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A Novel Advisory System for the Psychological Guidance of University Students

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ABSTRACT

This paper presents a novel advisory system for university students that can diagnosis and guidance of ten common psychological problems. These problems are Anger, Boredom, Fear, Sadness, Generalized anxiety, Internet addiction, Mood swings, Sleep problems, Stress and Test anxiety. The proposed system consists of three main tools. These tools are facial expressions, speech emotions, and diagnostic test. The obtained results show that the proposed system achieved a high accuracy.

Keywords:- Psychological Problems, Advisory Systems, Facial Expression Recognition, Local Binary Pattern, Speech Emotion Recognition.

I. INTRODUCTION

Psychological problems can be defined generally through a combination of features that reflect the feelings of a person or his actions and explain his thinking and perceptions [1]. Psychological health is a very important part of any human being as it guides to an emotional, social wellbeing, and the adaptability towards a changing environment [2]. University students often claim to have stress, anxiety, symptoms of depression, eating problems and other psychological issues, which have significant negative impact on their academic performance and their psychological health. Early diagnosis of such problems can help college students to get rid of them faster [3]. Facial expression is the first sign used by most of the psychiatrist to identify students' psychological condition. Most of students don't speak to doctors or don't want to share anything with others at that time facial expression will be useful [4]. Besides facial expressions, speech has proven to be one of the most promising modalities for automatic human emotion recognition. The researchers increasingly focus on speech emotion recognition due to the influence of emotions on the physical as well as psychological health of people [5-6]. Identification of psychological problems signs is not always easy. The health care professionals use Patient Health Questionnaire (PHQ) as a tool for diagnosing of psychological problems as it quick and easy for patients to complete. Answering all questions honestly is the best way to ensure that you will receive the right diagnosis.

The paper is organized as follows:
Section1: Introduction.
Section2: Related work.
Section3: Advisory Systems.
Section4: The proposed System Description.
Section5: Application and Experimental Results.
Section6: Conclusions and Future Studies.

II. RELATED WORK

There are many systems have been developed for psychological problems identification. Particle Swarm Optimization (PSO) and Artificial Neural Network (ANN) had combined for predicting Generalized anxiety problem by Dilip Roy Chowdhury, et al [7]. A fuzzy based expert system had built to treat the sleep apnea using musical therapy by Ms. Jeyalakshmi M.S, et al [8]. Both image and speech processing had investigated to estimate the Apnea Hypopnea Index (AHI) by Fernando Espinoza-Cuadros, et al [9]. Implementation of neural networks methods for depression data mining using Back Propagation Algorithm (BPA) and Radial Basis Function (RBF) had presented by R. Bhuvana, et al [10]. Temperament and Mood Detection System (TAMDS) had presented using case-based reasoning technique by Adebayo Kolawole John, et al [11].

III. ADVISORY SYSTEMS

Advisory systems help for problems solving and assist to take decision in such a problem where more than one decisions are possible. However, they leave the final

decision-making to the decision maker. They can be classified as a type of expert systems [12]. Advisory systems support intelligent, unstructured, novelty, complexity, and open-endedness decisions in health diagnostics, business intelligence, mechanical diagnostics, pharmaceutical research, and others [13].

IV. THE PROPOSED SYSTEM DESCRIPTION

A. The Questionnaire of the Psychological Problems of University Students

The questionnaire steps were as follows:

- **The Goal of the Questionnaire**

This questionnaire aimed at recognizing the most important psychological problems that Mansoura university students suffer from. It also specifying the percentage rates of these problems to build the suggested advisory system for the most common problems.

- **The Stages of Doing the Questionnaire**

- Many previous Arabic and foreign studies have been reviewed to reach the way of design the questionnaire and to select its proper vocabulary for the study.
- Thirty-three psychological problems were listed.
- The psychological problems shown to ten arbitrators in psychology to know if the list is applicable and how realistic the shown problems are.
- The problems that got less than 90% of the arbitrators agree were omitted and it is a high rate of agreement. Thus, the questionnaire has a reasonable degree of credibility that makes it applicable to undergraduate students.
- The list was in a form of questionnaire in its final form as a five-graded scale (Lykert Quintet Scale).
- The questionnaire was distributed among the sample of the pilot study concerned with identifying the psychological problems that the university students suffer from. By estimated the percentage rates of students suffering for each problem the top ten problems suffered by university students were identified. These ten problems which gave the top ten averages.

The following table shows the top ten psychological problems that face Mansoura university students from their own point of views.

Table 1. The top ten psychological problems that face Mansoura university students from their own point of views

No. of Problem	The name of the problem	Percentage
1	Test anxiety	80.52
2	Mood swings	77.2
3	Boredom	72.8
4	Anger	72.42
5	Stress	71.92
6	Sadness	67.48
7	Generalized anxiety	67.08
8	Sleep problems	65.12
9	Fear	64.12
10	Internet addiction	62.76

B. Diagnostic Test (Questionnaires) for the Ten Psychological Problems of the University Students

Due to the results of the questionnaire of the psychological problems of Mansoura university the dimensions of the diagnostic test were pointed. It will be used to know if the psychological problems are found for students or some of them of the ten problems that were agreed upon. Every dimension (questionnaire) has some of phrases show the symptoms of every problem.

The diagnostic test has the following steps:

- **The Goal of the Diagnostic Test**

Its goal is knowing the psychological problems which the student is suffering from so that the suitable guidance for each problem can be given.

- **Determining the Axes of Each Dimension of the Diagnostic Test**

The axes for each dimension of the test which represents a psychological problem were identified in four main axes as shown in the following table.

Table 2. The axes of the diagnostic test for each psychological problem of the ten problems under study

The axis	No of axis
1	Physical dimension
2	Behavioral dimension
3	The emotional dimension
4	The social dimension

- **The Psychometric Properties of Diagnostic Testing**

- **Firstly, Validity of the Test:**

The test is presented to (15) of the arbitrators in the field of psychology and computer to express their views. It was agreed between the arbitrators on the items of psychological problems of the study and the rate of agreement ranged from 85-100%, which are high ratios of agreement so the diagnostic test has a reasonable degree of trustful make it applicable to university students. The arbitrators' instructions focused on modifying, deleting and reforming some phrases to be clearer and to avoid repetition.

- **Secondly, Stability of the Test:**

The re-test method was used. The diagnostic test was applied on (25) sample of the university students without the original sample. The same test was re-applied on the same sample two weeks after the first time. The coefficient of correlation was calculated between the students' grades at the first time of the application and their degrees in the second time. The researcher obtained a stability coefficient of (0.91) which is acceptable, high and functional at (0.01). This shows that the form is applicable and trustful.

- **Diagnostic Test Correction**

The students' responses to the test were given degrees as follows:

Always	Often	Sometimes	Slightly	Rarely
5	4	3	2	1

Each questionnaire (Q**)** has number of phrases, maximum degree (Mx_Deg), minimum degree (Mn_Deg) and average degree (Av_Deg) as shown in the following table.

Table 3. The number of phrases, Mx_Deg, Mn_Deg and Av_Deg for each questionnaire of diagnostics test of the psychological problems of the study

Q No.	Q. Name	No. of Phrases	Mx_Deg	Mn_ Deg	Av_ Deg
1	Anger	20	100	20	60
2	Boredom	14	70	14	42
3	Fear	20	100	20	60
4	Sadness	20	100	20	60
5	Generalized anxiety	20	100	20	60
6	Internet addiction	20	100	20	60
7	Mood swings	20	100	20	60
8	Sleep problems	14	70	14	42
9	Stress	18	90	18	54
10	Test anxiety	20	100	20	60

C. Facial Expression Recognition

Emotion is a psychological state which involves many types of behavior actions thoughts and feelings. Emotions constitute an essential part of our existence as it exerts great influence on the physical and psychological health of people. Human face is an important part of an individual's body that contains a lot of information about the expressional state of the person. Human can express her/his emotion through lip, nose and eyes. Facial expression reflects not only emotions but also other mental activities, social interaction and psychological signals [14]. The speaker's facial expression gives about 55 % of the effect, 38 % of the expression is conveyed by voice intonation and 7 % by the spoken words. Therefore, deriving an effective facial representation from the original face image is a vital step and very tough task in the field of computer science for successful facial expression recognition [15]. Facial expression recognition consists of detecting the face in the image, pre-process the face regions, extracting facial expression features by analyzing the change in the appearance of facial features and then classifying this information into facial expression categories. Figure1 shows the proposed facial expression recognition framework.

Facial expression recognition passed through the following stages:

- **Student's Image Acquisition**

The digital images for each student are acquired by putting him/her in some of situations and asking him to give an expression using his face as a reaction for this situation. They are captured using digital camera. There are two types of captured images individual student or student among group. These images are related to five facial expression categories. These categories are Anger, Boredom, Fear, Natural and Sadness. Figure 2 shows examples of facial expression categories.

