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**SUBJECT**

**Istashirni**  
**Mobile application for depression diagnostic using**  
**machine learning**

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**ABBREVIATION TABLE**

<b>MDD</b>	<b>Major depression</b>
<b>SAD</b>	<b>Seasonal Affective Disorder</b>
<b>PHQ-9</b>	<b>patient-health-questionnaire-9</b>
<b>CBT</b>	<b>Cognitive Behavioral Therapy</b>
<b>EMA</b>	<b>Mobile ecological momentary assessment</b>
<b>EDA</b>	<b>Electro dermal activity</b>
<b>LIWC</b>	<b>Linguistic Inquiry and Word Count</b>
<b>ML</b>	<b>Machine learning</b>

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**General  
Introduction**

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# GENERAL INTRODUCTION

## Context of the Study

Many people suffer from different mental illnesses as a result of they live in various traumas and daily pressures, depression is one of the most common mental disorders, across human lifetime.

Depression is a type of mental illness that affects a person's and social productivity; it is leads to many serious consequences such as social and practical failures and in the most serious cases suicidal thoughts.

The use of smartphones has been increasing rapidly in recent years to become an important factor to diagnosis individual's behavior; researchers have shown that mental health can be greatly affected by the use of smartphones which are powerful to treat in real-time data of the user.

## Statement of Problem

Despite the high prevalence and substantial burden that depression causes, treatment rates are low, because the recognition of a disease, especially psychological ones, is always embarrassing and unacceptable to the patient and may feel very ashamed when going to a psychiatrist.

Since the use of internet services via smartphones give a new social life with new opportunities, our research question is: how to take advantage of this opportunity to patients face cultural and logistical barriers that limit access to mental healthcare.

## Objective

In this work we want to help people self-diagnosis through their smartphones to track their mental state based on their time, site and confidentiality conditions.

Through our application we will help the user to diagnose if he is in a depressed state and determine the type of depression and this helps to reduce his risk mental disorders.

## Motivation

Depression is a common mental disorder affecting more than 264 million people worldwide [1]. depression may become a serious health condition. It can cause the affected

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person to suffer greatly and function poorly at work, at school and in the family. At its worst, depression can lead to suicide. Close to 800 000 people die due to suicide every year. Suicide is the second leading cause of death in 15-29-year-olds[1].

## **Methodology**

Our methodology to implement the target application is based on the following steps:

1. Theoretical study of depression to extract main properties of each depression type.
2. Depression Datasets construction.
3. Patient typed expression analysis.
4. Machine Learning depression type prediction

## **Report outline**

This document was divided into four chapters:

- 1 The First chapter:** This chapter presents the important concepts: type of depression, symptoms, diagnostic criteria; that we need in our work.
  - 2 The Second chapter:** In this chapter, we clarify the concept of electronic mental health and its role in improving the life of the individual. We also present the types of methods that are used to detect mental illnesses, and mention some previous works proposed in the field of electronic mental health to detect depression.
  - 3 The Third chapter:** In this chapter we explain our methodology to determine the type of depression, our work is divided into two model
    1. Use language processing to extract user symptoms that he enters by typing.
    2. Build our machine learning model that predicts depression type through extracted symptoms
  - 4 The Fourth chapter:** In this chapter we present the implementation and experimentation procedures that we will take to develop and test our application in order to determine the type of depression.
- **And finally,** a general conclusion of our work that contains the important points in our project and its perspectives.



**Chapter 1**  
Depression

## **1 Introduction**

Many people suffer from different mental illnesses as a result of what they live in various traumas and daily pressures, The most common mental illnesses include depression, this latter continues to grow and poses an enormous challenge for health systems.

This chapter presents the important concepts: type of depression, symptoms, diagnostic criteria; that we need in our work .

## **1.2 Depression**

### **1.2.1 What is depression?**

Many of us, when we're in a state of grief and losing energy and enthusiasm, say, " I'm depressed", so what's "depression"?

Depression is a type of mental illness that affects a person's productive and social ability, it is different from usual mood fluctuations and short-lived emotional responses to challenges in, it is leads to many serious consequences such as social and practical failures and in the most serious cases suicidal thoughts, depression can lead to suicide. Close to 800 000 people die due to suicide every year [1].

The clinical definition of depression is a period of at least two weeks when a person experienced a depressed mood or loss of interest or pleasure in daily activities, and had a majority of specified symptoms, such as problems with sleep, eating, energy, concentration, or self-worth.

Depression is not limited to only one type, each type has a range of characteristics depending on severity and condition, what are the types of depression and what are the characteristics?

### **1.2.2 Type of Depression**

Each type of depression has its own characteristics and specific symptoms

There are nine types of depression [2]:

- Major depression
- Seasonal Affective Disorder
- Atypical Depression
- Bipolar Disorder
- Psychotic Depression
- Postpartum Depression
- Premenstrual Dysphoric Disorder
- Situational Depression
- Persistent Depressive Disorder

We'll start with **Major depression**:

### 1.2.2.1 Major depression

Is the classic type of depression and what's diagnosed, or labeled, as MDD. People with major depression have symptoms of depression most of the day, nearly every day, for episodes of at least two weeks and can experience recurrent episodes throughout their lives. Under MDD, you can further break down depression into several specific subtypes [2].

The symptoms of major depression are :

- 1) Negative thinking with inability to see positive solutions
- 2) Agitation
- 3) Restlessness
- 4) Inability to focus
- 5) Lashing out at loved ones
- 6) Irritability
- 7) Withdrawing from loved ones and regular activities
- 8) Increase in sleeping

- 9) Exhaustion and lethargy
- 10) Morbid, suicidal thoughts
- 11) Weight loss or gain

#### **1.2.2.2 Seasonal Affective Disorder (SAD):**

Emerges during particular seasons of the year commonly winter brought on from diminished natural sunlight [2].

The symptoms of **Seasonal Affective Disorder** are :

- 1) Feeling sad or having a depressed mood
- 2) Loss of interest or pleasure in activities once enjoyed
- 3) Changes in appetite; usually eating more, craving carbohydrates
- 4) Change in sleep; usually sleeping too much
- 5) Loss of energy or increased fatigue despite increased sleep hours
- 6) Increase in purposeless physical activity (e.g., inability to sit still, pacing, handwringing) or slowed movements or speech (these actions must be severe enough to be observable to others)
- 7) Feeling worthless or guilty
- 8) Difficulty thinking, concentrating, or making decisions
- 9) Thoughts of death or suicide

#### **1.2.2.3 Atypical Depression**

It's biggest differentiator is mood reactivity. People with this kind of depression see their mood improve when something positive happens[2].

The symptoms of **Atypical Depression** are:

- 1) Mood improvement due to positive events or good news

- 2) At least two of the following:
  - a. Increased appetite or significant weight gain
  - b. Hypersomnia (usually more than 10 hours a day)
  - c. Lethargy (i.e., heavy limb sensation, lasting more than an hour per day)
  - d. Interpersonal rejection sensitivity, leading to social or occupational impairment
- 3) Criteria are not present in Major Depressive Disorder with Melancholic or Catatonic Features during depressive episodes

#### **1.2.2.4 Bipolar Disorder**

Used to be called manic depression and involves alternating between episodes of depression and extremely elevated energy [2].

The symptoms **of Bipolar Disorder** are:

- 1) Feel very sad, “down,” empty, worried, or hopeless
- 2) Feel slowed down or restless
- 3) Have trouble falling asleep, wake up too early, or sleep too much
- 4) Experience increased appetite and weight gain
- 5) Talk very slowly, feel like they have nothing to say, forget a lot
- 6) Have trouble concentrating or making decisions
- 7) Feel unable to do even simple things
- 8) Have little interest in almost all activities
- 9) Feel hopeless or worthless
- 10) think about death or suicide

### **1.2.2.5 Psychotic Depression**

It occurs when a person experiences depressive episodes so severe they start having false fixed beliefs (delusions) or hearing or seeing things that others can't hear or see (hallucinations) [2].

The symptoms of **Psychotic Depression** are :

- 1) depression exhibits a low,
- 2) sad mood
- 3) with poor concentration and feelings of lack of self-worth and guilt
- 4) Illusions and sounds that don't exist

### **1.2.2.6 Postpartum Depression**

It occurs after giving birth. Mothers may feel disconnected from their new baby or fear that could hurt their child [2].

The symptoms of **Postpartum Depression** are:

- 1) Feeling down or depressed for most of the day for several weeks or longer
- 2) Feeling distant and withdrawn from family and friends
- 3) A loss of interest in activities (including sex)
- 4) Changes in eating and sleeping habits
- 5) Feeling tired most of the day
- 6) Feeling angry or irritable
- 7) Having feelings of anxiety, worry, panic attacks, or racing thoughts
- 8) Crying more often than usual
- 9) Feelings of anger

10) Withdrawing from baby

### **1. 2.2.7 Premenstrual Dysphoric Disorder:**

It is a severe type of depression that shows up during the second half of the menstrual cycle [2]

The symptoms of **Premenstrual Dysphoric Disorder** are :

- 1) Mood swings
- 2) Irritability or anger or increased interpersonal conflicts
- 3) Depressed mood, feelings of hopelessness, or self-deprecating thoughts
- 4) Anxiety, tension, and/or feelings of being on edge
- 5) Decreased interest in usual activities
- 6) Difficulty concentrating
- 7) Marked lack of energy
- 8) Changes in appetite
- 9) Hypersomnia or insomnia
- 10) A sense of being overwhelmed or out of control
- 11) Physical symptoms such as breast tenderness or swelling, joint or muscle pain, a sensation of bloating, or weight gain

### **1.2.2.8 Situational Depression**

Refers to depression that is triggered by a significant life-changing event [2].

The symptoms of Situational Depression are:

- 1) sadness
- 2) hopelessness

- 3) lack of enjoyment in normal activities
- 4) regular crying
- 5) constant worrying or feeling anxious or stressed out
- 6) sleeping difficulties
- 7) disinterest in food
- 8) trouble focusing
- 9) trouble carrying out daily activities
- 10) feeling overwhelmed
- 11) avoiding social situations and interaction
- 12) not taking care of important matters like paying your bills or going to work
- 13) thoughts or attempts at suicide

### **1.2.2.9 Persistent Depressive Disorder**

Used to be called dysthymia. It's a chronic form of depression usually with milder symptoms in which an episode lingers for a long period of time, sometimes two years or more. It could be described as feeling like you're living on autopilot [2].

The symptoms of **Persistent Depressive Disorder** are :

- 1) Loss of interest in daily activities
- 2) Sadness, emptiness or feeling down
- 3) Hopelessness
- 4) Tiredness and lack of energy
- 5) Low self-esteem, self-criticism or feeling incapable
- 6) Trouble concentrating and trouble making decisions
- 7) Irritability or excessive anger
- 8) Decreased activity, effectiveness and productivity
- 9) Avoidance of social activities

- 10) Feelings of guilt and worries over the past
- 11) Poor appetite or overeating
- 12) Sleep problems

**1.3. Psychiatric diagnostic criteria:**

Psychological tests are formalized measures of mental functioning. Most are objective and quantifiable; however, certain projective tests may involve some level of subjective interpretation. Also known as inventories, measurements, questionnaires, and scales.

Psychological tests are administered in a variety of settings, including preschools, primary and secondary schools, colleges and universities, hospitals, outpatient healthcare settings, and social agencies. They come in a variety of formats, including written, verbal, and computer administered.

Patient Health Questionnaire (*PHQ-9*) and the *Beck Depression* Inventory, are brief tool used to diagnose and measure severity of depression.

**1.3.1 Beck *Depression* Inventory**

1.	0	I do not feel sad
	1	I feel sad
	2	I am sad all the time and I can't snap out of it
	3	I am so sad and unhappy that I can't stand it
2.	0	I am not particularly discouraged about the future
	1	I feel discouraged about the future
	2	I feel I have nothing to look forward to
	3	I feel the future is hopeless and that things cannot improve

## Chapter 1-Depression

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3.	0	I do not feel like a failure
	1	I feel I have failed more than the average person
	2	As I look back on my life, all I can see is a lot of failures
	3	I feel I am a complete failure as a person
4.	0	I get as much satisfaction out of things as I used to
	1	I don't enjoy things the way I used to
	2	I don't get real satisfaction out of anything anymore
	3	I am dissatisfied or bored with everything
5.	0	I don't feel particularly guilty
	1	I feel guilty a good part of the time
	2	I feel quite guilty most of the time
	3	I feel guilty all of the time
6.	0	I don't feel I am being punished
	1	I feel I may be punished
	2	I expect to be punished
	3	I feel I am being punished
7.	0	I don't feel disappointed in myself
	1	I am disappointed in myself
	2	I am disgusted with myself
	3	I hate myself
8.	0	I don't feel I am any worse than anybody else
	1	I am critical of myself for my weaknesses or mistakes
	2	I blame myself all the time for my faults
	3	I blame myself for everything bad that happens

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9.	0	I don't have any thoughts of killing myself
	1	I have thoughts of killing myself, but I would not carry them out
	2	I would like to kill myself
	3	I would kill myself if I had the chance
10.	0	I don't cry any more than usual
	1	I cry more now than I used to
	2	I cry all the time now
	3	I used to be able to cry, but now I can't cry even though I want to
11.	0	I am no more irritated by things than I ever was
	1	I am slightly more irritated now than usual
	2	I am quite annoyed or irritated a good deal of the time
	3	I feel irritated all the time
12.	0	I have not lost interest in other people
	1	I am less interested in other people than I used to be
	2	I have lost most of my interest in other people
	3	I have lost all of my interest in other people
13.	0	I make decisions about as well as I ever could
	1	I put off making decisions more than I used to
	2	I have greater difficulty in making decisions more than I used to
	3	I can't make decisions at all anymore
14.	0	I don't feel that I look any worse than I used to
	1	I am worried that I am looking old or unattractive
	2	I feel there are permanent changes in my appearance that make me look unattractive
	3	I believe that I look ugly

