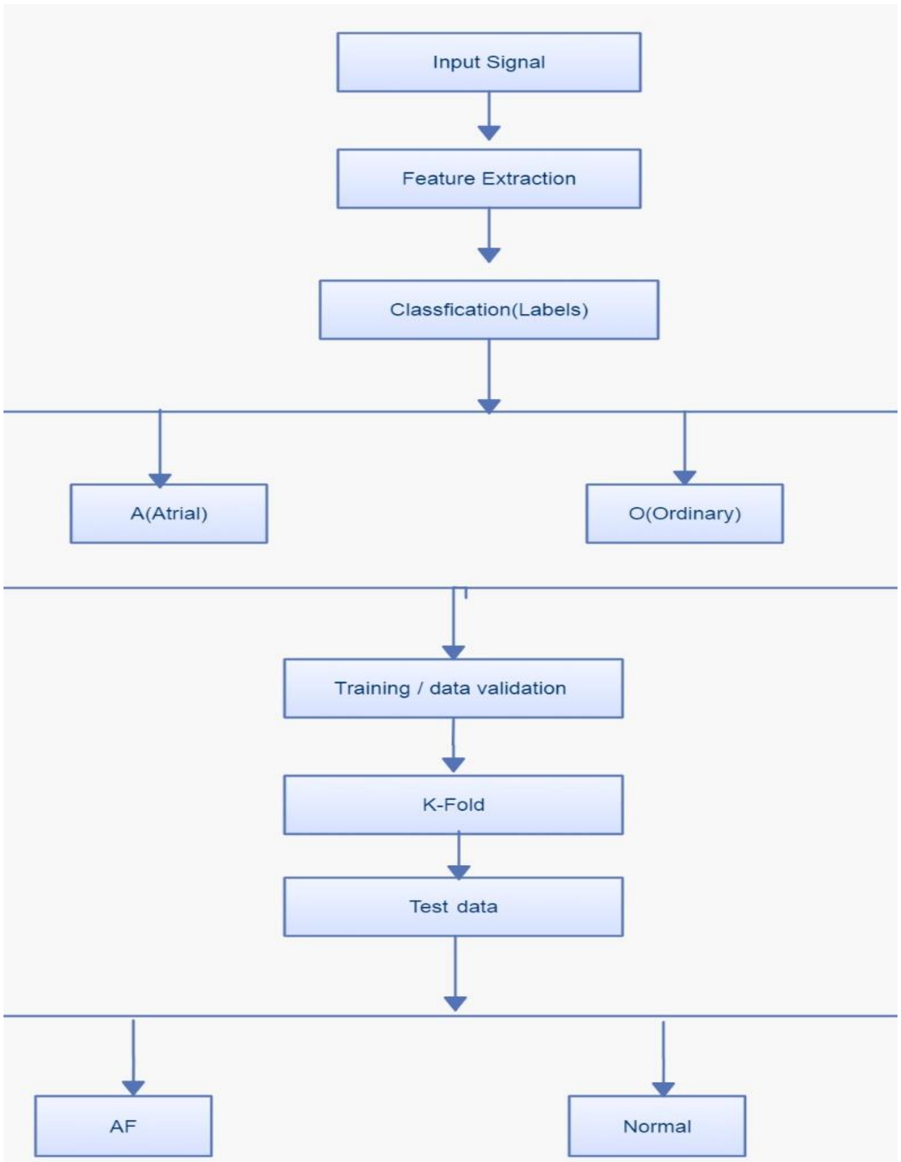


Figure 6.3 : AF ML Flowchart

- AF-Deep learning:

  We do it all over again until the data is classified, at this point we convert it to a numeric float with (one) mean atrial and (zero) mean normal.