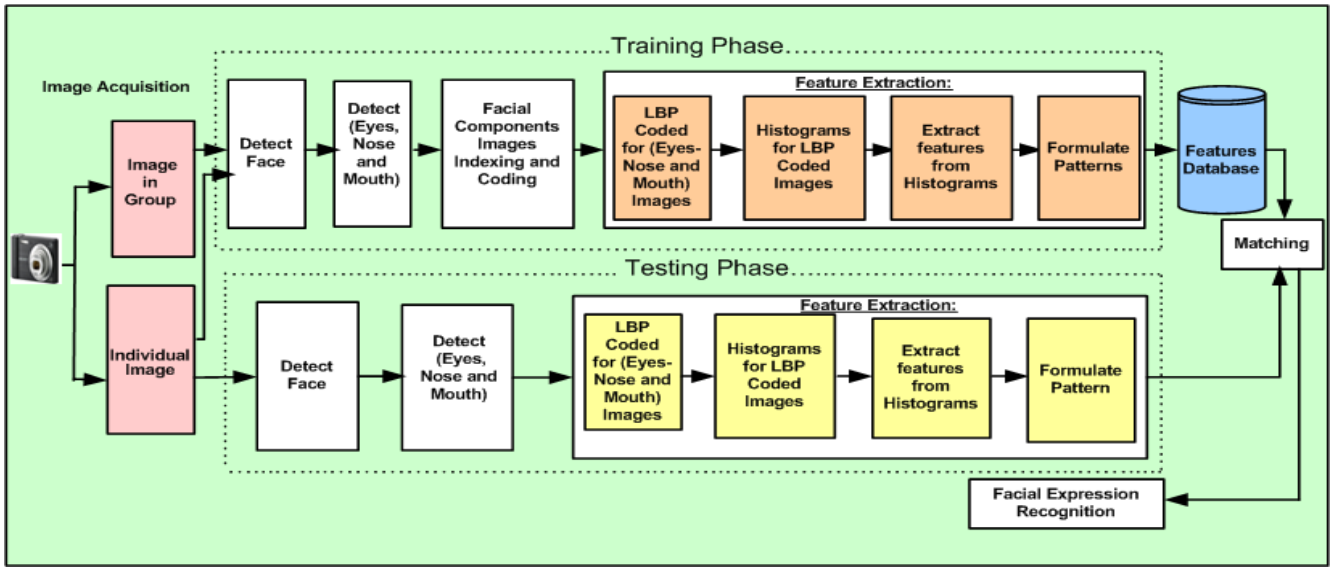


Fig1: The proposed facial expression recognition framework

Fig 2: Examples of facial expression categories

- **Face and its Components Detection**

MATLAB 2016 is used to detect face and its components portions (eyes, nose and mouth) since these areas carry the more essential emotion information. The computer vision system toolbox contains Vision. Cascade Object Detector System function which detects facial objects based on Viola-Jones face detection algorithm. [16-17]. Facial objects are divided into four segments in which various parts of the face is detected.

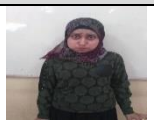
- **Face Detection**
- **Eyes Detection**
- **Nose Detection**
- **Mouth Detection**

The details of these segments are as follows:

- **Face Detection**

The face object can be detected from individual image or image in group. Table 4 shows example of detection face from different types of images.

Table 4. Example of detection face from different types of images

Image Type	Student Image	Face Detection	Face Cropping
Individual			
In group			

- **Eyes Detection**

Eyes are often viewed as important features of facial expressions. A person's eyes reveal much about how they are feeling, or what they are thinking. Figure 3 shows detected eyes from face image.

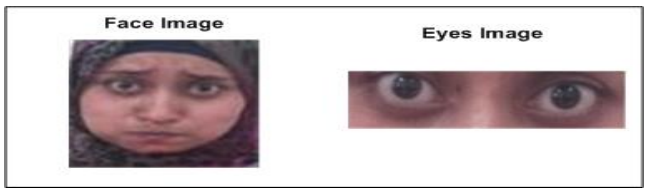


Fig 3: Detected eyes from facial expression image

- **Nose Detection**

Nose is one of the most important part of human face and plays a significant role in expression recognition. Figure 4 shows detected nose from face image.

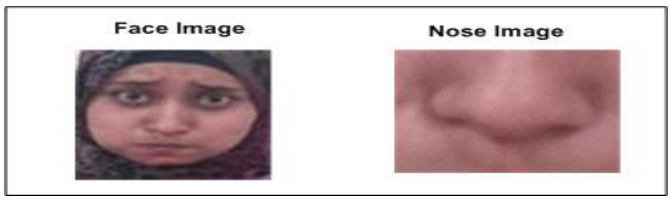


Fig 4: Detected nose from facial expression image

- **Mouth Detection**

Mouth plays a very significant role in expressions recognition and an important part of human face. Figure 5 shows detected mouth from face image.

Fig 5: Detected mouth from facial expression image

- **Images Coding and Saving**

Facial expression images were taken to each student by using digital camera. These images belong to five categories (Anger, Boredom, Fear, natural and Sadness). The student image was decomposed into four parts (face, eyes, nose and mouth). There are two approaches for saving these images, either in separate folders or in one database. Using database is preferred in this approach because of its data consistency and integrity, privacy, easy access to data, flexible, less storage, fast response to information requests and no redundant data. Consequently, coding of these images to be saved in database is important. The following part will explain this coding:

Choose a vector of 9 bits, first four bits were assigned for image number (till 9999 images). Fifth and sixth bits were assigned for facial components (face, eyes, nose and mouth). Finally, seventh, eightth and ninth bits were assigned for category type (Anger, Boredom, Fear, natural and Sadness). Figure 6 shows the bits' assignment for image coding.

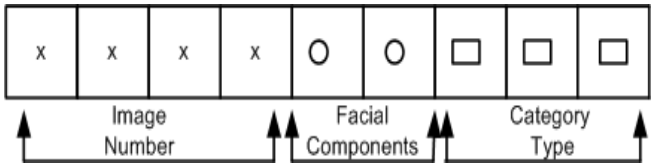


Fig 6: The bits' assignment for image coding

Facial components assignment for an image is shown in the following table.

Table 5. The facial components assignment for an image

Facial Components	Face	Eyes	Nose	Mouth
Code:	0 0	0 1	1 0	1 1

Category type assignment for an image is shown in table 6.

Table 6. The category type assignment for an image

Category Type:	Anger	Boredom	Fear	Natural	Sadness
Code:	0 0 0	0 0 1	0 1 0	1 0 0	1 1 1

An example for this coding is shown in figure 7

2	1	9	5	0	0	1	1	1

Fig 7: Example for an image coding

This code can be interpreted (decoded) as follows:
The image is number 2195. The facial component is the face. The student category is "Sadness".

- **Feature Extraction**

The features for cropped facial components (eyes, nose and mouth) images are extracted using Local Binary Pattern (LBP) operator [18]. Figure 8 shows facial components, their LBP coded images and their accompanied histograms.

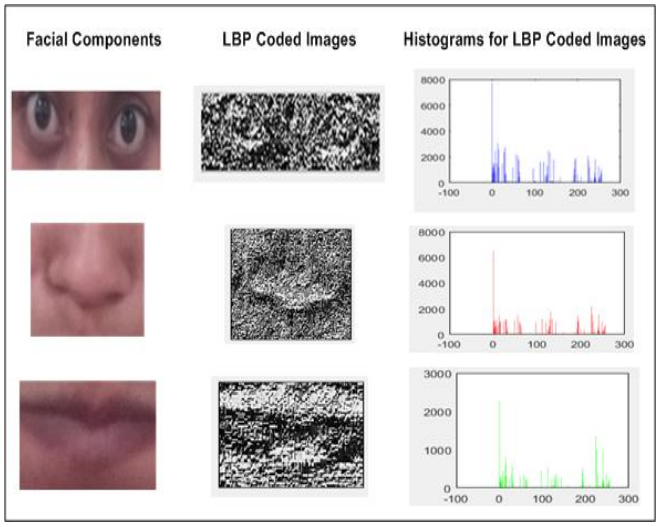


Fig 8: Facial components, LBP coded images and their accompanied histograms

Each histogram can provide five features (mean, median, variance, skewness and kurtosis). Accordingly, one can get fifteen features from each image of student. The features are calculated by using the equations in [19]. The flow chart of the proposed feature extraction is shown in the following figure.