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15.	0	I can work about as well as before
	1	It takes an extra effort to get started at doing something
	2	I have to push myself very hard to do anything
	3	I can't do any work at all
16.	0	I can sleep as well as usual
	1	I don't sleep as well as I used to
	2	I wake up 1-2 hours earlier than usual and find it hard to get back to sleep
	3	I wake up several hours earlier than I used to and cannot get back to sleep.
17.	0	I don't get more tired than usual
	1	I get tired more easily than I used to
	2	I get tired from doing almost anything
	3	I am too tired to do anything
18.	0	My appetite is no worse than usual
	1	My appetite is not as good as it used to be
	2	My appetite is much worse now
	3	I have no appetite at all anymore
19.	0	I haven't lost much weight, if any, lately
	1	I have lost more than five pounds
	2	I have lost more than ten pounds
	3	I have lost more than fifteen pounds
20.	0	I am no more worried about my health than usual
	1	I am worried about physical problems like aches, pains, upset stomach, or Constipation

	2	I am very worried about physical problems and it's hard to think of much else
	3	I am so worried about my physical problems that I cannot think of anything else
21.	0	I have not noticed any recent change in my interest in sex
	1	I am less interested in sex than I used to be
	2	I have almost no interest in sex
	3	I have lost interest in sex completely

**Table 1.1: Beck *Depression* Inventory [3].**

<b>Total Score</b>	<b>Levels of Depression</b>
1-10	These ups and downs are considered normal
11-16	Mild mood disturbance
17-20	Borderline clinical depression
21-30	Moderate depression
31-40	Severe depression
Over 40	Extreme depression

**Table 1.2: Beck *Depression* score [3]**

### 1.3.2 PHQ-9 Inventory :

This inventory is based on the following criteria:

## Chapter 1-Depression

	Not at all	Several days	More than half the days	Nearly every day
1. Little interest or pleasure in doing things.	0	1	2	3
2. Feeling down, depressed or hopeless.	0	1	2	3
3. Trouble falling or staying asleep or sleeping too much.	0	1	2	3
4. Feeling tired or having little energy.	0	1	2	3
5. Poor appetite or overeating.	0	1	2	3
6. Feeling bad about yourself – or that you are a failure or have let yourself or your family down.	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching TV.	0	1	2	3
8. Moving or speaking so slowly that others notice. Or the opposite – being so fidgety or restless that you have even moving around a lot more than usual.	0	1	2	3
9. Thoughts that you would be better off dead, or thought of hurting yourself in some way.	0	1	2	3

**Table 1.2: PHQ-9 inventory[6]**

Total Score	Levels of Depression
1-10	These ups and downs are considered normal
11-16	Mild mood disturbance
17-20	Borderline clinical depression

21-30	Moderate depression
31-40	Severe depression
Over 40	Extreme depression

**Table 1.3: PHQ-9 Score[6]**

**1.4. Conclusion:**

In this chapter we touched on all types of depression and symptoms of each type based on the consultation of professors specialists in the field of psychology at Mohammed Boudiaf University and the Center for psychological counseling. in the next chapter we'll talk about previous work in the field of diagnosis of depression.

# Chapter 2

E-Depression  
diagnostic approaches

### **2.1 Introduction:**

In this chapter, we will clarify the concept of electronic mental health (e-mental health) and its role in improving the life of the individual. We will also clarify the types of methods that are used to detect mental illnesses, and we will mention some proposed methods in the field of e-mental health to detect depression.

### **2.2 E-mental health:**

E-mental health is one of the fastest growing fields in mental health research and can be defined as the ‘use of digital technologies and new media for the delivery of screening, health promotion, prevention, early intervention, treatment, or relapse prevention as well as for improvement of health care delivery (e.g. electronic patient files), professional education (e-learning) [8].

The use of technology may hold great promise. In particular, it has been suggested that internet-based mental health interventions have the potential to overcome traditional barriers to care, and also to reduce the demand on clinicians at lower costs. Currently, computerized interventions are available for a broad range of disorders, particularly common mental disorders such as depression and anxiety , eating disorders and substance abuse and dependence [8].

The vast majority of e-mental health interventions are based on cognitive-behavioral principles. This is unsurprising, given that Cognitive Behavior Therapy (CBT) has demonstrated efficacy across a range of mental disorders. In addition, CBT approaches translate well into computerized interventions, as they are based on learning models in which the therapist (or other support worker) has the function of a teacher or coach who imparts important information to the patient and teaches them a set of reproducible skills [8].

### **2.3 CBT for depression:**

Cognitive Behavioral Therapy (CBT) is a type of psychotherapy. This form of therapy modifies thought patterns in order to change moods and behaviors. It's based on the idea that negative actions or feelings are the result of current distorted beliefs or thoughts, not unconscious forces from the past.

CBT helps an individual to identify negative thought patterns and replace them by positive ways of thinking

CBT is a more short-term approach than psychoanalysis and psychodynamic therapies. Other types of therapies may require several years for discovery and treatment. CBT often requires only 10 to 20 sessions [4].

CBT is used to treat a wide range of problems including depression and anxiety.

#### **2.3.1- Internet-based CBT for depression treatment**

When the internet began to spread to our home, workplace and government institutions in the mid-1990s, new opportunities began to emerge in the field of clinical psychology. For in psychotherapy have been used so far: Provision and transmission Information. This feature has been designed across programs in more or less user-friendly ways. It was done in the best cases. A written communication between a patient and a therapist, readings for Patients to find out about a specific mental health condition and patient questionnaires so that, the therapist can immediately receive the scores.[4]

#### **2.3.2- Smartphone-based CBT for depression treatment:**

MHealth has gained more importance with the rapid uptake and utilization of the smartphones, which are powerful and monitor the real-time data of the user. Many researchers have claimed that MHealth is a mechanism which can deliver more effective and more accessible mental health care. Since mobile phones have become an extension of individual's behavior, researchers have shown that behavioral health, which can be considered closely related to mental health, can be greatly affected by the use of smartphones. Smartphone devices run various software applications (mobile

apps) which tap the hardware features of the phone and can provide the user with valuable information in a user-friendly format. When these apps are built with mHealth orientation, they can provide patient-specific and user-centered health information which is meaningful, accurate, relevant and up-to-date. By the use of mobile apps, caregivers are able to target the patient, based on their condition and response to treatment.

Apart from delivering CBT, mobile devices can perform functions that can track a user's mental status in real time which has the capability to correlate the user data to the real-time data provided by the smartphone. This allows monitoring the user's status in real time and providing apt information to the user [9].

#### **2.4 Methods for mental health diagnostic:**

Mobile studies of mental health aim to predict specific actions using smartphone data. However, measures and methods for mental health differ from one study to another. Most of the three kinds of basic truth are: once, periodic, and Mental health outcome events [5].

##### **2.4.1 One-time ground truth:**

A number of survey tools are available to evaluate the mental health. PHQ-9, for example, is a common tool to screen for depression severity, PHQ-7 , GAD-7 are general anxiety disorder measurement questionnaire; a short mental health questionnaire Rating scale (BPRS) is an evaluation scale used to measure psychiatric disease by clinicians Symptoms of depression, hallucinations and extraordinary behavior.[5]

##### **2.4.2- Periodic ground truth:**

Additional studies are intended to monitor how states of mental health change over time. Researchers could periodically administer (e.g. once a week), to evaluate the mental health of the participants. The (mobile ecological momentary assessment) EMA

issues are generally brief and respond quickly. The PHQ4, could be administered by researchers for depression studies. For studies described in schizophrenia every Monday, Wednesday, they administer a 10-point EMA to participants. And on Friday, The EMA questions require participants to report the severity of their symptoms [5].

## **2.5-previous works for detecting depression:**

In this section we present some anterior works on e-mental health for depression diagnostic.

### **2.5.1-using sensing mobile phone:**

This work [5] use a smartphone sensing system to detect depression while the smartphone system consists of a sensing app running on the phone and a backend service running in the cloud. The sensing app collects data by sampling from a series of sensors, apps, and phone logs and uploads the data to the backend service. The backend service consists a number of behind-the-scenes features to facilitate data collection. For example, the backend service stores the uploaded sensing data in a database and provide tools to manage participants and monitor study adherence.

The smartphone sensors can perform several actions:

- 1-Conversation detection: Smartphones are able to infer whether or not there is a conversation around a user aka social interaction.
- 2- Mobility detection: The GPS sensor on the smartphones identifies locations, which can infer the significant places.
- 3- Sleep detection: implements a sleep classifier that unobtrusively infers sleep duration without any special interaction with the phone.
- 4- Phone use detection. Smartphone operating systems record lock/unlock events, app usage, and call/SMS logs.
- 5- Mobile ecological momentary assessment.: smartphones is used in studies to capture additional human behavior beyond what the surveys and automatic sensing provide.

But this method, its results are not guaranteed, because the result of the sensors is inaccurate, and even if it is accurate at times, but it can help to the violation of individual privacy.

### **2.5.2-using electrodermal activity (EDA):**

This work [10] is based on electrodermal activity, as depression usually produces a mental state of tiredness that may result in physical and mental disorders as a major depression, insomnia or generalized anxiety. From an emotional point of view, calm and stress situations cause a variation in arousal. Arousal is the increase of activation or deactivation produced in the brain in the presence of a stimulus. Stress detection is a very current topic in many clinical and educational areas. For this reason, there is a growing interest in developing methods that make automatic detection possible.

In addition, in order to detect emotions in all places and at all times, the technologies used are focusing on the adoption of wearable devices and the implementation of machine learning (ML) techniques. These technologies usually work with the physiological conditions of the human body. The acquisition, processing and monitoring of physiological variables allow the creation of a map of the physical, mental and cognitive state of a subject.

There are numerous physiological variables that are used for stress detection. In particular, this work focus on the analysis of electrodermal activity (EDA) and different ML methods used to detect depression from EDA Which is based on previous data related to the electrical charges of the skin of people with depression and healthy people, where (ML) compares these data to determine whether the person is depressed or not. But this method is not very accurate because the skin charges are unstable to a certain extent.

### **2.5.3 Depression Detection from Social Media Texts:**

This work [11] is based on the possibility of analyzing the behavior of users in social networks. In particular, methods of computational linguistics are successfully used in

analyzing the texts from social networks. The computerized analysis method of texts LIWC (Linguistic Inquiry and Word Count) allows assessing the extent to which the author of a text uses the words of psychologically significant categories.

The method works on the basis of manually compiled dictionaries of words that fall into different categories: meaningful words (social, cognitive, positive/negative words, etc.), functional words (pronouns, articles, verb forms, etc.). LIWC is used for different languages, but does not consider the specifics of the language, since it is simply a translation of dictionaries. It uses neural network model to reveal the risks of self-harm and depression based on posts from Reddit and Twitter and showed the high accuracy of this diagnostic method.

it was found that usefulness of the proposed method may depend on the platform: for Facebook users these features predicted a greater severity of depression, and lower for Twitter. examined the usage of absolute words (i.e., always, totally, entire) in text writings from various forums devoted to different disorders: depression, anxiety, suicidal ideation, posttraumatic stress disorder, eating disorder, etc. It was found that the number of absolute words in anxiety, depression, and suicidal ideation related forums was significantly greater than in forums from the control group.

This method is difficult to have accurate results to a large extent because we cannot analyze the meanings of all languages and even the analysis of texts requires great effort and careful work to get satisfactory results, so it is preferable to find alternative solutions to detect depression.

### **2.6 Conclusion**

In this chapter, we have presented different concepts of e-mental health and some existing works for detecting mental illnesses through smart phone applications. In the following chapter we will present our own method to implement a smart phone application to diagnosis depression type.

# Chapter 3

## Design Methodology

### 3.1 Introduction

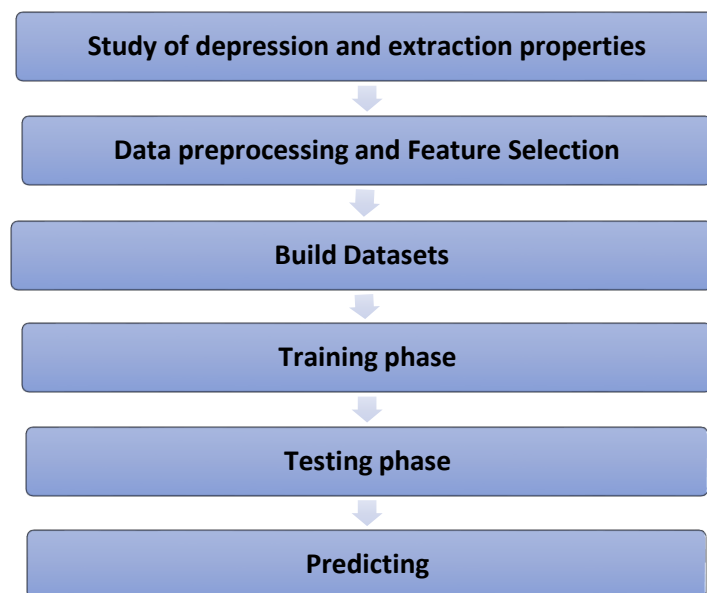
In this chapter we will explain our methodology to determine the depression type; our work is divided into two main axes:

1. Use expression processing to extract user symptoms from his typed expression.
2. Build our machine learning model that predicts the type of depression through extracted symptoms.