  Started building deep learning CNN model using 3 layers resulted. 99% same percentage in 10 epoch which cause over fitting, so we use machine learning technique. (Figure 6.4)

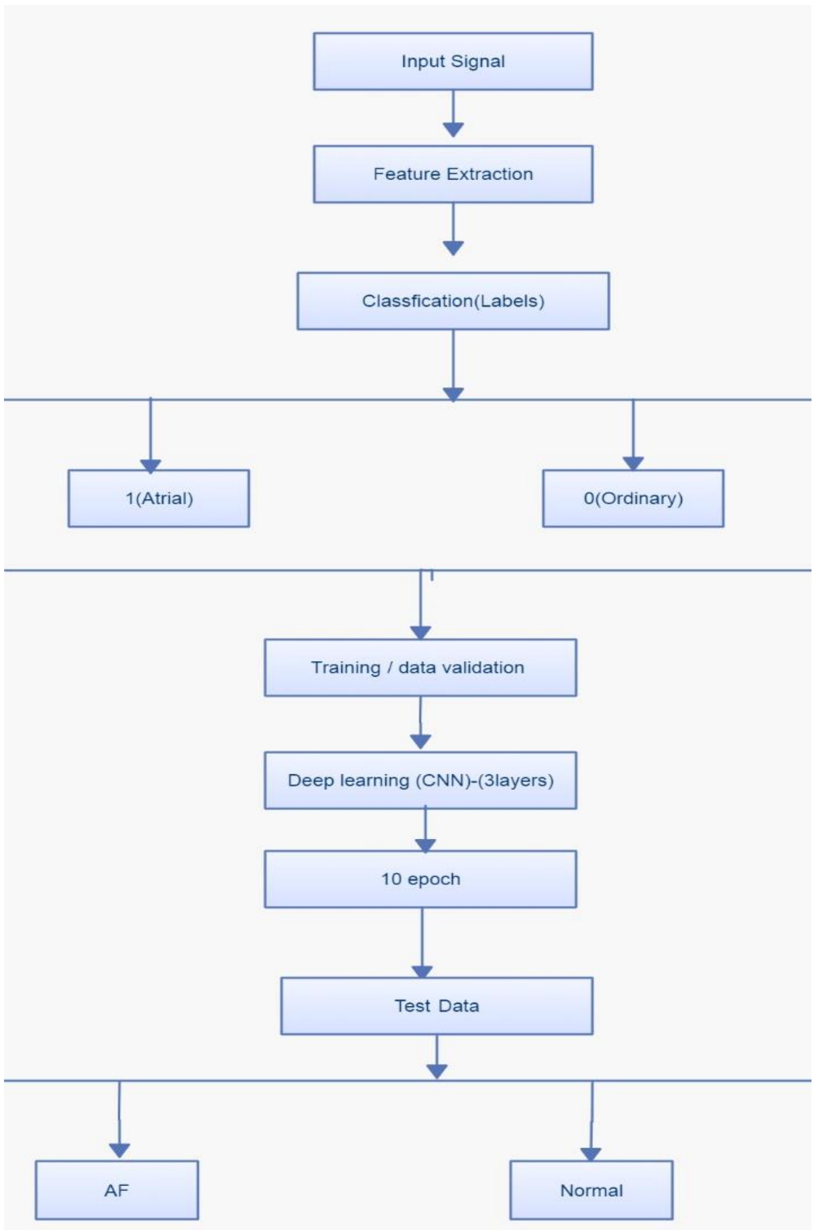


Figure 6.4 : AF DL Flowchart

CHAPTER SEVEN

RESULTS

We analyzed the two models to discover which one best fit our dataset because each one generates results either in Machine Learning (ML) or Deep Learning (DL).