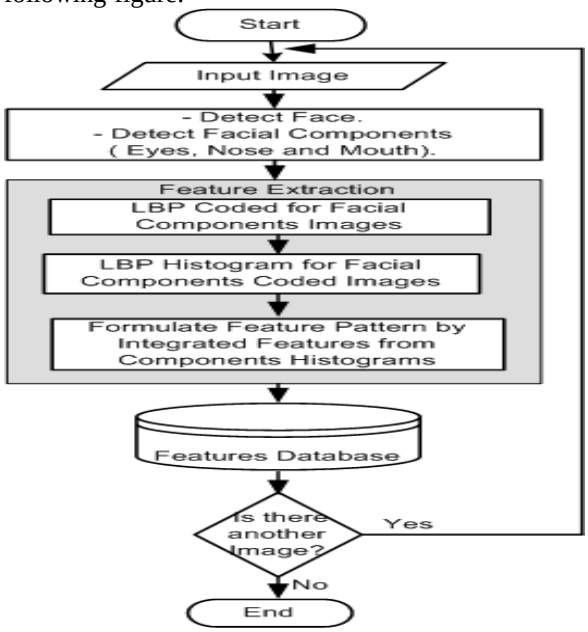


Fig 9: Flow chart for feature extraction pattern of image

- **Facial Expression Image Matching**

- **Matching Technique**

There are many methods used for pattern matching. The Weighted Euclidean Distance measure is the technique used in the proposed system. It is one of the fundamental and widely used techniques in matching. The formula of WED measure can be written as follows [20].

$$d(v,v^k)=\sqrt{\sum_{i=1}^{n} p_i(v_i - {v^k}_i)^2} \quad \dots (1)$$

Where:
v_i : to balance the variations in the dynamic range.
P_i : the weight added to the component.
k : is the matched image index.

$$p_i = \frac{N}{\sum_{K=1}^{N}(v_i{}^k - \overline{v_i})^2} \quad \dots (2)$$

N : the number of images in databases.

$$\overline{v_i} = \frac{\sum_{K=1}^{N} v_i{}^k}{N} \quad \dots (3)$$

- **Final Decision**

The steps to recognize facial expression are as follows:

1. Enter query image.
2. Find similarity measure between query image pattern and each image pattern in database using WED.
3. Sort similarity values in descending order.
4. Find average of the similarity values for each facial expression category (Avg_c):
   $Avg_c=Sum_c/ N_c$ … **(4)**

Where:

Sum_c: sum of the similarity values for each facial expression category.
N_c: number of retrieved images in each category.
c :1, 2, …, I and I is the number of categories.

5. Build vector of averages (Av) that contains all averages for facial expression categories.
   $Av=\{Avg_1, Avg_2,\dots, Avg_i,\dots.., Avg_I\}$
6. Find the max value (Avg_v) in the vector Av
   $Avg_v=Max\ (Av)$ … **(5)**

Where:

v: the index of the decision category.

Figures 10 shows a flowchart for facial expression recognition.

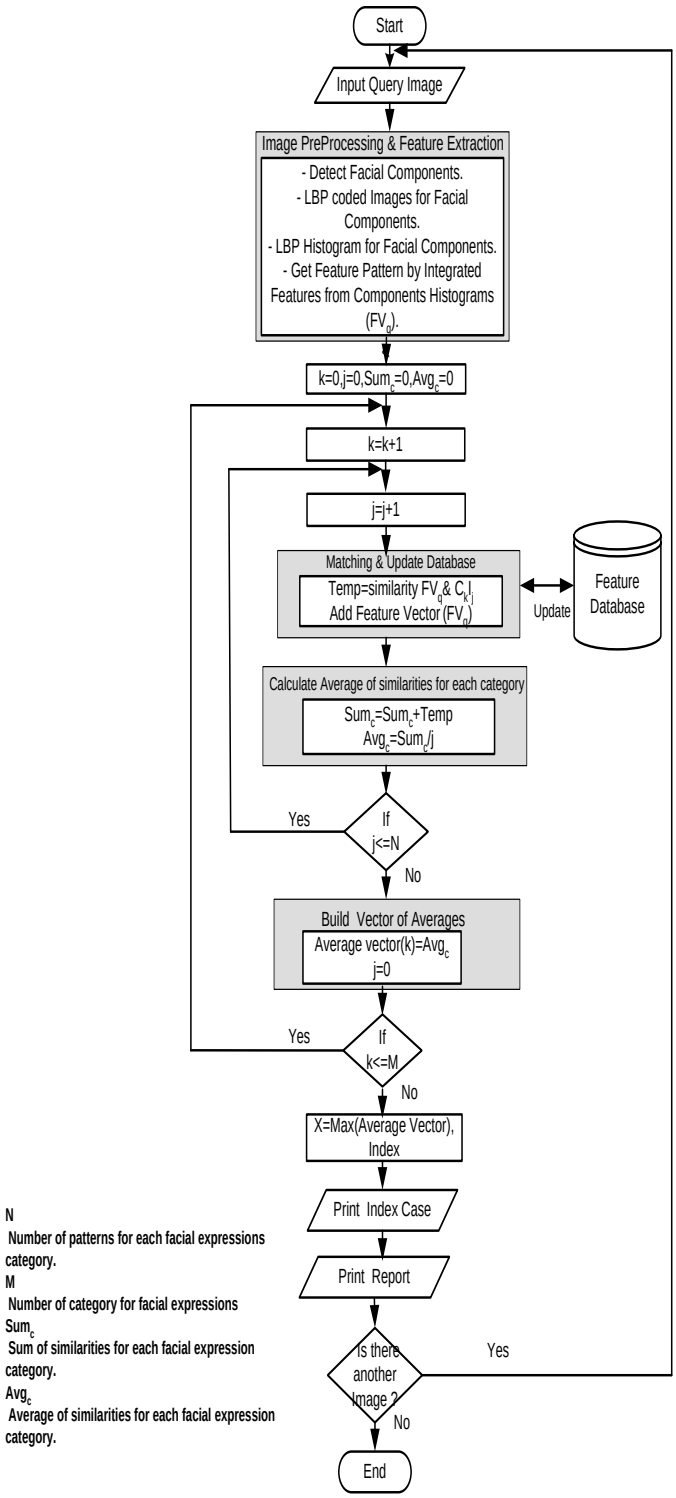


Fig 10: Flowchart for facial expression recognition

D. Speech Emotion Recognition

Speech is a complex signal which contains information about the message, speaker and emotions. Now the psychologists have dived to new level in which the voice can tell many important physical, mental and psychological aspects of human being [21]. Speech Emotion Recognition (SER) is defined as extraction of emotional state of the speaker from his/her speech. It is also referred to the task of classifying speech phrases into emotional classes. There are many applications of speech emotion recognition systems include [22]:

- Medical diagnosis for psychiatric patients.
- Emotion analysis during telephonic conversation.
- Mental Stress analysis during human conversation.
- E-learning for student emotional state etc.

Figure 11 shows the proposed speech emotion recognition framework.

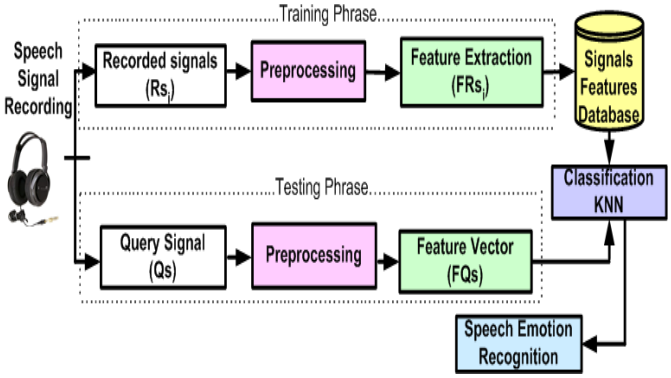


Fig 11: The proposed speech emotion recognition framework

Speech emotion recognition is passed through the following stages:

- **Student's Speech Emotional Signals Acquisition**

The speech signals for students were acquired using microphone. They were saved in WAV format. The sample frequency (fs) was 44100Hz with resolution 16-bits/sample. Each student recorded saying the same sentence with five different categories of emotions. These categories are: Anger, Boredom, Fear, Natural and Sadness. Figure 12 shows examples of the five emotional speech categories.

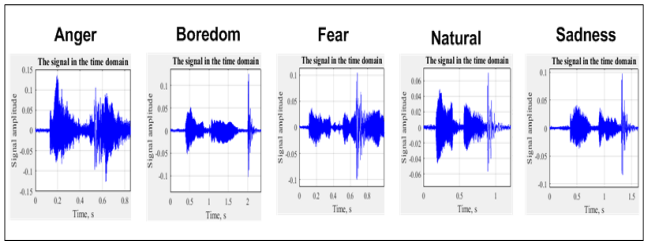


Fig 12: Examples of the emotional speech categories

- **Signal Preprocessing**

Speech signals are normally preprocessed before feature extraction to enhance the accuracy and efficiency of the feature extraction process. The preprocessing stages are filtering, framing and windowing. Figure 13 shows signal preprocessing stages.