### 3.2 Methodology Steps

Our work consists of the following steps:

1. Theoretical study of depression to extract main properties of each depression type.
2. Data preprocessing and feature selection.
3. Datasets construction.
4. Training phase: build machine learning models from dataset.
5. Testing phase: use expression processing to extract depression symptoms keywords to build numeric testing vector.
6. Predicting the type of depression



**Figure 3.1: Methodology steps**

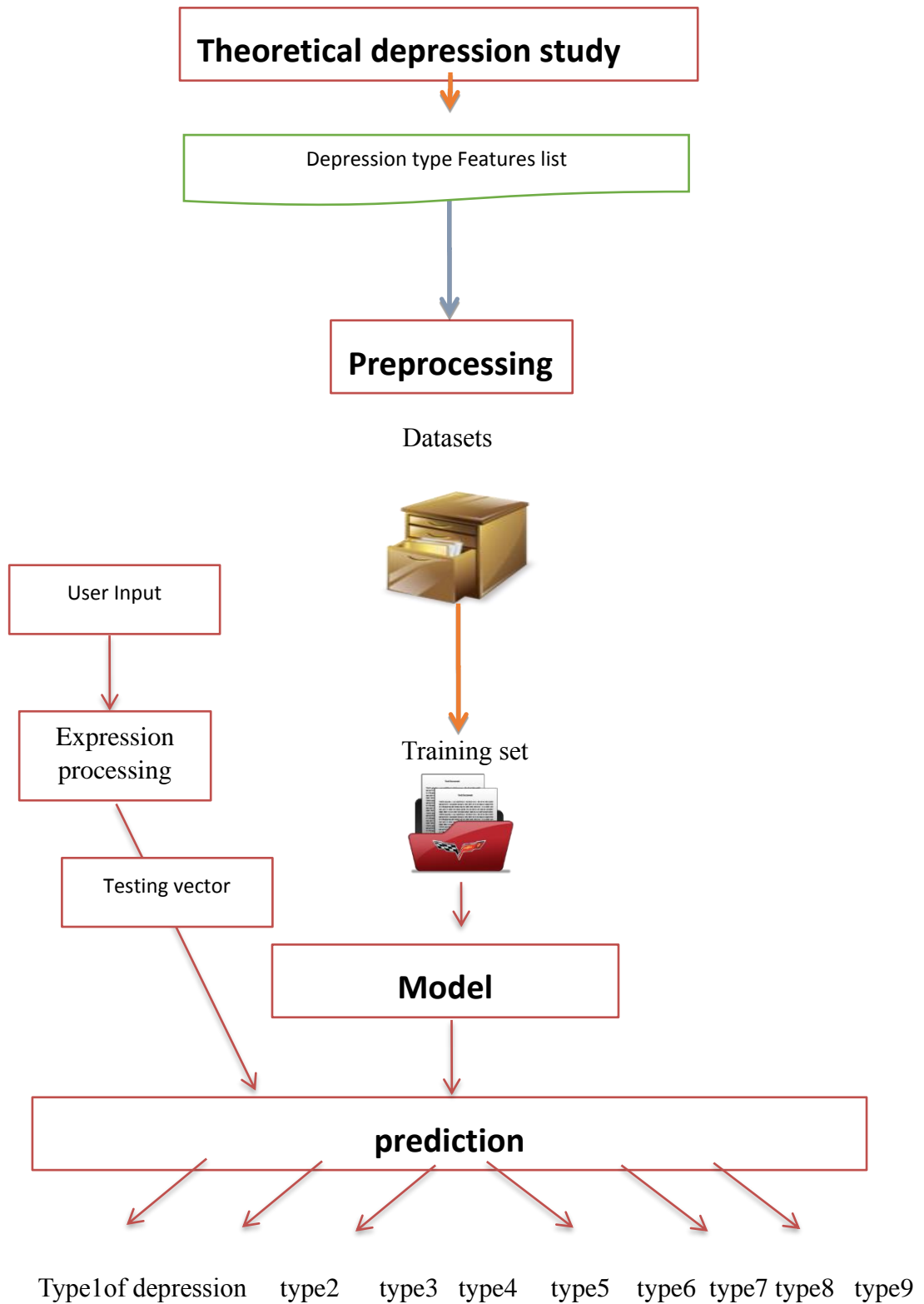


Figure 3.2: Project tasks

### 3.3Dataset construction

The first step of our work is to build our dataset for depression types, for this aim we perform the following steps:

### 3.3.1 Study of depression symptoms and extraction of feature

We study all types of depression and extract feature relating to each type by consulting a group of professors specialized in the field of psychology in the Department of psychology and the center of psychotherapy at Mohammed Boudiaf University and in addition to the information provided by the book of the DSM5[3].

The following table shows the extracted properties:

<b>Type of depression</b>	<b>Featur</b> s
<b>Major depression</b>	Five (or more) of the following symptoms have been present during the same 2-week depressed mood loss of interest loss of pleasure feels sad feels empty feels hopeless weight loss loss of energy thinking about suicide
<b>Seasonal Affective Disorder</b>	The period : winter months depressed mood loss of interest loss of pleasure feels sad feels empty feels hopeless increased appetite(eating more) <b>Increase</b> in purposeless physical activity loss of energy thinking about suicide
<b>A typical Depression</b>	The period: 2years mood improve if something positive happens Sleeping too much Increased appetite or weight gain depressed mood loss of interest loss of pleasure feels sad feels empty feels hopeless loss of energy
	Illusions and mania talking very quickly Decreased need for sleep Poor decision-making

<p><b>Bipolar Disorder</b></p>	<p>mood swings depressed mood loss of interest loss of pleasure feels sad feels empty feels hopeless loss of energy thinking about suicide</p>
<p><b>Psychotic Depression</b></p>	<p>Illusions and mania trouble sleeping depressed mood loss of interest loss of pleasure feels sad feels empty feels hopeless</p>
<p><b>Postpartum Depression</b></p>	<p>The period: After giving birth Feeling guilty about not being a good mom mood swings Non-acceptance of the baby crying easily trouble sleeping mood swings depressed mood loss of interest loss of pleasure feels sad feels empty feels hopeless loss of energy</p>
<p><b>Premenstrual Dysphoric Disorder</b></p>	<p>The period: during the second half of the menstrual cycle Difficulty concentrating trouble sleeping mood swings depressed mood loss of interest loss of pleasure feels sad feels empty feels hopeless loss of energy joint or muscle pain</p>
<p><b>Situational Depression</b></p>	<p>The period: intensity of stressful life events trouble sleeping mood swings depressed mood loss of interest loss of pleasure feels sad feels empty feels hopeless</p>

	loss of energy
<b>Persistent Depressive Disorder</b>	for at least 2 years of depressed mood loss of interest loss of pleasure feels sad feels empty feels hopeless loss of energy trouble sleeping

Table 3.1 : Depression extracted properties

### 3.3.2 Data preprocessing and Feature Selection

We analyzed the properties to create all the possibilities for each type, the result is the construction of dataset shown in the following figure

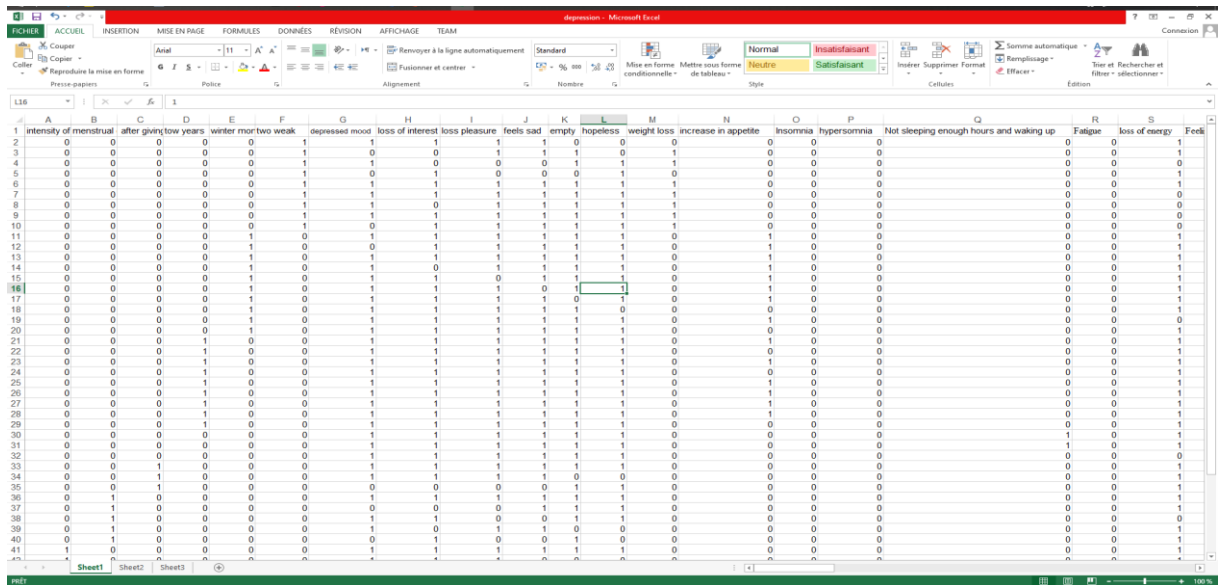


Figure 3.3: Dataset csv construction

After finishing the dataset we used it in building our machine learning model.

### 3.4 Build machine learning

In order to build the model, we need data sets and machine learning algorithm(ML), after we have created datasets, we test and select the appropriate algorithm, which gives the best accurate prediction, for this reason we used two prediction algorithms: random forest and decision tree algorithm

To train the model by random forest algorithm and decision tree algorithm we followed those steps:

1. Load dataset
2. Preparing data for training: two tasks will be performed in this step. The first task is to divide data into 'attributes' and 'label' sets. The resultant data is then divided into training and test sets
3. divide the data into training and testing sets: 80% training set and 20% testing set
4. training the model
5. testing the model by testing set
6. evaluate the performance of the algorithm.
  - The prediction accuracy after using random forest algorithm was 99.5%
  - The prediction accuracy after using decision tree algorithm was 100%

After calculating the accuracy of each algorithm and compare them we have selected decision tree algorithm because it got the best accuracy value.

In order to determine the type of depression, the built model needs numeric vector to predict types, we process and analyze the text entered by the user related to his psychological state in order to extract the features in the form of numeric vector for that we use language processing;

### **3.5 languages processing to extract depression symptoms**

To process user expression we perform the following steps:

1. **User Expression analysis:** we divide the text into words and put them into a words list
2. **Clean the words list:** to delete the irrelevant words as: and, then , because , iam ,..., we keep just signed words of depression.
3. **Build a synonyms list:** we need a list of synonyms for each feature key word in the data set to verify its existence in the user expression.
4. **Similarity calculation:** we compare each key word in the list of synonyms with list of tokenize words using levenshtein distance algorithm [12] , this algorithm

return a number that tells you how different two strings are. The higher the number, the more different the two strings are, if found we found a similarity we return 1.

5. **Missed features value:** after user expression processing we can find features without values, in this case we ask the user via prepared questions about the missing feature, if the answer is negative we return the value 0, and if it's positive we return 1.

Eventually we get numeric vector that used by model to predict type of depression like this

[0,1,0,0,0,0,1,1,0,1,0,0,0,1,0,0,0,0,1,0,1,0,0,0,1,1,0,0,0,1,0,0,1,0,0,0,1]

### 3.5.1 Levenshtein distance

The Levenshtein distance is a string metric for measuring difference between two sequences. Informally, the Levenshtein distance between two words is the minimum number of single-character edits (i.e. insertions, deletions or substitutions) required to change one word into the other. It is named after Vladimir Levenshtein, who considered this distance in 1965[12].

Levenshtein distance may also be referred to as **edit distance**, although it may also denote a larger family of distance metrics. It is closely related to pairwise string alignments.[12]

#### Definition

Mathematically, the Levenshtein distance between two strings a, b (of length |a| and |b| respectively) is given by  $lev_{a,b}(|a|,|b|)$  where:

$$lev_{a,b}(i, j) = \begin{cases} \max(i, j) & \text{if } \min(i, j) = 0, \\ \min \begin{cases} lev_{a,b}(i-1, j) + 1 \\ lev_{a,b}(i, j-1) + 1 \\ lev_{a,b}(i-1, j-1) + 1_{(a_i \neq b_j)} \end{cases} & \text{otherwise.} \end{cases}$$

**Figure 3.4: Levenshtein Algorithm**[12]

where  $1(a_i \neq b_i)$  is the indicator function equal to 0 when  $a_i = b_i$  and equal to 1 otherwise, and  $lev(a, b, i, j)$  is the distance between the first  $i$  characters of  $a$  and the first  $j$  characters of  $b$ . [12]

Note that the first element in the minimum corresponds to deletion (from  $a$  to  $b$ ), the second to insertion and the third to match or mismatch, depending on whether the respective symbols are the same. [12]

## 3.6 Application Modeling

In this section we present the main functions of our application via two UML diagrams.

### 3.6.1 Uses case diagram:

the main uses case in the system are:

1. Answer PHQ-9: the user answers PHQ-9 questions to measure the rate of depression
2. Description of the psychological state: the user describes his psychological state to be analyzed and treated
3. NLP analysis: the (robot) checks and search for depression features in user description psychological state.
4. Suggest question: The (robot) asks questions about the missing features after the treatment of the user expression of psychological state .
5. Answer question: the user answers questions about missing features.
6. Predict the type: the (robot) predicts the type of depression applying ML model.