- In CHF Machine learning model, we used different algorithms to determine the best algorithm
  - The RF algorithm was the best by accuracy 98.87%.
  - The other algorithms accuracy is shown in the following Table (Table 7.1)

Table 7.1: Different ML Algorithms Accuracy of CHF

Algorithm	Accuracy
Decision Tree (DT)	95.38%
K-Nearest Neighbor (KNN)	96.33%
Artificial Neural Network (ANN)	98.21%
Support Vector Machine (SVM)	98.29%
Random Forest (RF)	98.87%

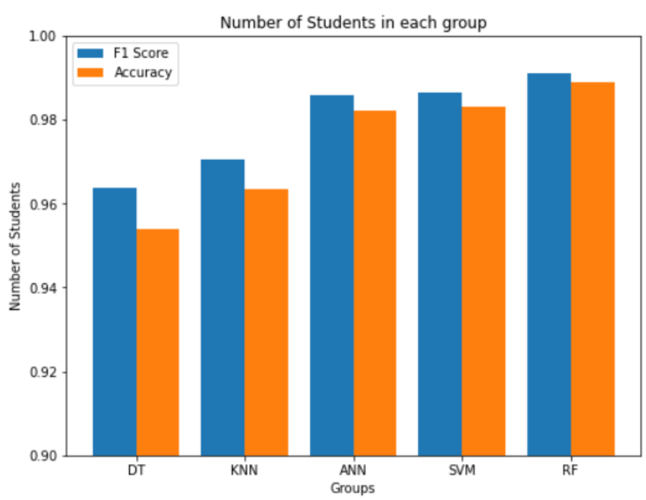


Figure 7.1 : ML algorithms Accuracy

- In CHF Deep learning model, we used CNN algorithm
    - The CNN algorithm gives accuracy is shown in the following table. (Table 7.2)
    - Showing accuracy and lose rate of CNN model (Figure 7.2 & 7.3)

Table 7.2 : CHF CNN Model Accuracy

Algorithm	Accuracy
CNN (3-Layers)	97.86%

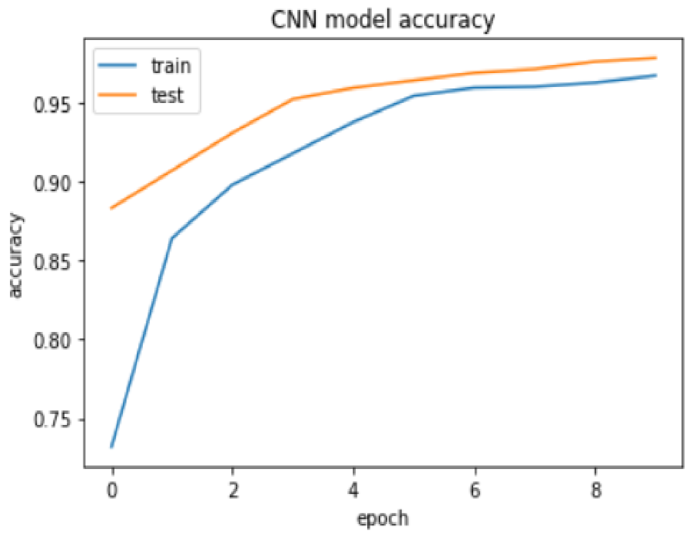


Figure 7.2: CNN algorithm Accuracy

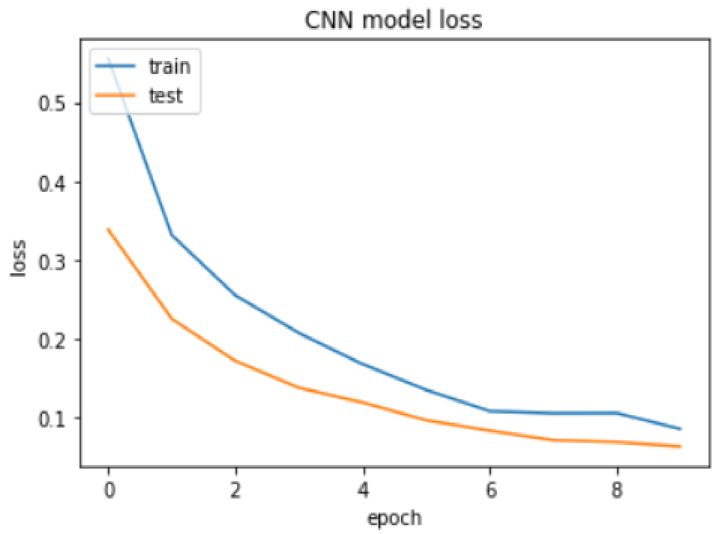


Figure 7.3: CNN algorithm Loss

- AF Machine learning model used k-fold and showing accuracy in the following table. (Table 7.3)