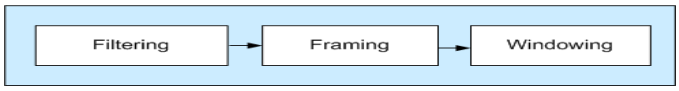


Fig 13: Signal preprocessing stages

- **Pre–emphasis**

Filter operations are performed to reduce the noise effect. This is done by using the high pass filter. Pre-emphasis process performs spectral flattening using a first order finite impulse response (FIR) filter. The principal goal of pre-emphasis is to compensate the high frequency part that was suppressed during the sound production mechanism of humans [23].

- **Framing**

The pre-emphasized speech signal has always a finite length. It is usually not processed whole due to its quasi-stationary nature. By blocking speech signal into short frames of N samples, it can be considered as stationary [24].

- **Windowing**

Windowing is done for minimizing the disruptions at the starting and at the end of each frame. The concept here is to minimize the spectral distortion by using the window to taper the signal to zero at the beginning and end of each frame [25]. The Hamming window [26] is used.

In this system, the pre-emphasized speech signal is divided into frames of 25ms (mille second) with a predefined overlapping value (50% overlapping).

- **Feature Extraction**

To achieve a successful classification, it is important to extract the relevant features from speech data. The extracted features used in this system are energy, duration, formant, pitch, Mel-Frequency Cepstral Coefficient (MFCC) and speech rate. These features are saved in database.

The detailed analysis of these features will be presented in the next sections:

- **Energy**

Energy gives the intensity of the spoken signal which is highly related to emotion. Speech signals of happy and angry emotion have much higher energy than sad [27-28]. Short-term energy function is used to extract the value of energy in each speech frame. The energy of each frame is calculated by [24]:

$$E = \sum_{n=0}^{N-1} |s_i(n)|^2 \quad \text{... (6)}$$

Where:

E: energy of each frame.
$s_i(n)$: denotes the i^{th} frame of the speech signal s(n).
N: the total number of samples in a frame or a window (frame length).

After applying previous equation for all frames in a signal, a vector of energies (E_v) is obtained. It consists of number of energy values for all frames in the signal.

$E_v = \{E_1, E_2, E_3, \ldots, E_n, .., E_N\}$ **... (7)**

Where:

E_n: Energy for the n^{th} frame.

Consequently, five proposed features are extracted from E_v. These features are: mean (E_m), max (E_{mx}), min (E_{mn}), median (E_{md}), standard division (E_{sd}).

$F\ Set_1 = \{ E_m, E_{mx}, E_{mn}, E_{md}, E_{sd}\}$ **... (8)**

- **Speech Duration**

Time durations of each emotion statement are important. These times include voiced and unvoiced parts, which are contributed to emotion. Voiced duration and unvoiced duration ratios of emotion statements are considered as recognition feature parameters [29].

To separate voiced and unvoiced parts of a signal Zero Crossing Rate (ZCR) and Short Time Energy (STE) methods can be used. The STE method is used in this paper. The following steps explain the process of detecting the signal voiced and unvoiced parts using STE method:

1) Calculate the average energy (E_{av}) for (E_v) and use it as a threshold level.
2) Compare elements of (E_v) with (E_{av}).
3) If $E_n > E_{av}$ then $Frame_n$ is "voiced frame"
Add n to (FN_v)
Else
$Frame_n$ is "unvoiced frame".

Where:
FN_v: vector contains frames numbers for the voiced parts.

4) Reconstruct signal for the voiced parts using (FN_v).

The total durations of voiced and unvoiced parts will be used as features in this paper. These durations are calculated from original signal and signal for the voiced parts as follows:

$D_s = Len(x) / fs$ **... (9)**
$D_v = Len(x_v) / fs$ **... (10)**
$D_u = D_s - D_v$ **... (11)**

Where:
D_s: Duration of the original signal (voiced+ unvoiced) parts.
D_v: Duration of voiced parts.
D_u : Duration of unvoiced parts.
Len(x): Length of original signal.
$Len(x_v)$: Length of signal for the voiced parts.

Consequently, five proposed features are extracted from signal durations. These features are:
$F\ Set_2 = \{ D_v, D_u, D_v/ D_u, D_v/ D_s, D_u/ D_s\}$ **... (12)**

- **Speech Rate**

Speech rate has strong connection with emotions. Human being speaks faster when gets excited than in cool mood. Thus, angry, Fear or high frequency content emotions are likely to have higher speech rate than neutral or sad or low excited voices. For an utterance, the average speaking rate (Sr) can be estimated as follows [30]:

$$S_r = \frac{n_w}{Ds}$$ **... (13)**

Where:
n_w : is number of words in utterance.

Calculating number of words in a signal is explained as follows:

1) Detect difference between FN_v elements using diff function in Matlab and put differences in DF_v vector.
$DF_v = \{Dif_1, Dif_2, Dif_3, \ldots, Dif_n, ..., Dif_N\}$ **... (14)**
Where:
Dif_n: n^{th} difference value between two frames numbers.

2) If Dif_n >1 then replace Dif_n by "1"
Else
replace Dif_n by "0".

3) Count the number of DF_v elements that is equal "1" and put the output in C.

4) Calculate n_w as follows:
$n_w = C+1$ **... (15)**

5) Compute the average of speaking rate through n_w divided by D_s.

- **Formant**

The shape of the vocal tract is changed by the emotional states. Formant is an acoustic resonance of the human vocal tract. It is measured as an amplitude peak in the frequency spectrum of the sound [31].

The first three formants F1, F2, F3 are extracted using Linear Predictive Coding (LPC) filter as shown in [32]. Three vectors ($F1_v$, $F2_v$, $F3_v$) are obtained for all frames in a signal.

$F1_v = \{ F1_1, F1_2, F1_3, \ldots, F1_n, .., F1_N \}$ **... (16)**
$F2_v = \{ F2_1, F2_2, F2_3, \ldots, F2_n, .., F2_N \}$ **... (17)**
$F3_v = \{ F3_1, F3_2, F3_3, \ldots, F3_n, .., F3_N \}$ **... (18)**

Where:

$F1_n$: F1 for the n^{th} frame.
$F2_n$: F2 for the n^{th} frame.
$F3_n$: F3 for the n^{th} frame.

Then, average for each vector is calculated to obtain total F1, F2, F3 for all frames. Finally, five proposed features are extracted from signal formant frequencies. These features are:

$F\ Set_3 = \{F1, F2, F3, F2/ F1, F3/ F1\}$ **... (19)**

- **Pitch**

Pitch is fundamental frequency of speech signal. It is the periodic time of a wave pulse generated by air compressed through the glottis from the lungs. With a change in the emotions of a person his/her biological characteristics like blood pressure and flow of air from the lungs also get changed. So extracting this feature helps to detect the emotion of a person [33].

Pitch of the speech signal can be estimated using the autocorrelation method as explained in [34]. After applying it for all frames in the signal, a vector of frequency pitch (FP_v) is obtained.

$$FP_v = \{FP_1, FP_2, FP_3, \ldots, FP_n, \ldots, FP_N\} \quad \textbf{... (20)}$$

Where:

FP_n: frequency pitch for the n^{th} frame.

Consequently, five proposed features are extracted from FP_v. These features are: mean (FP_m), max (FP_{mx}), min (FP_{mn}), median (FP_{md}), standard division (FP_{sd}).

$$F\ Set_4 = \{ FP_m, FP_{mx}, FP_{mn}, FP_{md}, FP_{sd}\} \quad \textbf{... (21)}$$

- **MFCC**

MFCC is one of the best distinctive features of emotion recognition problems. MFCC is based on the characteristics of the human ear's hearing & perception, which uses a nonlinear frequency unit to simulate the human auditory system [35]. MFCC consists of some of steps. These steps are explained in [36].

After applying MFCC for input utterance, it is transformed into a sequence of acoustic vector. The statistical features mean (M_m), standard division (M_{sd}), median (M_{md}), skewness (M_{sk}) and kurtosis (M_{ku}) are calculated from acoustic vector.

Consequently, five proposed features are extracted from signal MFCC. These features are:

$$F\ Set_5 = \{M_m, M_{sd}, M_{md}, M_{sk}, M_{ku}\}. \quad \textbf{... (22)}$$

Finally, 26 features are extracted from each speech signal. Table 7 shows these features.