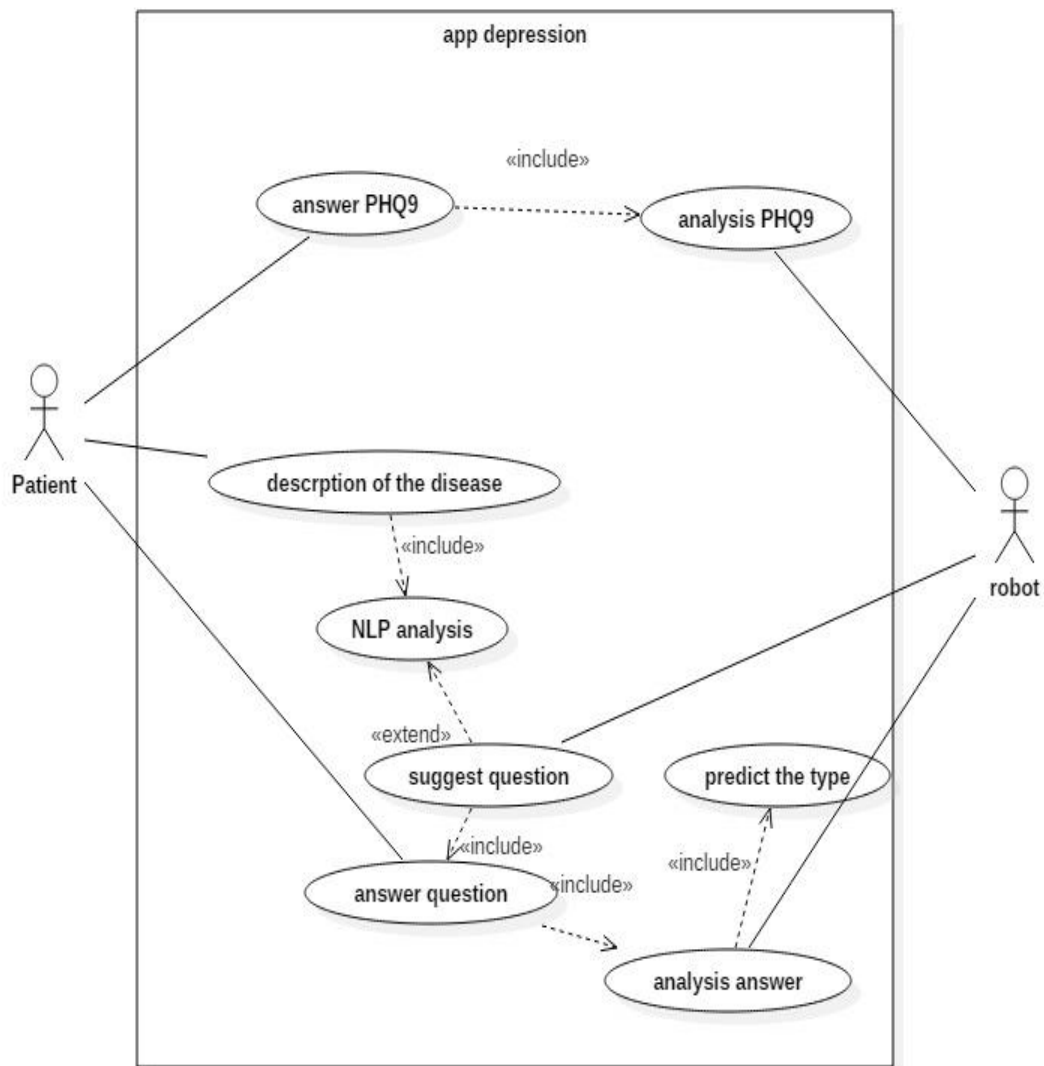


Figure 3.5: Uses case diagram

### 3.6.3 Sequence diagram:

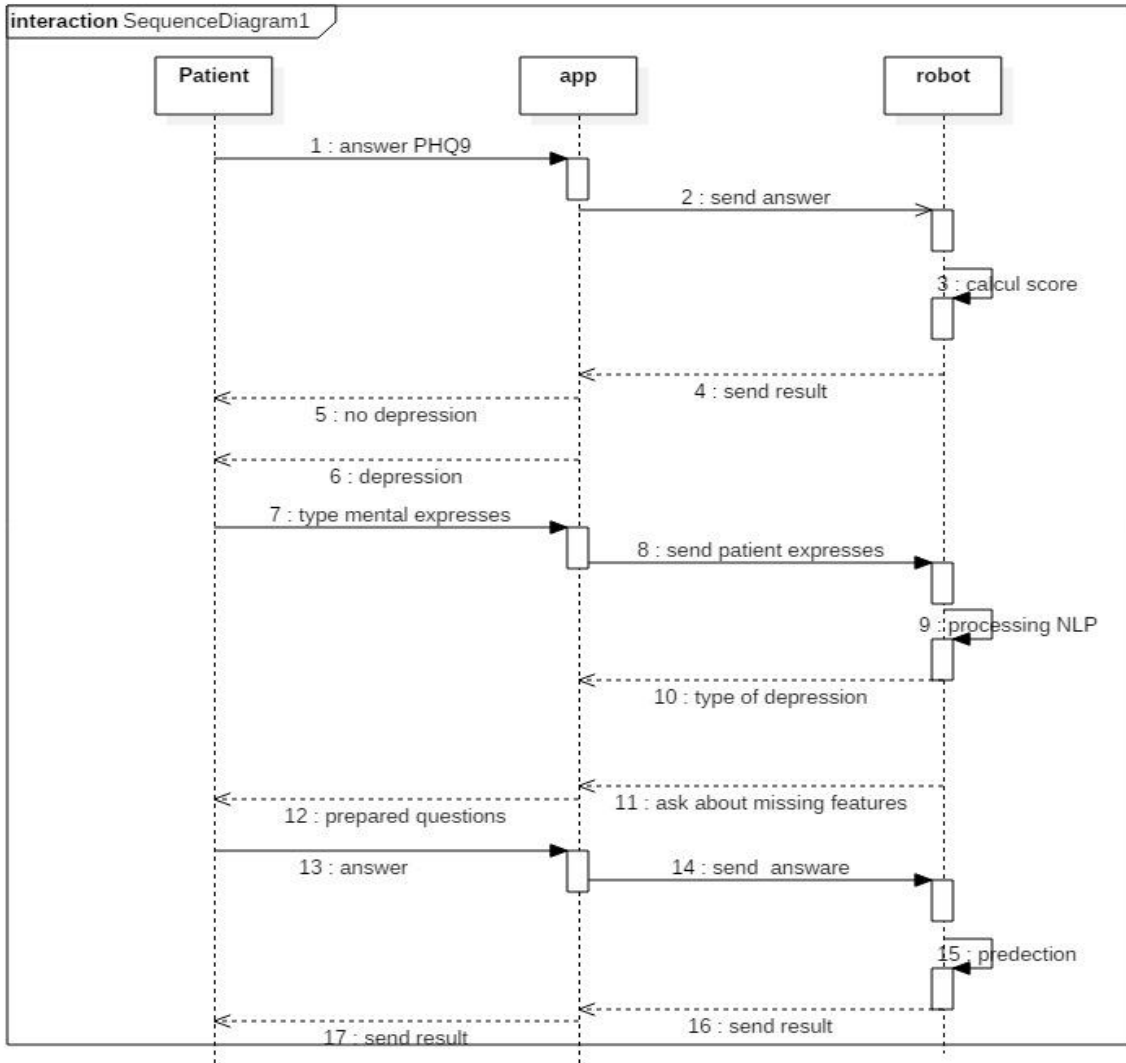
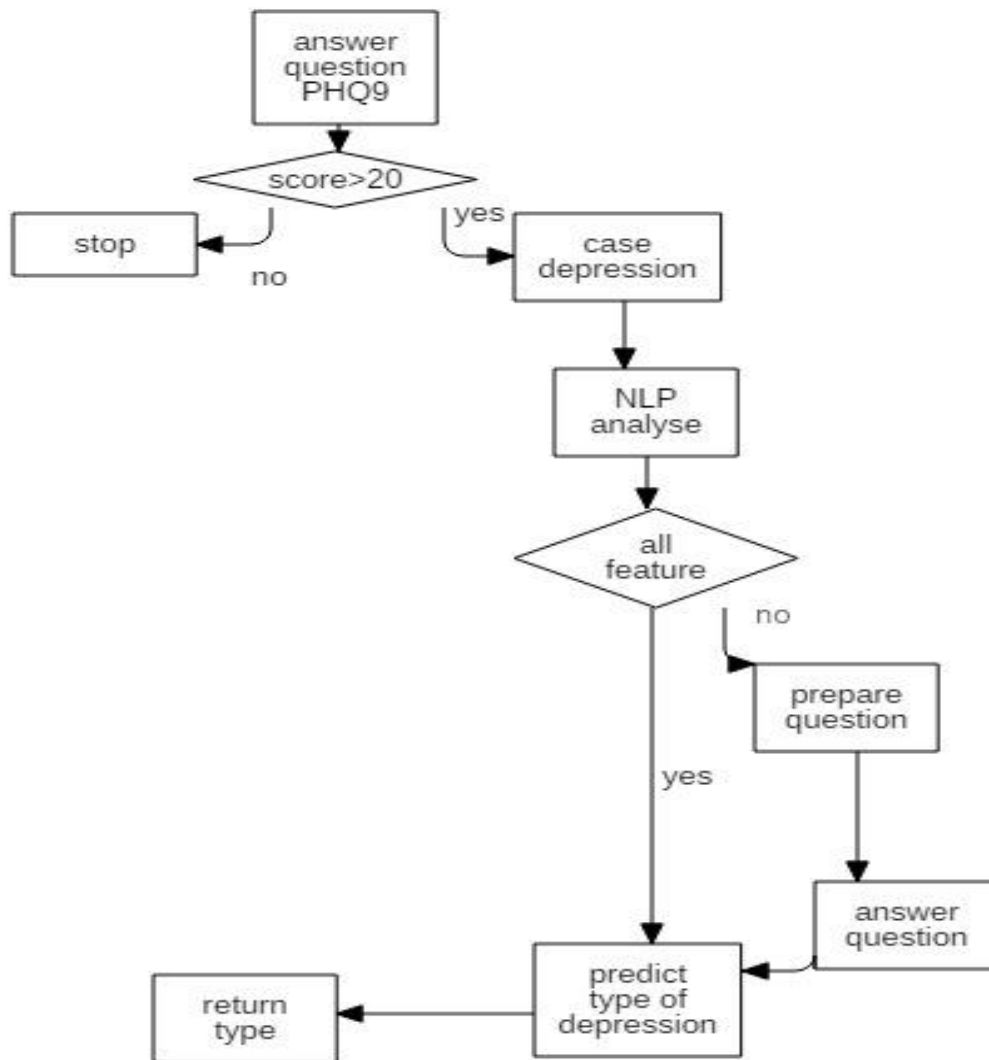


Figure 3.6: Sequence diagram of PHQ9

### 3.6.2 Flowchart diagram:

It is a diagram showing the operational mechanism of the application and its sequential steps.



**Figure 3.7: Flowchart diagram**

**3.7 Conclusion:**

In this chapter, we presented in detail our methodology steps to determine depression type and our application modeling via different UML models. In the next chapter, we will present how to implement and experiment our application.

# Chapter

# 4

**&** Implementation  
Experimentation

### 4.1 Introduction

In this section we will explain how to implement and experiment our application named ISTASHIRNI, in order to determine the type of depression explained in the previous chapters.

### 4.2 Implementation of ISTASHIRNI

The implementation is divided into two parts:

1. Front End: building a mobile application where users interact by answering questions, expressing the psychological state and tracking the diagnosis.
2. Back End: building API which analyzes the data and answers that user enters and predicts the type of depression.

#### 4.2.1 Font End

For building a mobile app, there are many work environments and programming languages, we worked in the Android Studio environment, and we use flutter and dart in order to build user interfaces.