Table 7.3 : AF ML Accuracy

Algorithm	Accuracy
K-Fold	99.67%

- In AF Deep learning model, we used CNN algorithm
  - The CNN algorithm gives accuracy is shown in the following table. (Table 7.4)
  - Showing accuracy of CNN model & overfitting (Figure 7.3)

Table 7.4 : AF CNN Model Accuracy

Algorithm	Accuracy
CNN(3-layers)	99.31%

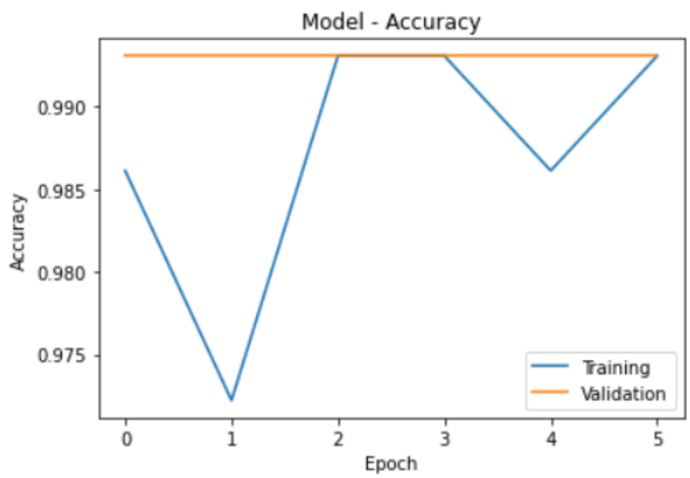


Figure 7.4: Predicting AF by CNN algorithm shows Overfitting

According to results & problem which appeared we Approved ML Technique to Predict Both CHF & AF

CHAPTER EIGHT

APPLICATION

The goal of the mobile application was to make it simple to use and to present the findings of the analysis of the patients' heart signals.

There are two predection machine learning models are deployed on the Application one for Atrial fibrillation prediction and the other one is for congestive heart failure

Application is installed on mobile phones , after installion you can find the icon of the application on your screen or between another app (Figure 8.1)

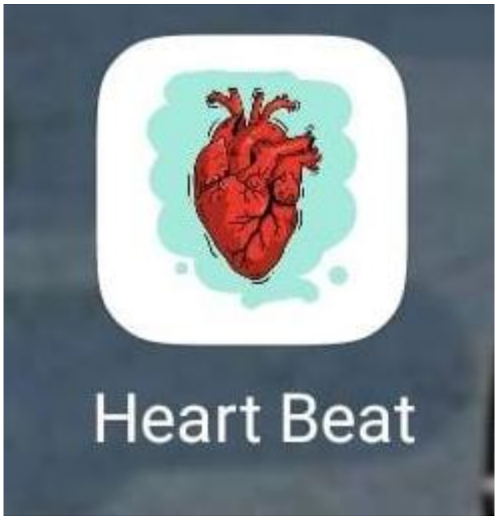


Figure 8.1 : Application icon

The application has a simple desgin that start with splash screen animation (Figure 8.2) which is the first thing the users see when they open our app. We chose a top-down animation for the start which shows app logo , name and slogan .

After that, we made button: While clicking on ‘check‘ button the apllication will show a result (CHF, AF and Normal) for the real time signals which are taken before by the divce. (Figure 8.3).