Table 7. The extracted features from speech signal

Features Name	Number of Extracted Features	Sets of Features
Energy	5	{ E_m, E_{mx}, E_{mn}, E_{md}, E_{sd} }
Duration	5	{ D_v, D_u, D_v/ D_u, D_v/ D_s, D_u/ D_s}
Formant	5	{ F1, F2, F3, F2/ F1, F3/ F1 }
Pitch	5	{ PF_m, PF_{mx}, PF_{mn}, PF_{md} PF_{sd}}
Speech Rate	1	S_r
MFCC	5	{M_m, M_{sd}, M_{md}, M_{sk}, M_{ku}}
Total	26	

The flowchart for training emotional speech signals is shown in figure 14.

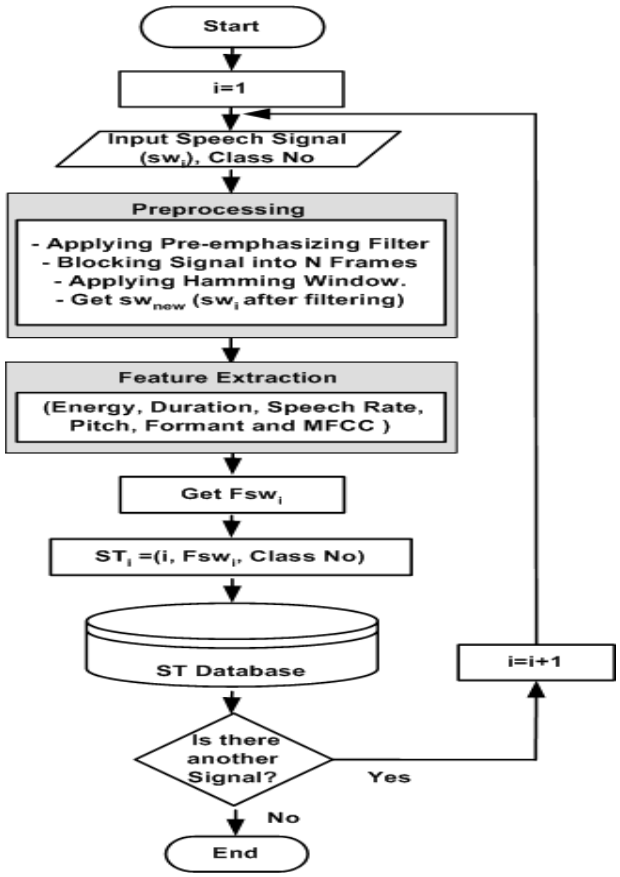


Fig 14: Flow chart for training emotional speech signals

- **Speech Emotion Classification**

K-nearest neighbor (k-NN) is one of the most popular and simple supervised learning algorithm. It is used in various pattern recognition and classification problems. KNN compares a given target instance with the k training instances that are the most similar or closest to it. There are a variety of metrics used to measure similarity and the Euclidian distance metric is frequently used. The target instance is assigned to the class to which the majority of these nearest neighbors belong [37]. An object is classified using k-NN algorithm as explained in [38].

Figure 15 shows flow chart for testing emotional speech signals.

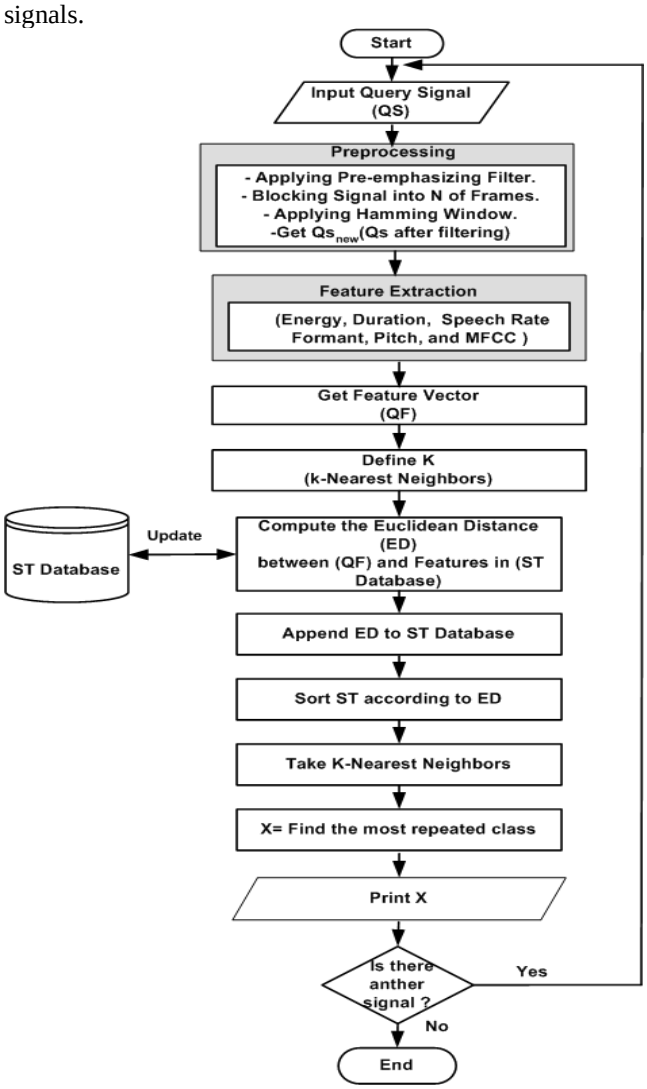


Fig 15: Flow chart for testing emotional speech signals

E. Final Decision for the Proposed System

There are three factors influencing in the decision - making for the four problems that depend on questionnaire decision (QD), facial expression decision (FD) and speech emotion decision (SD) and one factor for the six problems that depend only on QD. Numerical example for how to take final decision is shown in the next tables.

Considering student facial expression is "Anger" and student speech emotion is "Fear". The student degrees in questionnaires (St_Deg) are 65 for "Anger", 32 for "Boredom", 28 for "Fear", 22 for "Sadness", 29 for "Generalized anxiety", 24 for "Internet addiction", 26 for "Mood swings", 23 "Sleep problems", 56 for "Stress" and 74 for "Test anxiety".

Table 8. Facial expression decision for the four problems in case of "Anger"

FD_1 (Anger)	FD_2 (Boredom)	FD_3 (Fear)	FD_4 (Sadness)
1	0	0	0

Table 9. Speech emotion decision for the four problems in case of "Fear"

SD_1 (Anger)	SD_2 (Boredom)	SD_3 (Fear)	SD_4 (Sadness)
0	0	1	0

Table 10. Questionnaire decision for the four problems

Q No.	Q Name	St_Deg	Av_Deg	QD
1	Anger	65	60	1
2	Boredom	32	42	0
3	Fear	28	60	0
4	Sadness	22	60	0

Table 11. Final decision for the four problems from QD, FD and SD

Problem No.	Problem Name	QD	FD	SD	Final
1	Anger	1	1	0	2
2	Boredom	0	0	0	0
3	Fear	0	0	1	1
4	Sadness	0	0	0	0

Where:

Final=QD+FD+SD **... (23)**

From previous table the final decision for "Anger" is >=2, so student is suffering from "Anger" problem.

Table 12. Questionnaire decision for the six problems

Quest No.	Quest Name	St_Deg	Av_Deg	QD
1	Generalized anxiety	29	60	0
2	Internet addiction	24	60	0
3	Mood swings	26	60	0
4	Sleep problems	23	42	0
5	Stress	56	54	1
6	Test anxiety	74	60	1

From previous table student is suffer from "Stress" and "Test anxiety" problems as QD ="1". Finally, psychological guidance is presented in "Anger", "Stress" and "Test anxiety" problems.

V. APPLICATION AND EXPERIMENTAL RESULTS

A. The Approach of the Study

The study followed the semi experimental approach as it was suitable to process the study variables.

B. The Sample of the Study

- **The Pilot Sample**

The sample included 1000 student from Mansoura university. They were from different departments and academic levels. They were aged from 18 to 23 years old with the average (19.773) year and standard deviation around (1.35).

- **The Main Sample of the Study**

The basic study sample included 150 students from the faculty of specific Education in Mansoura university and it's both branches in meniat alnasr and meet ghamr. They were aged from 19 to 22 years old with an average (20.26) year and about (1.20) standard of deviation.

C. The Proposed System Description

The proposed system for student's psychological guidance is designed by combing Matlab with C# languages. The proposed system Graphical User Interface (GUI) is shown in figure 16. The language is chosen whether Arabic or English.