##### 4.2.1.1 Android Studio

It is a development environment for developing Android mobile applications. It is based on IntelliJ IDEA and uses the Gradle production engine. It can be downloaded under the operating systems Windows, macOS, Chrome OS.[13]



**Figure 4.1: Android Studio**

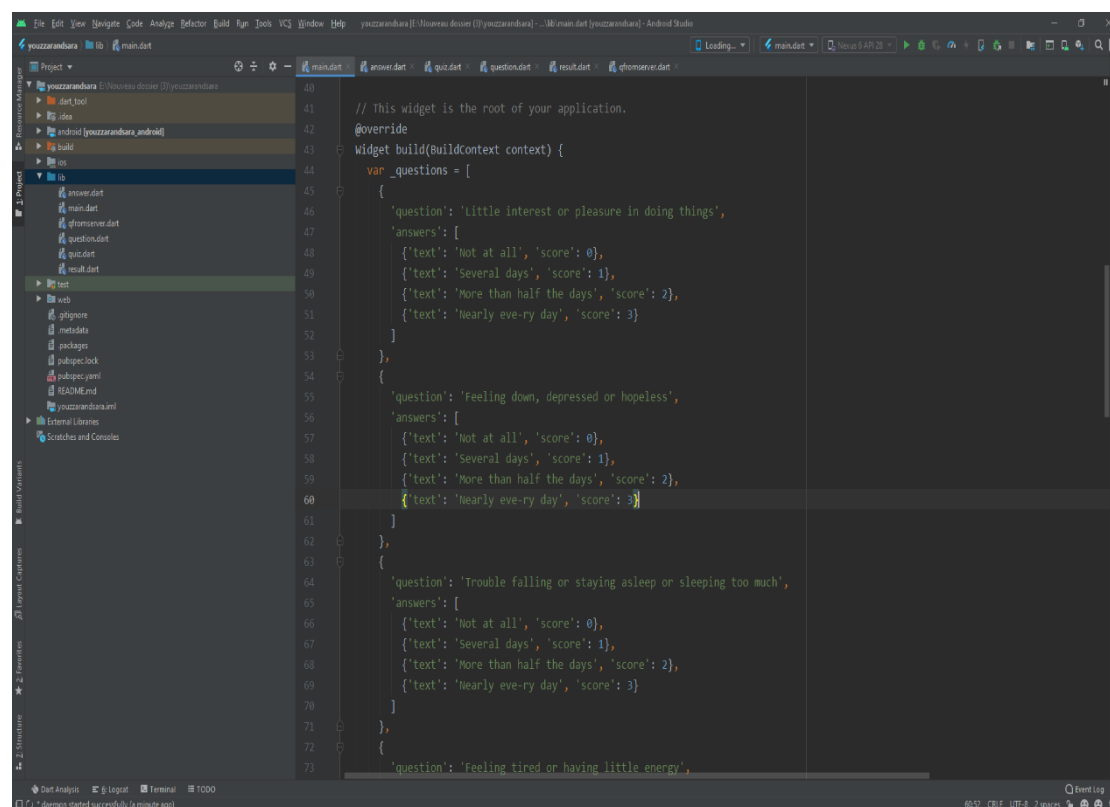
### 4.2.1.2 Flutter and Dart

Flutter is a free and open-source mobile UI framework created by Google and released in May 2017. In a few words, it allows you to create a native mobile application with only one codebase. This means that you can use one programming language and one codebase to create two different apps (for iOS and Android).[15]

Dart is the programming language used to code Flutter apps. Dart is another product by Google.[16]

### 4.2.1.3 User interface

The first user interface we built is the PHQ-9 test, each answer choice has a certain number of points, and the total points determine the degree of depression.



```
40 // This widget is the root of your application.
41
42 @override
43 Widget build(BuildContext context) {
44   var _questions = [
45     {
46       'question': 'Little interest or pleasure in doing things',
47       'answers': [
48         {'text': 'Not at all', 'score': 0},
49         {'text': 'Several days', 'score': 1},
50         {'text': 'More than half the days', 'score': 2},
51         {'text': 'Nearly eve-ry day', 'score': 3}
52       ]
53     },
54     {
55       'question': 'Feeling down, depressed or hopeless',
56       'answers': [
57         {'text': 'Not at all', 'score': 0},
58         {'text': 'Several days', 'score': 1},
59         {'text': 'More than half the days', 'score': 2},
60         {'text': 'Nearly eve-ry day', 'score': 3}
61       ]
62     },
63     {
64       'question': 'Trouble falling or staying asleep or sleeping too much',
65       'answers': [
66         {'text': 'Not at all', 'score': 0},
67         {'text': 'Several days', 'score': 1},
68         {'text': 'More than half the days', 'score': 2},
69         {'text': 'Nearly eve-ry day', 'score': 3}
70       ]
71     },
72     {
73       'question': 'Feeling tired or having little energy',
```

Figure 4.2: Programming questions Phq-9

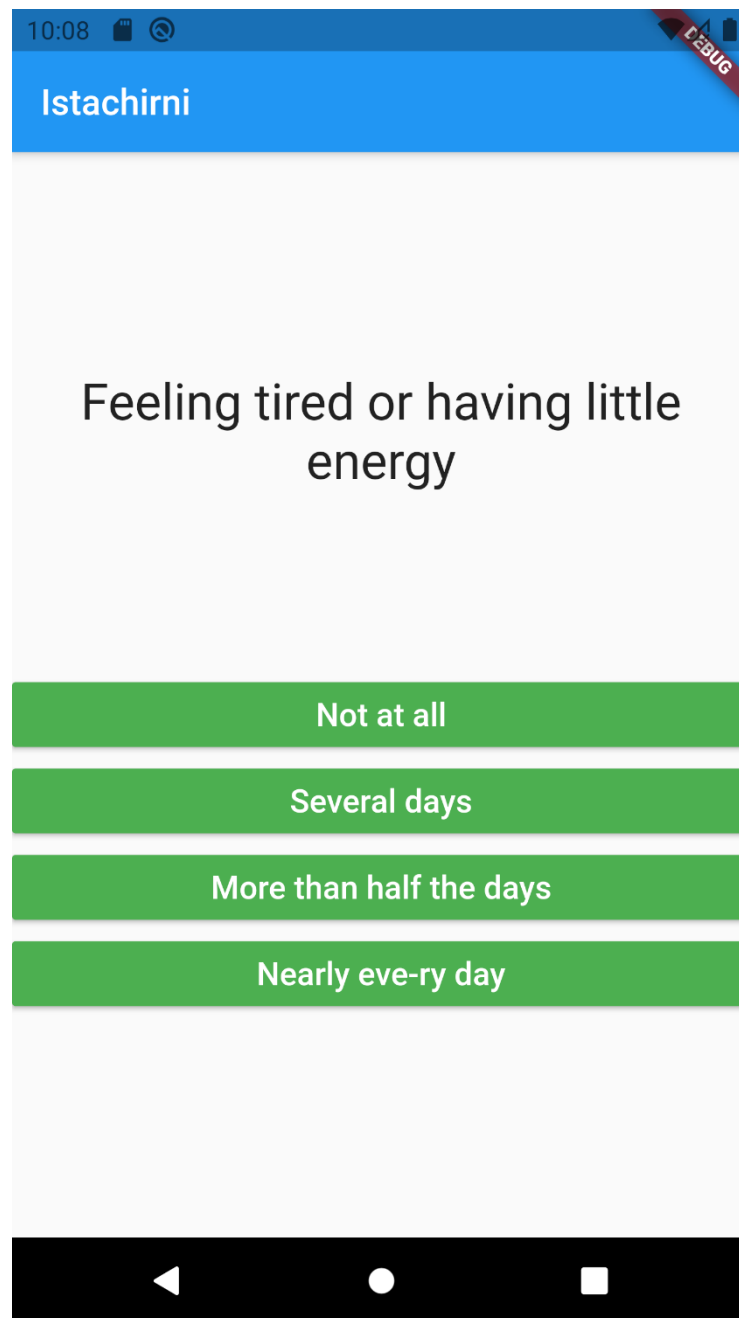
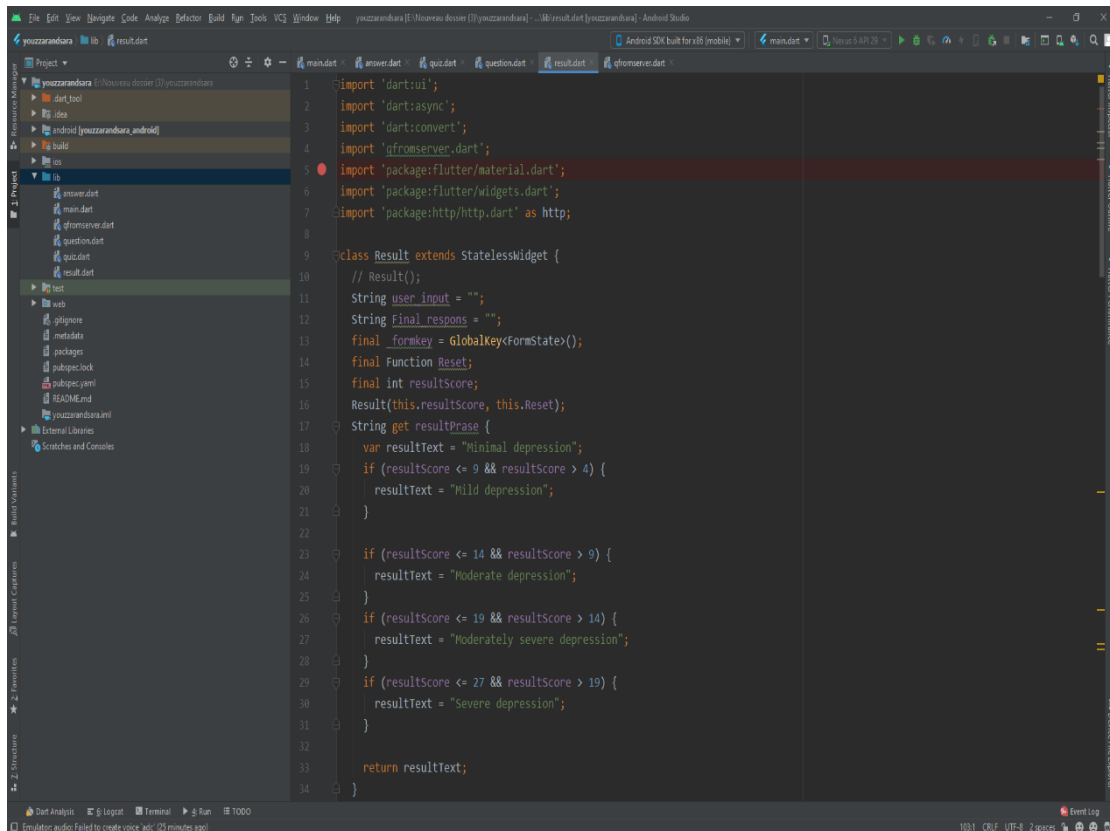


Figure 4.3: Phq-9 user interface

After completing the answer to the PHQ9 questions, we collect the points and display the degree of depression based on thePHQ9 obtained score.

## Chapter 4- Implementation and experimentation



The screenshot shows an IDE window with a project named 'youzzarandara'. The file explorer on the left shows a directory structure including 'lib' and 'test'. The main editor displays the code for 'result.dart'. The code defines a 'Result' class that extends 'StatelessWidget'. It includes imports for 'dart:ui', 'dart:async', 'dart:convert', 'gfromserver.dart', 'Flutter/material.dart', 'Flutter/widgets.dart', and 'http/http.dart'. The class has a constructor that takes 'resultScore' and 'Reset' as arguments. A 'get resultPrase' method is defined, which returns a string based on the 'resultScore' value. The score ranges are: 0-4 (Minimal depression), 5-9 (Mild depression), 10-14 (Moderate depression), 15-19 (Moderately severe depression), and 20-27 (Severe depression).

```
1 import 'dart:ui';
2 import 'dart:async';
3 import 'dart:convert';
4 import 'gfromserver.dart';
5 import 'package:flutter/material.dart';
6 import 'package:flutter/widgets.dart';
7 import 'package:http/http.dart' as http;
8
9 class Result extends StatelessWidget {
10   // Result();
11   String user_input = "";
12   String final_respons = "";
13   final _formkey = GlobalKey<FormState>();
14   final Function Reset;
15   final int resultScore;
16   Result(this.resultScore, this.Reset);
17   String get resultPrase {
18     var resultText = "Minimal depression";
19     if (resultScore <= 9 && resultScore > 4) {
20       resultText = "Mild depression";
21     }
22
23     if (resultScore <= 14 && resultScore > 9) {
24       resultText = "Moderate depression";
25     }
26
27     if (resultScore <= 19 && resultScore > 14) {
28       resultText = "Moderately severe depression";
29     }
30
31     if (resultScore <= 27 && resultScore > 19) {
32       resultText = "Severe depression";
33     }
34
35     return resultText;
36   }
37 }
```

Figure 4.4: Programming questions Phq-9 Score

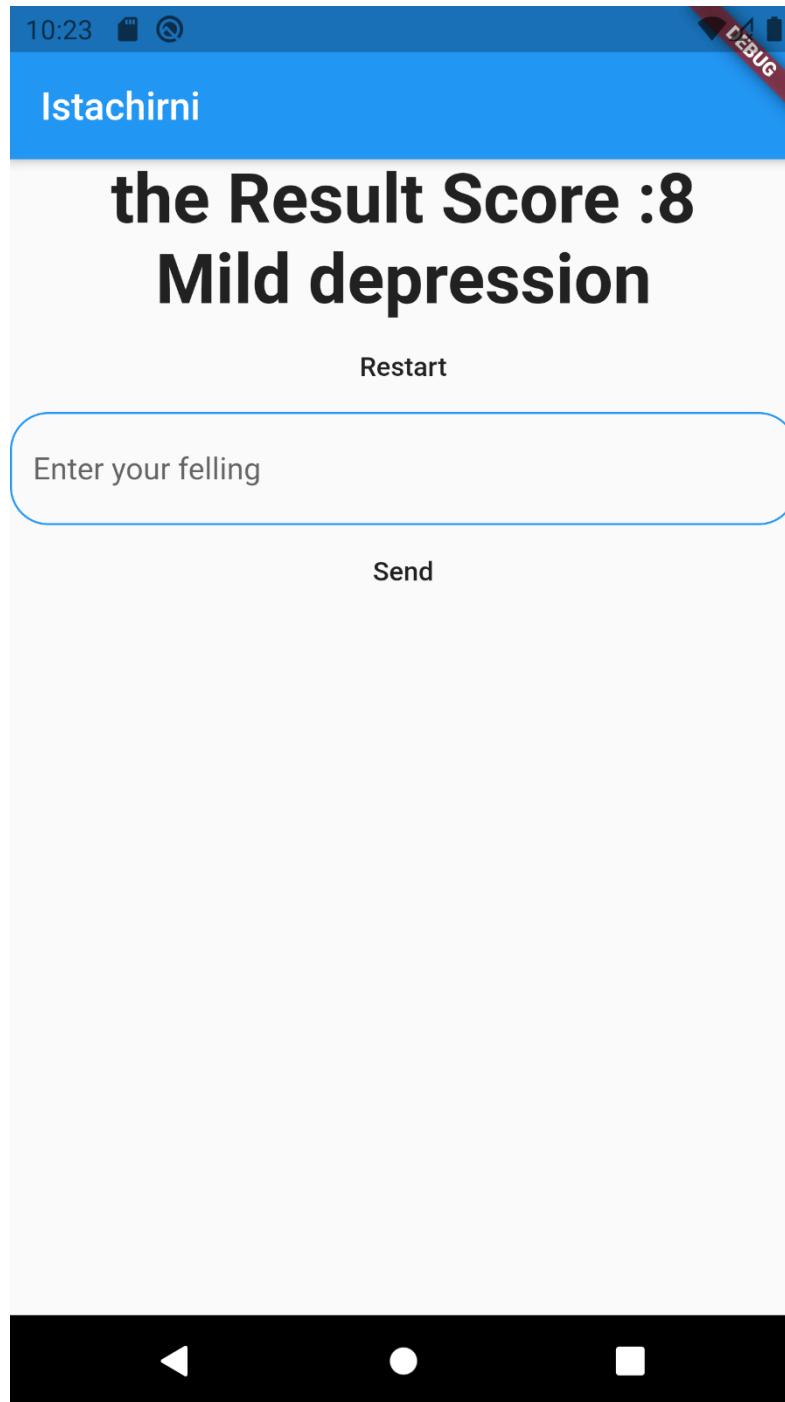


Figure 4.5: Phq-9 Score user interface



## 4.2.2 Back end

For building the API which analyzes the data and answers that user inputs and predicts the type of depression we use a set of tools to each step.