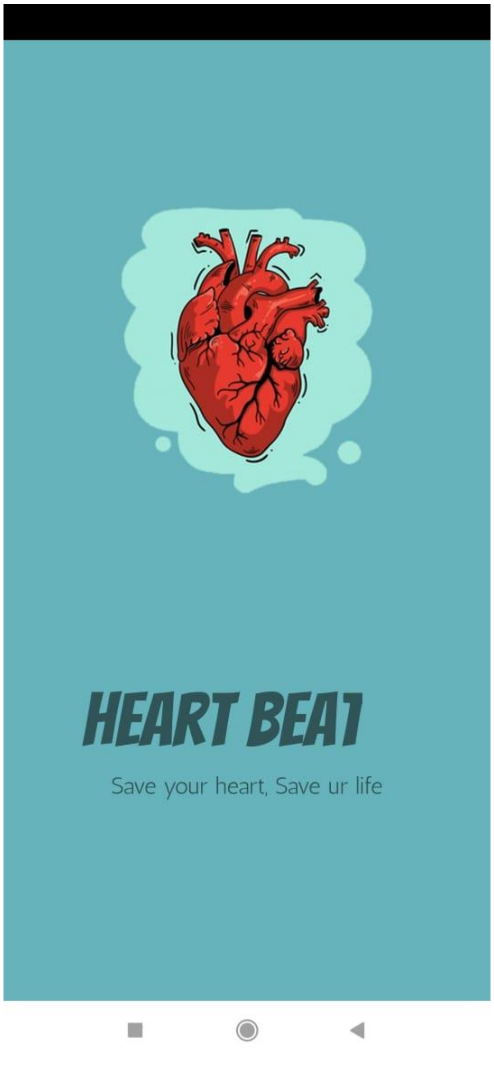


Figure 8.2 : Application splash screen

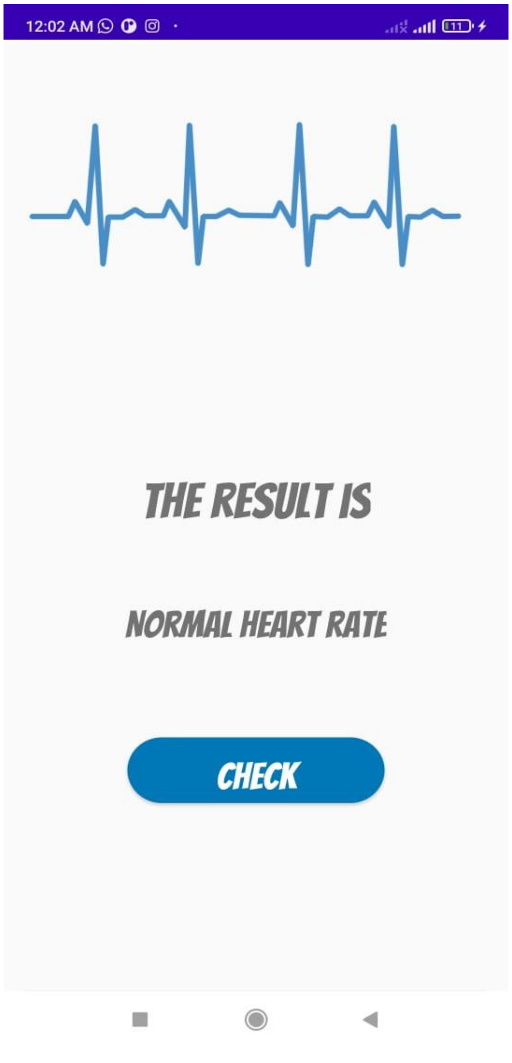


Figure 8.3 : Application Results

CHAPTER NINE

CONCLUSION

An application that predicts atrial fibrillation (AF) and congestive heart failure (CHF), two types of chronic heart disease.

The application is linked to a machine learning model that compares various algorithms of Machine learning such as SVM, DT, RF, ANN, KNN, and K-FOLD and compares them to CNN deep learning

We rely on machine learning algorithms because of overfitting in deep learning. It is also linked to hardware that we created and developed to gather signals from patients in real-time and display the results (Atrial fibrillated patient, Congestive Heart Failure patient, or Normal Healthy patient).