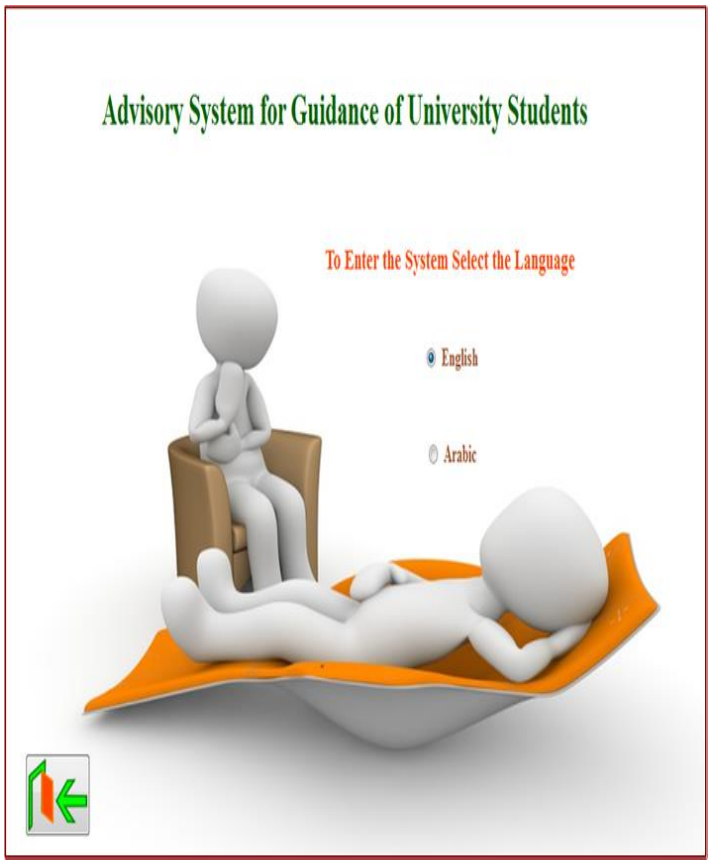


Fig 16: The proposed system graphical user interface

Figure 17 shows the main screen in the proposed system. It is divided in to six categories about: instructions are followed, ten questionnaires are filled in, student's image is entered, student's sound is entered, diagnosis process is done and exit to get out from the program at any time.

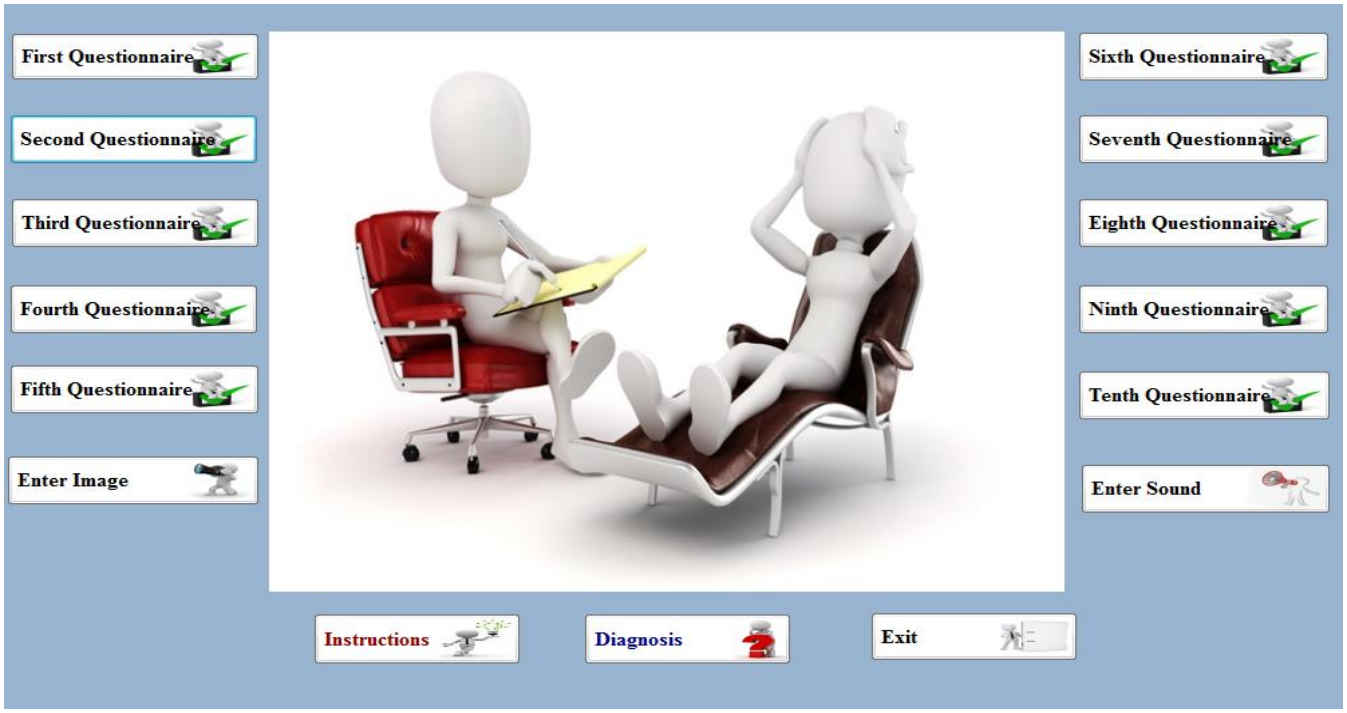


Fig 17: The main screen in the proposed system

The following is an explanation of the main screen components:

- **Instructions Button**

Instructions explain how student can fill in the questionnaires correctly. Figure 18 shows questionnaire instructions screen for the student.

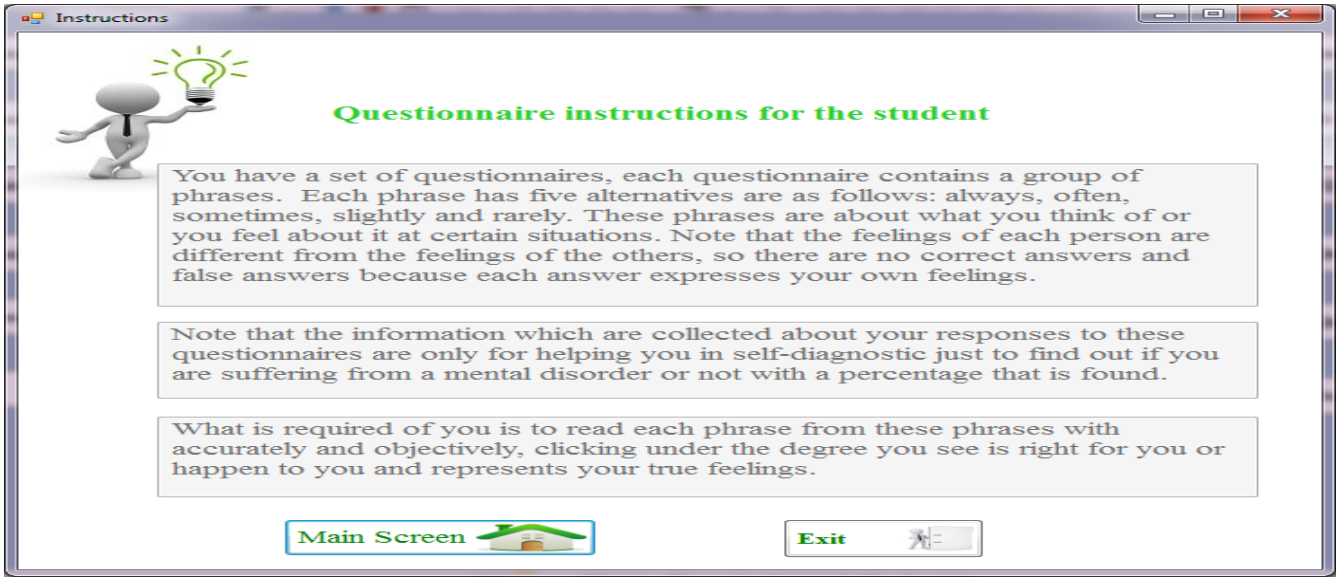


Fig 18: Questionnaire instructions screen for the student

❖ **Questionnaires Buttons**

Student fill in the ten questionnaires. Diagnosis is only done if all these questionnaires are completed. Figure 19 shows example of questionnaire content. Student must fill in all phrases in the questionnaire.