### 4.2.2.1 Build the model

To build machine learning model we use python and an anaconda environment.

- *Anaconda environment*

Anaconda environment supports multiple versions of Python and associated packages. An environment generally includes one version of Python or R language and some packages[18]

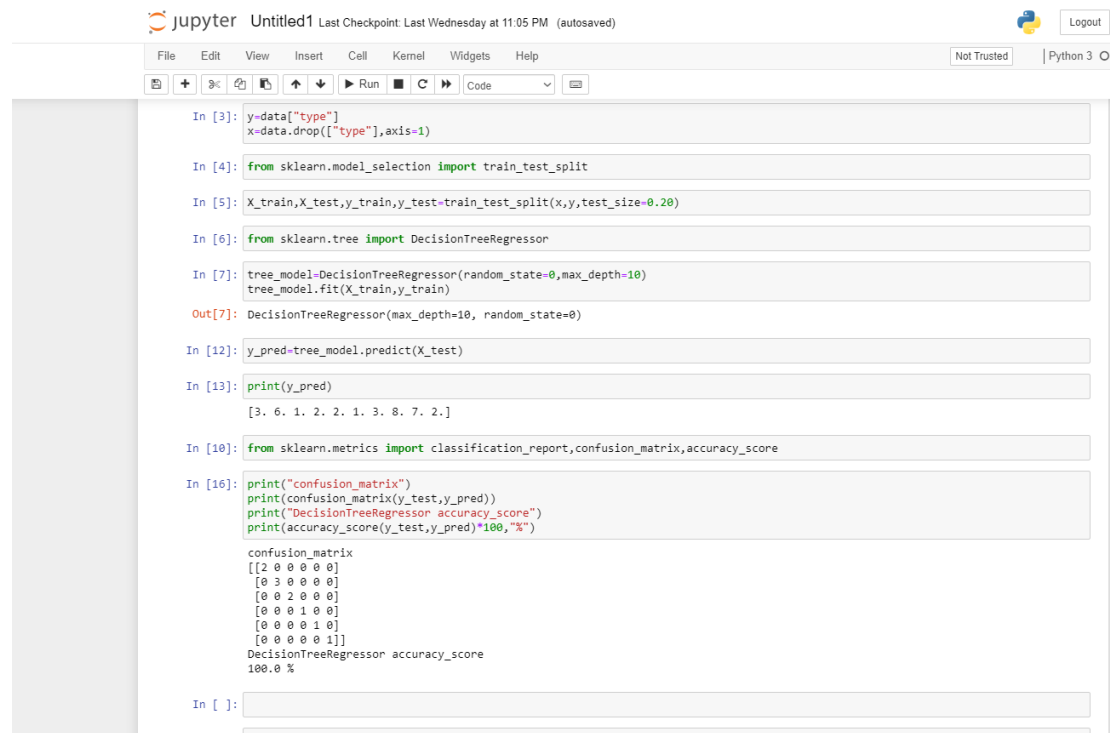


Figure 4.8:Anaconda logo[19]

### *Jupyter lab:*

JupyterLab is a web-based interactive development environment for Jupyter notebooks, code, and data. JupyterLab is flexible: configure and arrange the user interface to support a wide range of workflows in data science, scientific computing, and machine learning. JupyterLab is extensible and modular: write plugins that add new components and integrate with existing ones

*We use jupyter lab in anaconda environment to build machine learning model .*



```
In [3]: y=data["type"]
x=data.drop(["type"],axis=1)

In [4]: from sklearn.model_selection import train_test_split

In [5]: X_train,X_test,y_train,y_test=train_test_split(x,y,test_size=0.20)

In [6]: from sklearn.tree import DecisionTreeRegressor

In [7]: tree_model=DecisionTreeRegressor(random_state=0,max_depth=10)
tree_model.fit(X_train,y_train)

Out[7]: DecisionTreeRegressor(max_depth=10, random_state=0)

In [12]: y_pred=tree_model.predict(X_test)

In [13]: print(y_pred)

[3. 6. 1. 2. 2. 1. 3. 8. 7. 2.]

In [10]: from sklearn.metrics import classification_report,confusion_matrix,accuracy_score

In [16]: print("confusion_matrix")
print(confusion_matrix(y_test,y_pred))
print("DecisionTreeRegressor accuracy_score")
print(accuracy_score(y_test,y_pred)*100,"%")

confusion_matrix
[[2 0 0 0 0]
 [0 3 0 0 0]
 [0 0 2 0 0]
 [0 0 1 0 0]
 [0 0 0 1 0]
 [0 0 0 0 1]]
DecisionTreeRegressor accuracy_score
100.0 %

In [ ]:
```

**Figure 4.9: build machine learning model**

After creating a machine learning model, we built Rest API

### 4.2.2.2 Build Rest API

REST stands for **R**epresentational **S**tate **T**ransfer which means when a client machine places a request to obtain information about resources from a server, the server machine then transfers the current state of the resource back to the client machine.

In order to build the API we use flask and visual studio cod

- *Visual studio code environnement*

It is a source-code editor made by Microsoft for Windows, Linux and macOS Features, include support for debugging, syntax highlighting, intelligent code completion,

snippets, code refactoring, and embedded Git. Users can change the theme, keyboard shortcuts, preferences, and install extensions that add additional functionality.

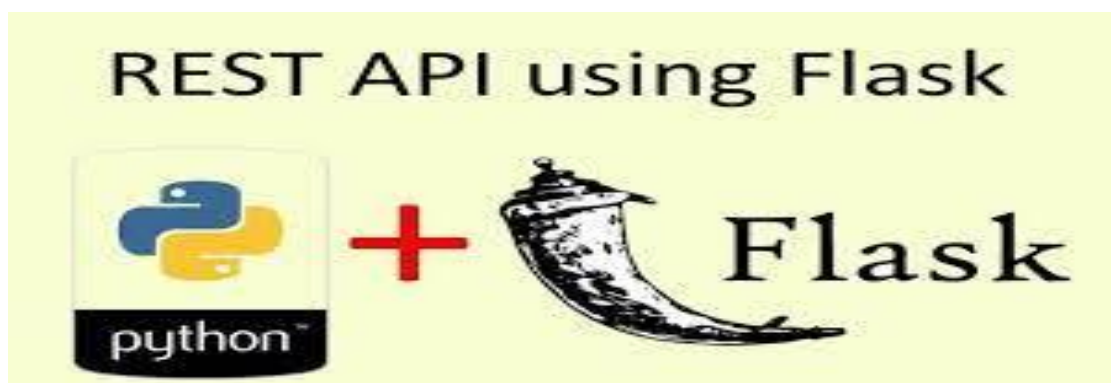


**Figure 4.10: visual studio code logo[20]**

We use visual studio to work with flask.

- *flask*

It is a micro web framework written in Python is play a major role as a communication channel between different services. It has become the de facto standard of passing information across multiple systems in the JSON format[21].



**Figure 4.11: Flask logo[21]**

For api testing we used Post man

- *Postman:*

Postman is the world's leading collaboration platform for API development. Postman's features simplify each step of building an API and streamline collaboration to help create better APIs faster[22]



**Figure 4.12: Postman logo[22]**

### A. Install flask

Install flask by the code `python3 -m venv flask_env`

```
TERMINAL  PROBLEMS  OUTPUT  DEBUG CONSOLE

Windows PowerShell
Copyright (C) Microsoft Corporation. Tous droits réservés.

Testez le nouveau système multiplateforme PowerShell https://aka.ms/pscore6

PS E:\چرختلا ڤرکڻم\depressio_flask_app> python3 -m venv flask_env
```

**Figure 4.13: Install flask**

### B. Integrating machine learning model

After installing flask we build the code where we integrate the machine learning model and the tasks that the API does.

```
main.py > ...
1 from flask import Flask,request,jsonify
2 from numpy import array
3 from model_file.ml_model import predict_dep,preprocess,empty,vec
4 import pickle
5 import json
6 app = Flask(__name__)
7
8 response = ''
9
10 with open('./model_file/model_pickle', 'rb') as f_in:
11     model = pickle.load(f_in)
12     f_in.close()
13
14
15
```

**Figure 4.14: integrate the machine learning model**

We create a function that receives data sent by the user through front end by HTTP post request:

```
@app.route('/predict',methods = ['GET', 'POST'])
def predict():

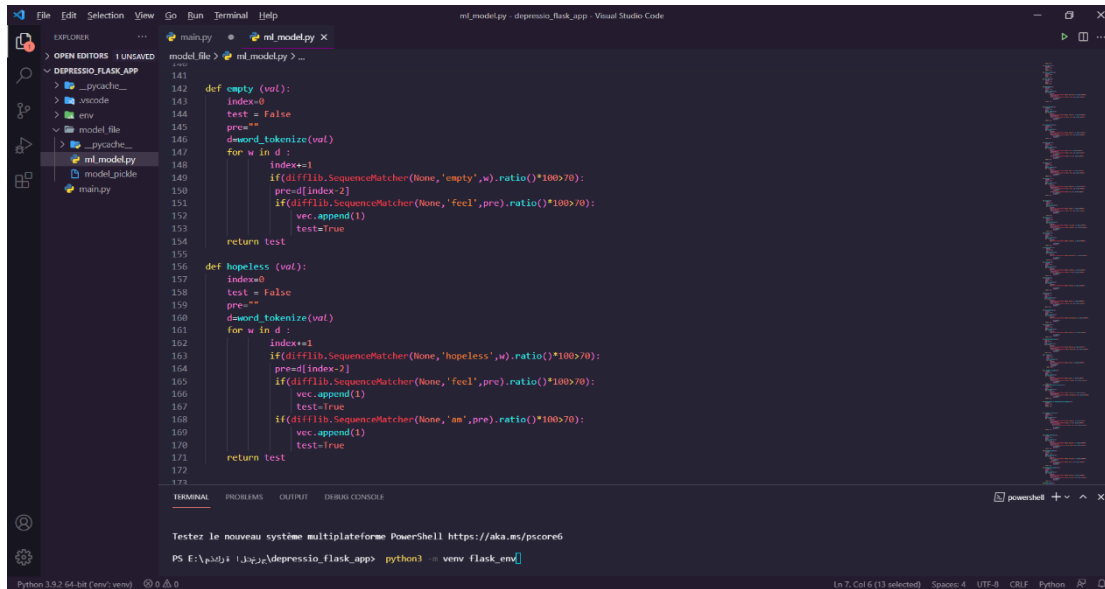
    #fetching the global response variable to manipulate inside the function
    global response

    #checking the request type we get from the app
    if(request.method == 'POST'):
        request_data = request.data #getting the response data
        request_data = json.loads(request_data.decode('utf-8')) #converting it from json to key value pair
        user_input_o=request_data["user_input"]
        index=int(request_data["index"])
```

**Figure 4.15: Post Get Predict method server side**

C. Then we create part of code using python to extract features from received data by language processing for extract symptoms and build numeric vector .