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تم عرض تفاصيل المشروع فى شكل فصول و هى :

١- المقدمة

٢- مراجعة الأعمال ذات الصلة

٣- التخطيط و اختيار اساليب العمل

٤- تحليل المشروع

٥ - الجهاز

٦ - البيانات المستخدمه و النماذج

٧ - النتائج

٨ - تطبيق المحمول

٩ - ملخص

١٠ – مصادر

الملخص باللغه العربيه

مع انتشار العديد من حالات الوفاة نتيجة أمراض عدة , إحتلت أمراض القلب السبب الرئيسي فى وفاه أكثر من ٣٢ % من ١٧.٩ مليون حالة وفاة , و فى حالات الوفيات لـ ١٧ مليون مريض (أقل من سن السبعين) مثلت أمراض القلب ٣٨ % من الوفيات _ طبقاً لما نشرته منظمة الصحة العالمية فى عام ٢٠١٩ – ذلك بالإضافة إلى أكثر من ٢٣ مليون مريض حول العالم لذلك يهدف هذا العمل للإكتشاف المبكر لأمراض القلب و خصوصاً الأمراض المنتشرة و التي يتم اكتشافها فى مراحل متأخرة من المرض مثل عدم انتظام ضربات القلب الأذينيه و احتشاء أو تضخم عضلة القلب

عدم انتظام ضربات القلب الأذينيه و هى حالة متعارف عليها حيث تزداد ضربات قلب المريض لتصل لـ أكثر من ١٠٠ ضربة فى الدقيقة الواحدة مما يسبب الكثير من الأخطار مثل ارتفاع ضغط الدم و الجلطات و غيرها من الأخطار الأخرى التى تؤدى بحياة المرضى

احتشاء عضلة القلب و هو مرض يتسبب فى تضخم عضلات القلب و خصوصاً عضلات الحجرات السفلية من القلب و التي تعرف باسم البطين و ذلك يتسبب فى ضعف قوة ضربات القلب و بالتالى عدم وصول الدم بالكمية الكافية لجميع أجزاء الجسم مما يتسبب فى احتباس السوائل بداخل الأعضاء كـالرئتين و الكليتين و فى الكثير من الأحيان يصبح سبب رئيسي فى السكتات الدماغيه , لذلك يهتم المشروع بالكشف المبكر لهذين المرضين بالتحديد

قام الطلبه العاملين على هذا المشروع بتصميم جهاز يستعمل مستشعرات تعمل على تجميع إشارات القلب من المريض و فى نفس الوقت يعمل على نقلها لـ تطبيق قواعد الهاتف المحمول , قام الطلبه ايضا باستخدام تقنيات الذكاء الاصطناعى ببناء نماذج مدربة بواسطة تقنية تعلم الآلة و التعلم العميق و التى تكون مدربة لتفرقة الاشارات لـثلاثة انواع اما طبيعيه او عدم انتظام ضربات القلب الاذنينه او احتشاء فى عضلة القلب و قارن الطلاب بين التقنيتين و الخوارزميات المستخدمه فى كل منهما و انتهى البحث على الاعتماد على تقنية تعلم الآلة حيث كانت النتائج عن تلك التقنيه اكثر دقه من غيرها

تمت اضافة النماذج المدربه بواسطة تعلم الاله على تطبيق الهاتف المحمول حتى يقوم بتحليل الاشارات المنقولة اليه من الجهاز الذي تم بناؤه و عرض النتائج على شاشة التطبيق

جامعة بنها

كلية الحاسبات و الذكاء الاصطناعى

الكشف المبكر عن عدم انتظام ضربات القلب الاذيني و احتشاء عضلة القلب

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تحت إشراف

د / محمد فوزي

بنها , يوليو ٢٠٢٢