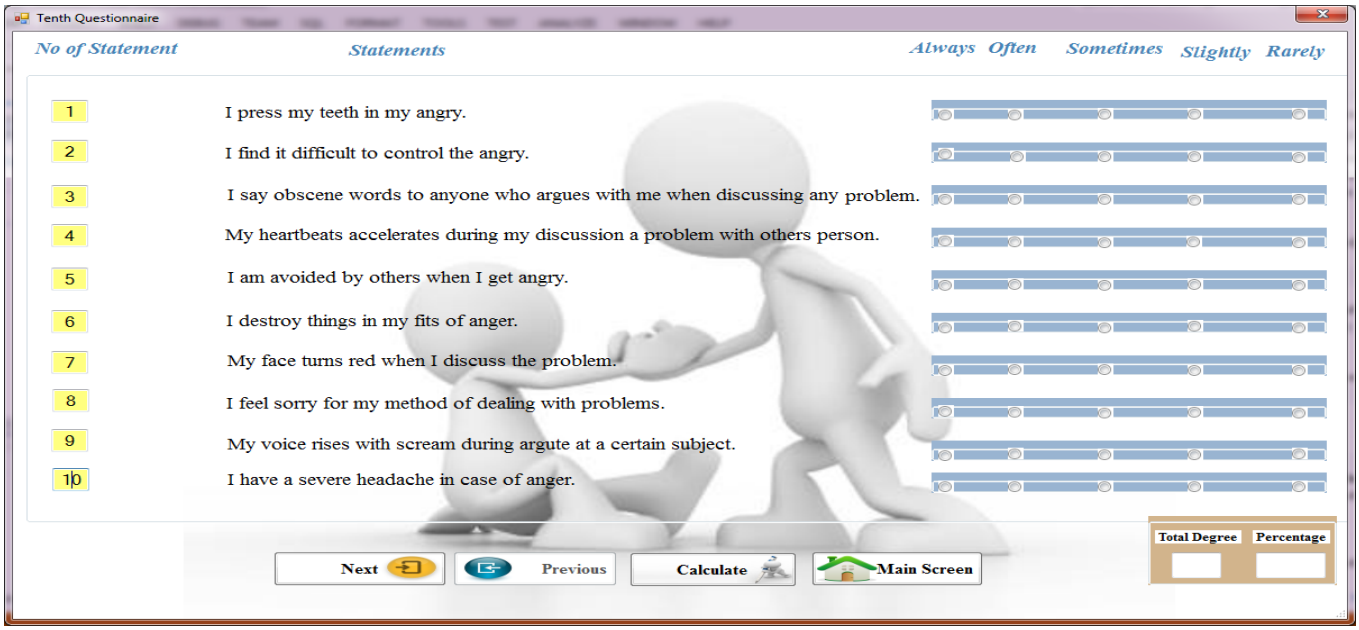


Fig 19: Example of questionnaire content

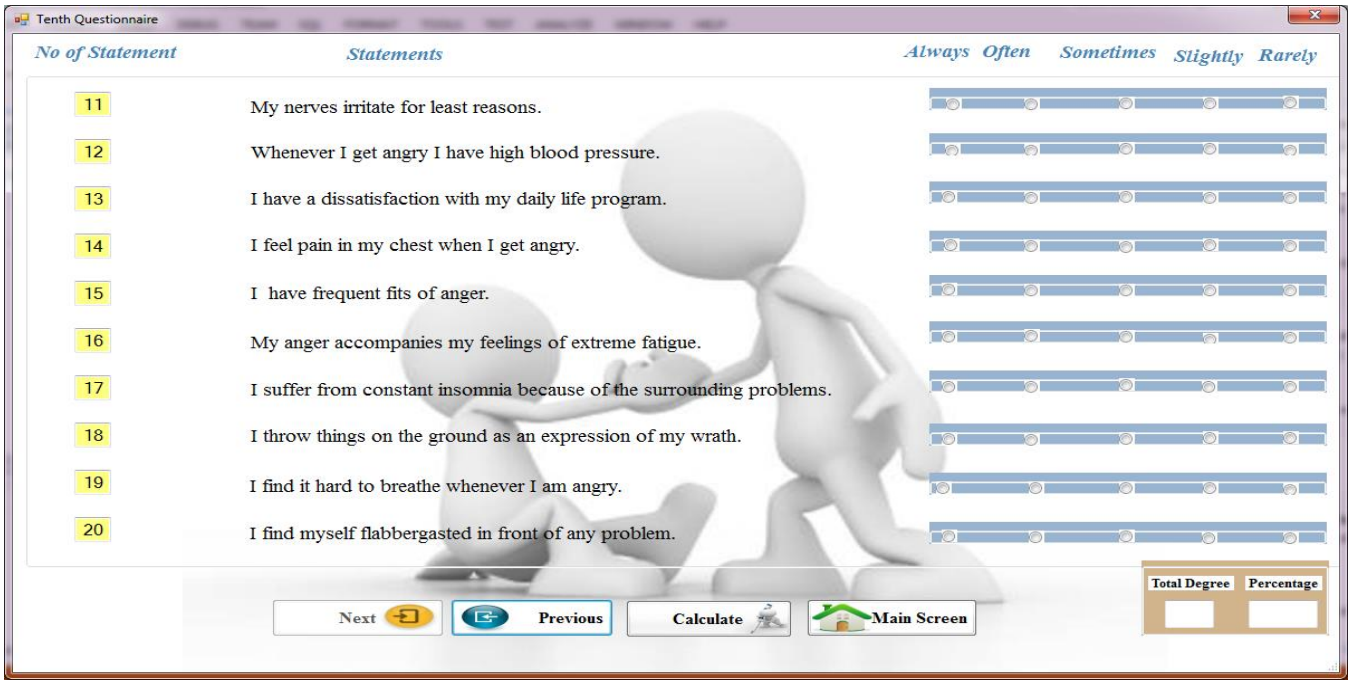


Fig 19: Continue: Example of questionnaire content

❖ **Enter Image Button**

The facial expression system is designed by Matlab language. An image database is used for facial expression recognition. It includes 3750 facial expression images for 150 students. Each student has 25 images for 5 categories. Five images for each category. Random student image is introduced. Final decision is "Anger" with probability "97.75". Figure 20 shows the proposed facial expression graphical user interface.

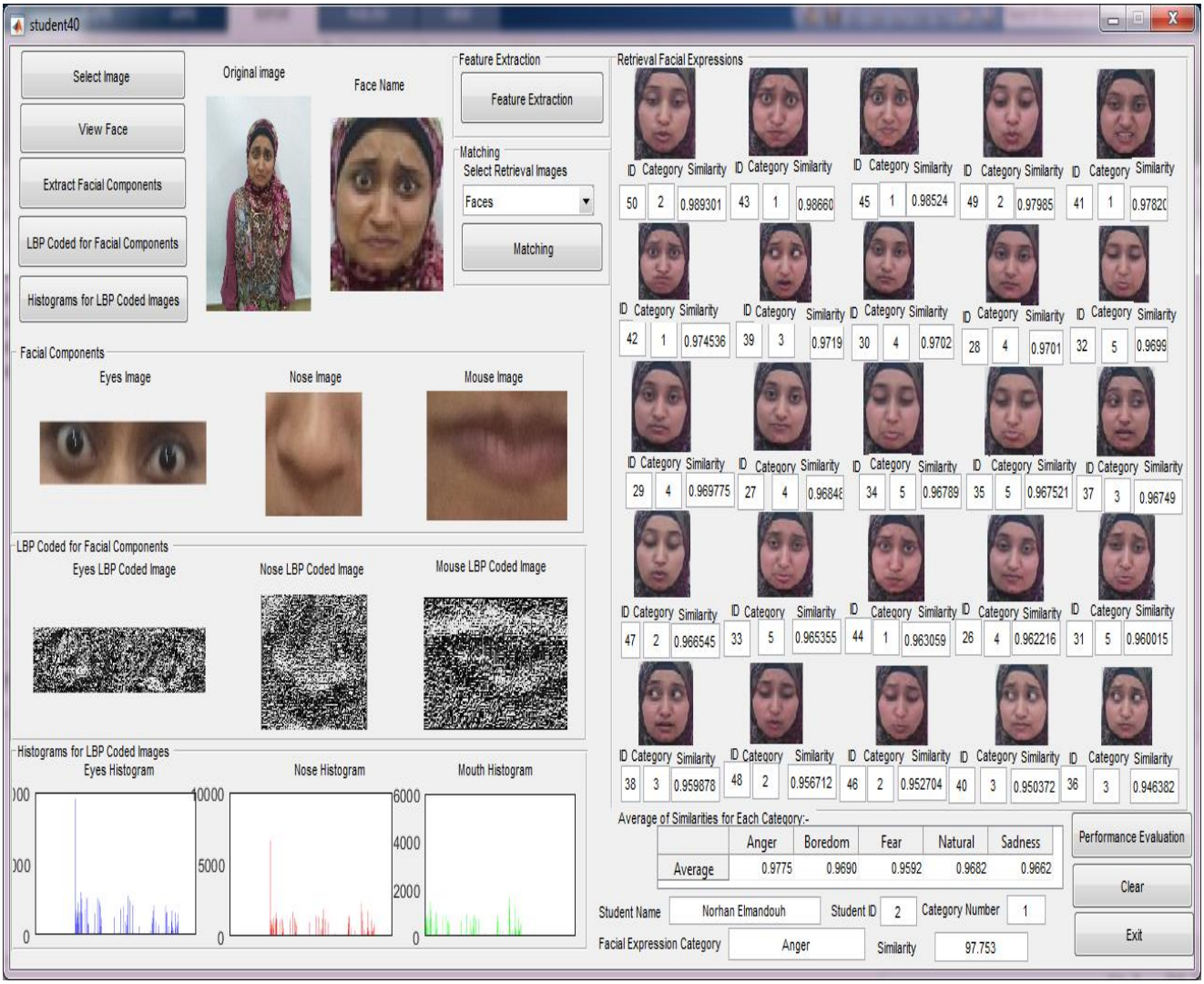


Fig 20: The proposed facial expression graphical user interface

❖ **Enter Sound Button**

The emotional speech recognition system is designed by Matlab language. A sound database is used for emotional speech recognition. It includes 3750 emotional sounds for 150 students. Each student has 25 sounds for 5 categories. Five sounds for each category. Random student sound is introduced. Final decision is "Anger" with probability "99.5". Figure 21 shows the proposed sound graphical user interface.