## Chapter 4- Implementation and experimentation

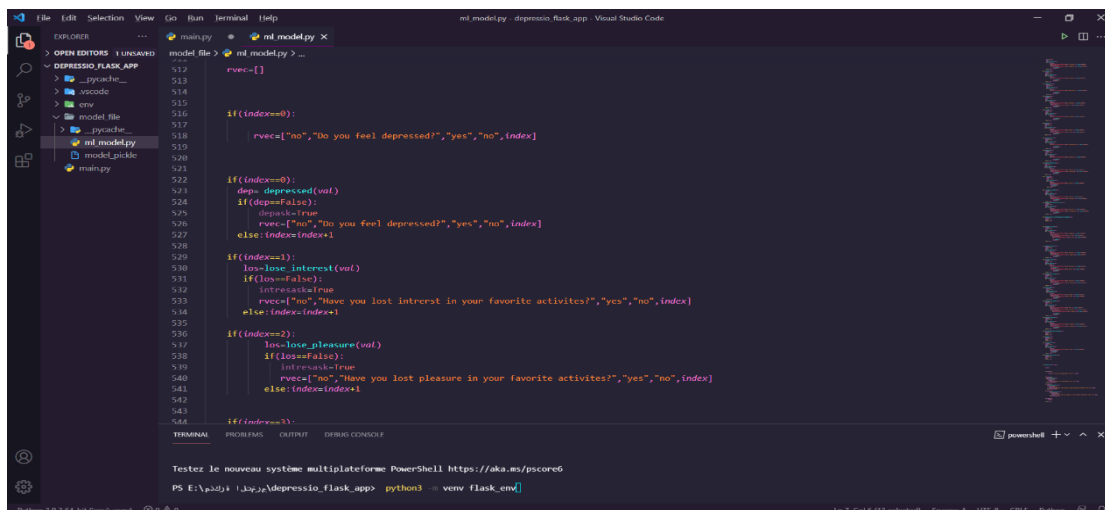


```
141
142
143 def empty (val):
144     index=0
145     test = False
146     pre=""
147     d=word_tokenize(val)
148     for w in d :
149         index+=1
150         if (difflib.SequenceMatcher(None, 'empty',w).ratio()*100>70):
151             pre=d[index-2]
152             if (difflib.SequenceMatcher(None, 'feel', pre).ratio()*100>70):
153                 vec.append(1)
154                 test=True
155     return test
156
157 def hopeless (val):
158     index=0
159     test = False
160     pre=""
161     d=word_tokenize(val)
162     for w in d :
163         index+=1
164         if (difflib.SequenceMatcher(None, 'hopeless',w).ratio()*100>70):
165             pre=d[index-2]
166             if (difflib.SequenceMatcher(None, 'feel', pre).ratio()*100>70):
167                 vec.append(1)
168                 test=True
169             if (difflib.SequenceMatcher(None, 'am', pre).ratio()*100>70):
170                 vec.append(1)
171                 test=True
172     return test
173
```

Figure 4.16: NLP method

There are 33 functions for each property

We have prepared questions for each property in case if the feature value does not exist



```
512 rvec=[]
513
514
515
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522
523 def depressed (val):
524     if (dep=False):
525         depressed=True
526         rvec=["no", "Do you feel depressed?", "yes", "no", index]
527     else: index=index+1
528
529
530 def lose_interest (val):
531     if (los=False):
532         interested=True
533         rvec=["no", "Have you lost intrerst in your favorite activities?", "yes", "no", index]
534     else: index=index+1
535
536
537 def lose_pleasure (val):
538     if (los=False):
539         interested=True
540         rvec=["no", "Have you lost pleasure in your favorite activities?", "yes", "no", index]
541     else: index=index+1
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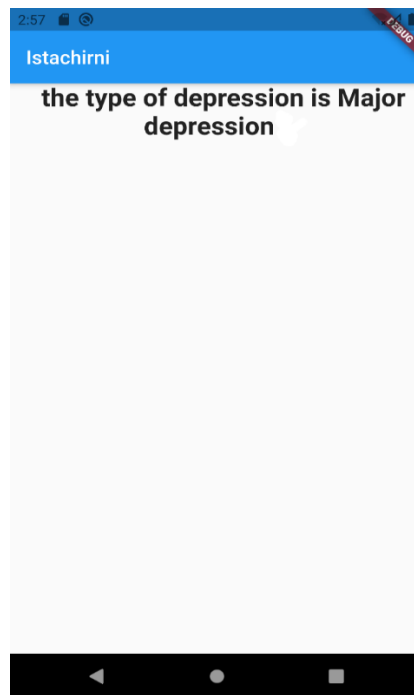
Figure 4.17: Prepare questions for missing properties

After building the numeric vector to predict type of depression by the model , we call predict to detect the type of depression:

```
ml_model.py 29
model_pickle
main.py      30
            31 def predict_dep(mod, val):
            32     d_pred = mod.predict(val)
            33     return d_pred
            34
            35
            36
            37
```

**Figure 4.18: to predict type of depression by the model**

And return result to the front end



**Figure 4.19: return result to the front end**

### 4.3 Experimentation of ISTASHIRNI

In order to accurately predict depression through our application, we need two things:

- Effective machine learning model
- Accuracy in extraction Features by language processing

### 4.3.1 Experimentation of machine learning model

After we have created datasets we test and select the appropriate algorithm, which gives an accurate prediction.

For this we used two prediction algorithms random forest regressor and decision tree regressor.

After building the model we calculate the accuracy value of each algorithm :

```
In [26]: from sklearn import metrics
import numpy as np

print('Mean Absolute Error:', metrics.mean_absolute_error(y_test, y_pred))
print('Mean Squared Error:', metrics.mean_squared_error(y_test, y_pred))
print('Root Mean Squared Error:', np.sqrt(metrics.mean_squared_error(y_test, y_pred)))

Mean Absolute Error: 0.5042857142857142
Mean Squared Error: 1.0592142857142857
Root Mean Squared Error: 1.0291813667737508

In [27]: accuracy = regressor.score(X_train,y_train)
print( "Linear Regression Accuracy: ", accuracy*100,'%')

Linear Regression Accuracy: 99.5742953478977 %
```

**Figure 4.20: calculating the accuracy of random forest regressor**

The model accuracy after using random forest algorithm is 99.5%

```
In [10]: from sklearn.metrics import classification_report,confusion_matrix,accuracy_score

In [16]: print("confusion_matrix")
print(confusion_matrix(y_test,y_pred))
print("DecisionTreeRegressor accuracy_score")
print(accuracy_score(y_test,y_pred)*100,"%")

confusion_matrix
[[2 0 0 0 0]
 [0 3 0 0 0]
 [0 0 2 0 0]
 [0 0 0 1 0]
 [0 0 0 0 1]]
DecisionTreeRegressor accuracy_score
100.0 %
```

**Figure 4.21: calculating the accuracy decision tree regressor**

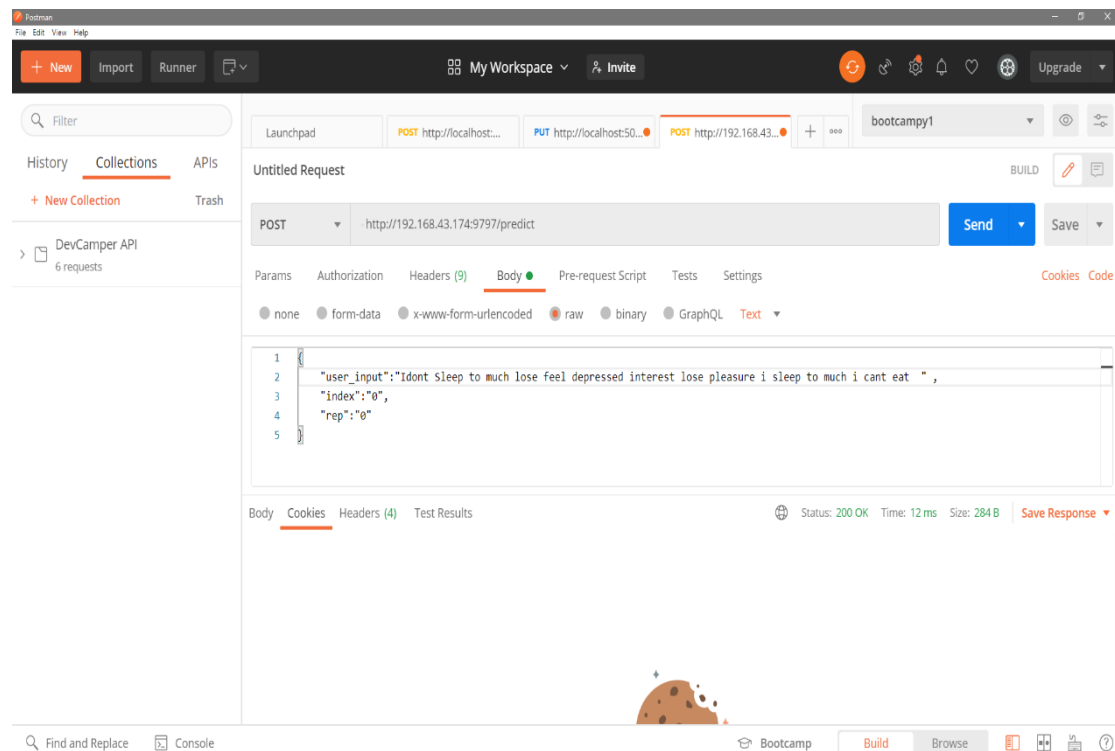
The model accuracy after using decision tree algorithm is 100%.

After calculating the accuracy of each algorithm and compare them we have selected decision tree algorithm because it gives the best accuracy value .

### 4.3.2 Experimentation of Features extraction by language processing

At this point, we tested our API for extraction Features by language processing by Postman platform:

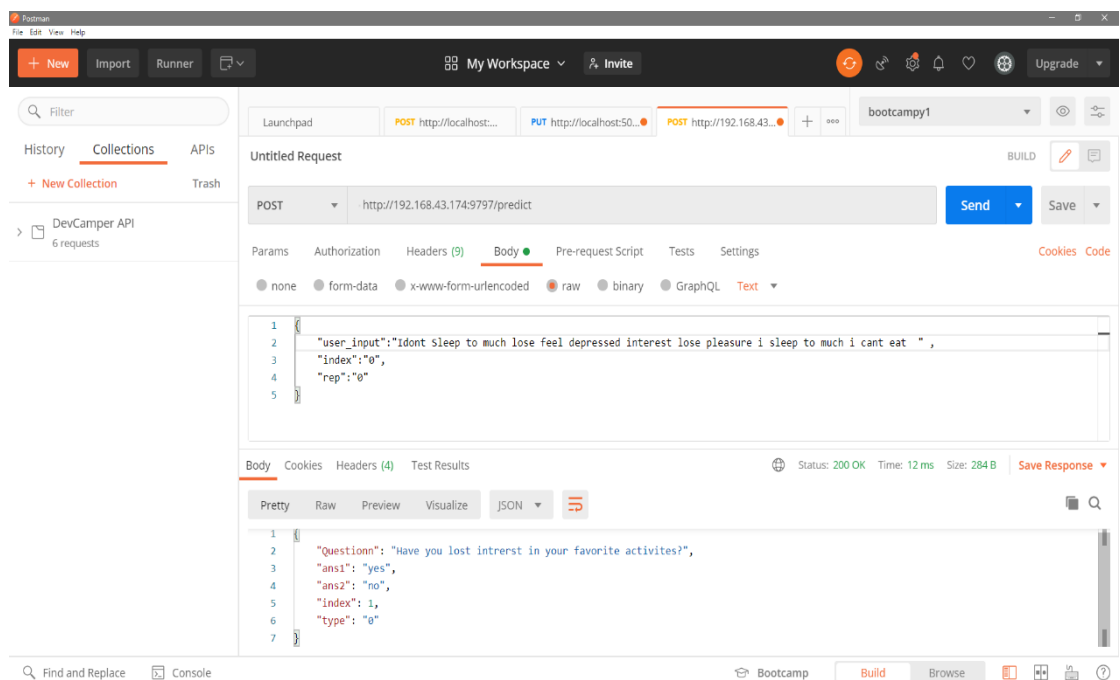
We send a text containing a set of properties to the API via predict post method by post man,



**Figure 4.22: Send Text to Test API**

The API analyzes and processes the text and when finding the missing property returns a question about missing feature, as it shown in figure 4.22.

## Chapter 4- Implementation and experimentation



**Figure 4.23: API response**

### 4.3.3 ISTASHIRNI operational steps interfaces

In this section we explain ISTASHIRNI architecture through the following steps:

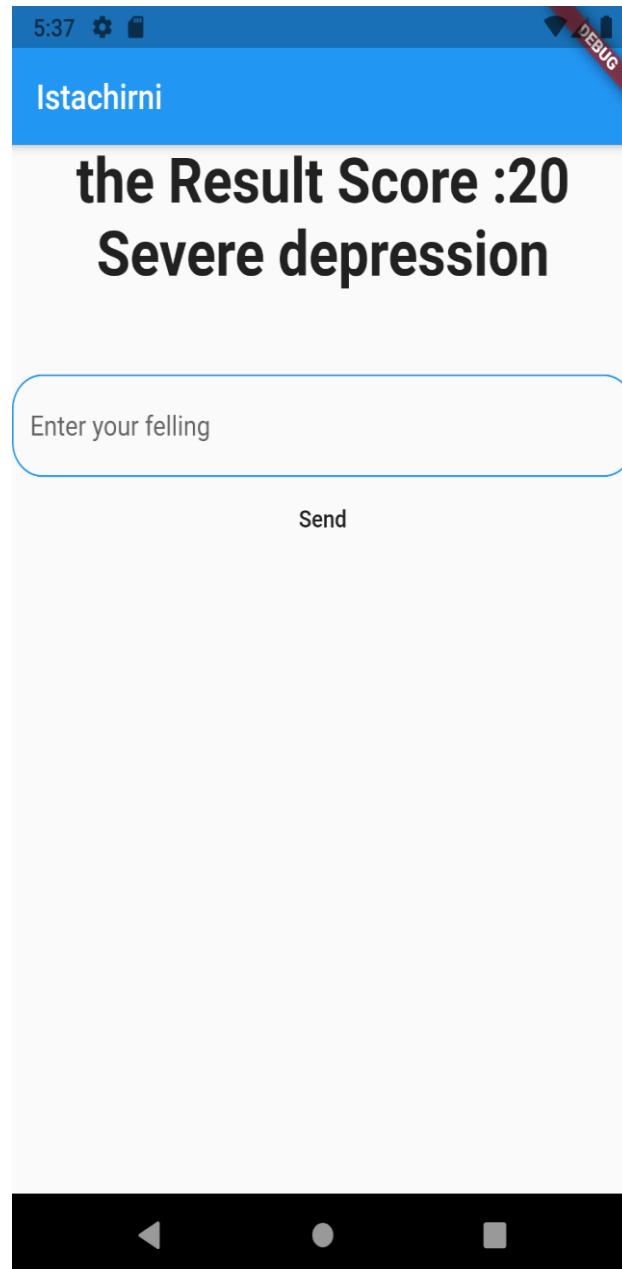
1. Answer the questions of PHQ-9.
2. Get the PHQ-9 test result.
3. Express the psychological state by writing in the application.
4. Answer questions posed by the application for missing symptoms .
5. Get the result of prediction.

1-Answer the questions of PHQ-9



Figure 4.24: Answer the questions of PHQ-9

2- Get the PHQ-9 test result



**Figure 4.25: Phq-9 Score user interface**

- 3- Express the psychological state by typing user mental expression

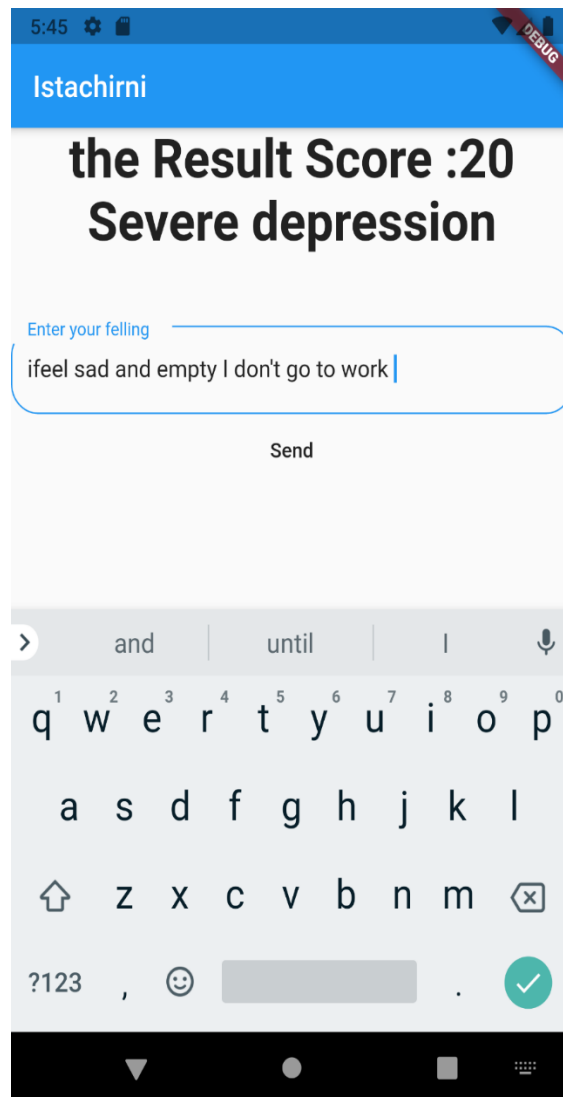


Figure 4.26: Express the psychological state by writing in the application

4- Answer questions posed by the application for missing symptoms in order to check

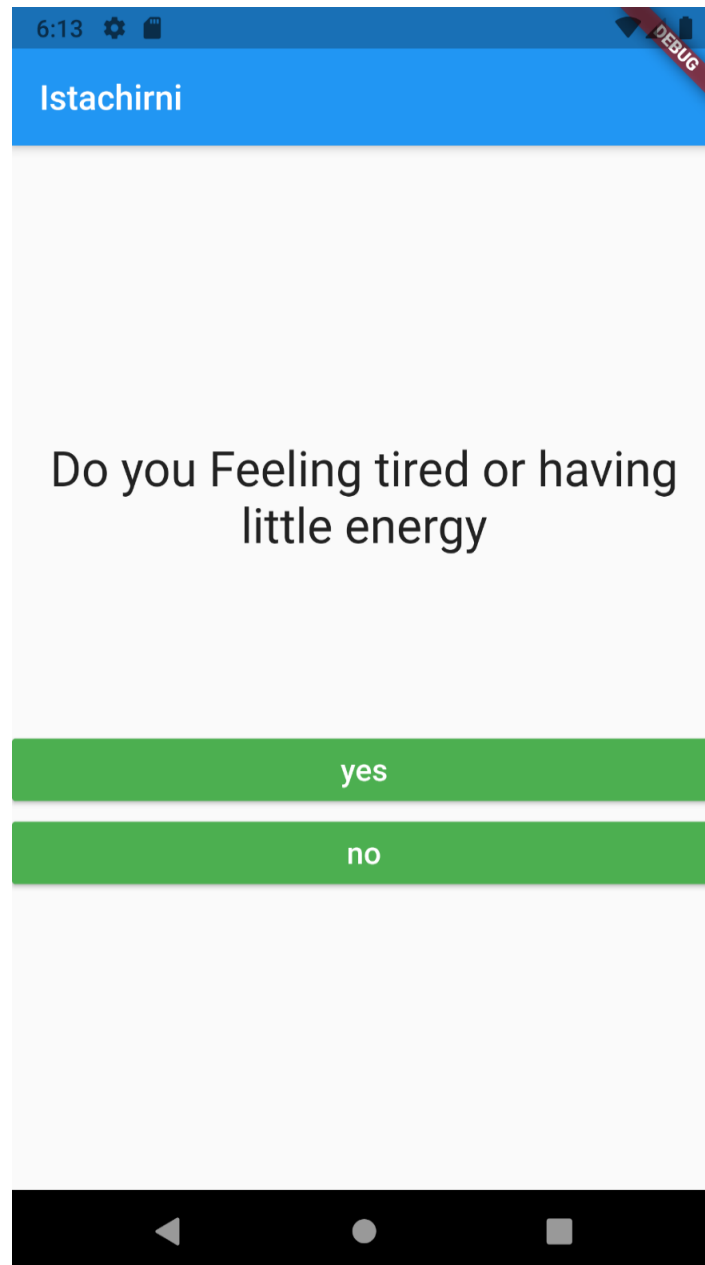
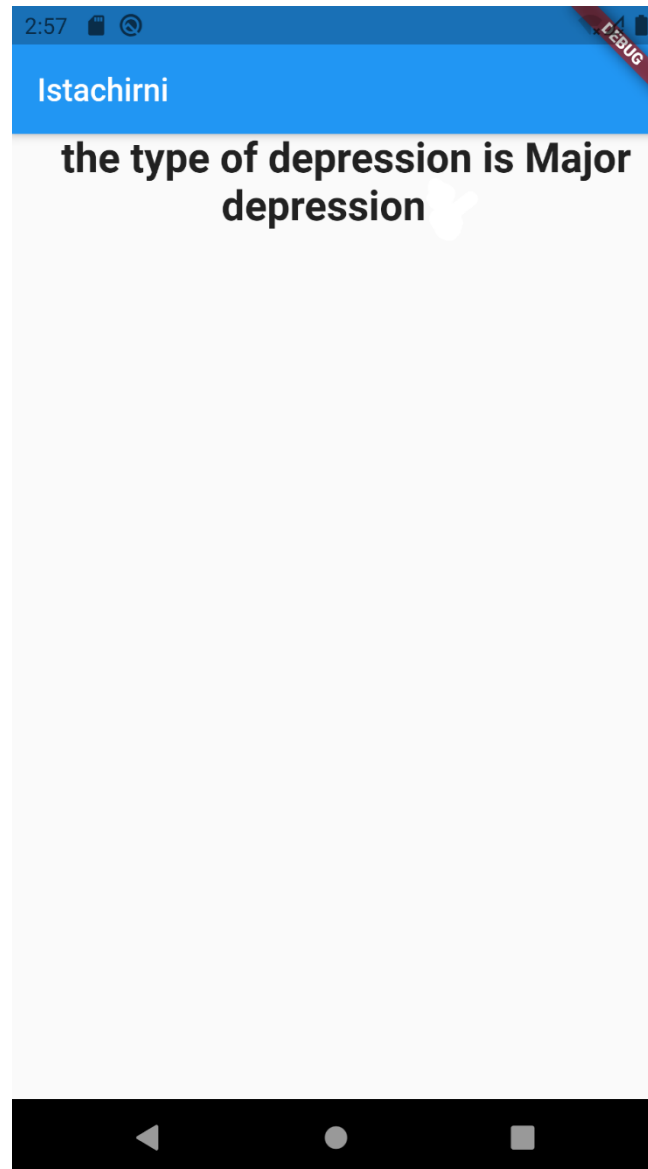


Figure 4.27 Answer questions posed by the application for missing symptoms

5-Get the result of prediction



**Figure 4.28: return result of prediction**

### **4.4 Conclusion:**

In this chapter we presented all the techniques and tools that we have exploited to build the application based on the study we did and the solutions that we embodied in order to identify and diagnose the type of depression.

After the experimentation we found that our application is very useful and operational.



General conclusion

### General Conclusion

Due to the significant increase of the Symptoms of depressive disorder in the last years according to recent studies and the increase sense of shame from visiting psychiatrists, we thought about developing a smartphone application to facilitate mental health diagnosis . This study was interested in diagnosing depression through a smartphone application without the need to visit psychiatrists and we hope that everyone will benefit from this application.

Our application is based on the following points:

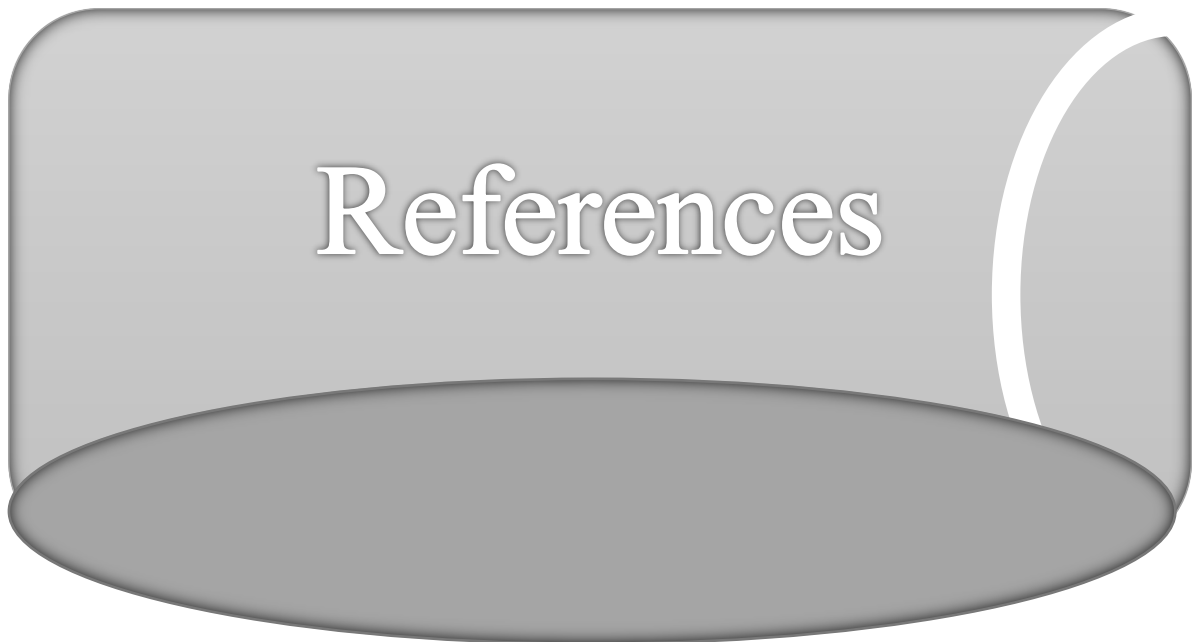
1. Theoretical study of depression to extract main properties of each depression type.
2. Data preprocessing and feature selection.
3. Datasets construction.
4. Training phase: build machine learning models from dataset.
5. Testing phase: use language processing to extract depression symptoms keywords to build numeric testing vector.
6. Predicting the type of depression

In our project we have built our own dataset to determine the type of depression.

During the experiment phase, we tested our application with the data that we generated. The experimental results show that our application identifies depression and detects its type which proves the effectiveness of the list of features selected to detect the type of depression.

#### **Perspectives:**

Our approach focused more on patient expression analysis than application response, it could be improved by adding a database to speed up response by saving the results obtained in the database and using them in future analyzes and adding medical advice for treatment.



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### Abstract

Depression has become the disease of the times and has spread widely in the world, where its spread has led to a decrease in the effectiveness of individuals in society and prompted many people to contemplate suicide. Many modern methods and techniques have been used to diagnose depression and guide patients to recover from the disease. In this project we designed an application that aims to identify people with depression. Determining the type of depression using machine learning techniques, where a comparison is made between the specific characteristics of each disease and the data entered by each patient, and as a result, the case is diagnosed and the type of depression is determined. The experimental results obtained have proven the effectiveness of our application.

**Keywords:** Depression diagnosis , E-mental health, Machine learning, depression ,smartphone-based CBT for depression.

### ملخص

أصبح الاكتئاب مرض العصر وانتشر على نطاق واسع في العالم حيث أدى انتشاره إلى انخفاض فعالية الأفراد في المجتمع ودفع الكثير من الناس إلى التفكير في الانتحار. تم استخدام العديد من الأساليب والتقنيات الحديثة لتشخيص الاكتئاب وتوجيه المرضى للشفاء من المرض. في هذا قمنا بتصميم تطبيق يهدف إلى التعرف على الأشخاص المصابين بالاكتئاب. تحديد نوع الاكتئاب باستخدام تقنيات التعلم الآلي، حيث يتم إجراء مقارنة بين الخصائص المحددة لكل مرض والبيانات التي يدخلها كل مريض، ونتيجة لذلك يتم تشخيص الحالة وتحديد نوع الاكتئاب. وقد اثبتت النتائج التجريبية لمتحصل عليها فعالية تطبيقنا .

كلمات مفتاحية: تشخيص الاكتئاب , الصحة النفسية الالكترونية, تعلم الآلة , علاج الاكتئاب باستخدام الهواتف, الاكتئاب .