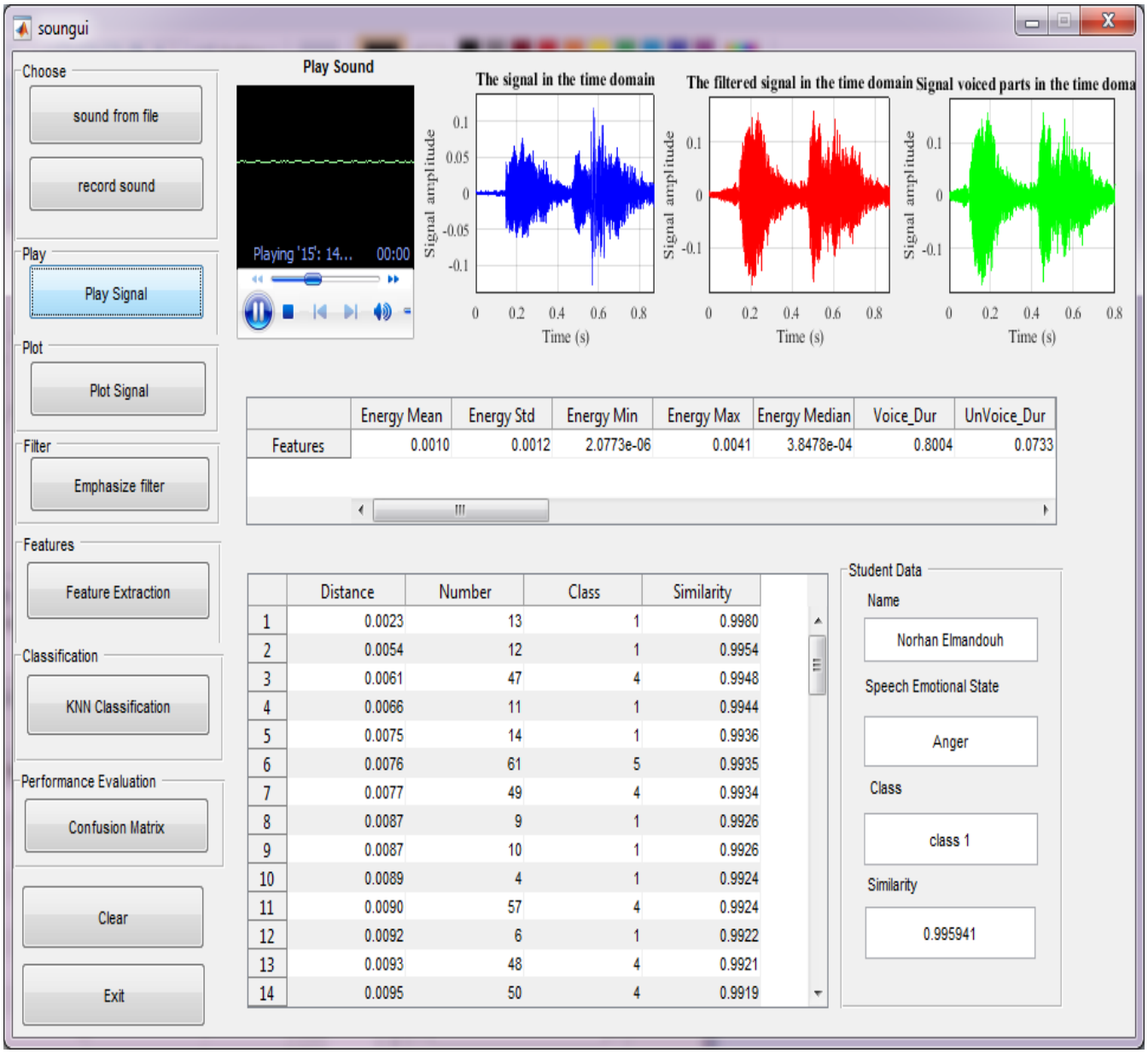


Fig 21: The proposed sound graphical user interface

- **Diagnosis Button**

Figure 22 shows diagnosis process graphical user interface which appears when student press diagnosis in the proposed system main screen. To print report with psychological problems student, suffer from click "Final Report" as shown in figure 23.

Fig 22: Diagnosis process graphical user interface

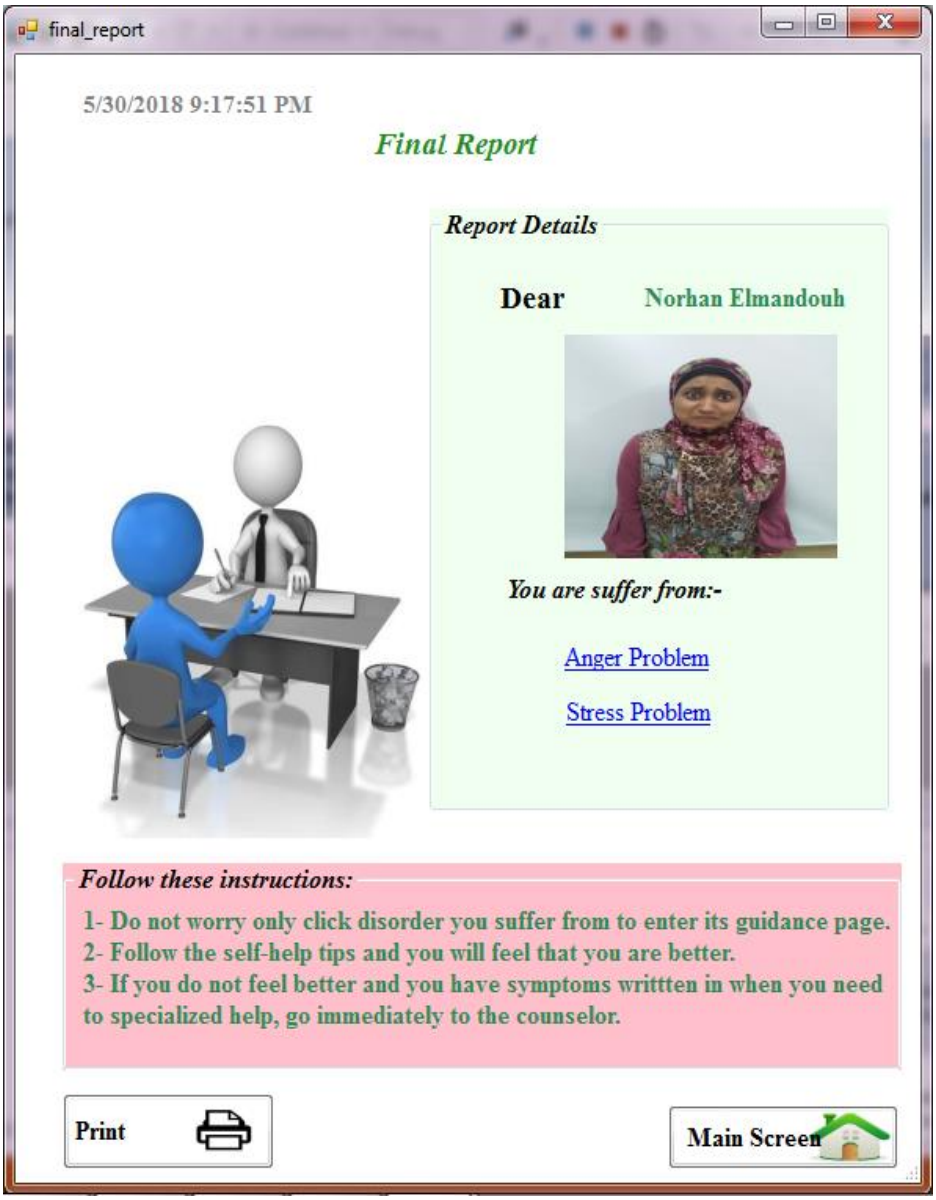


Fig 23: Final report with psychological problems student suffer from

Previous figure showed that student suffers from two psychological problems namely: "Anger" and "Stress". Student clicks on "Anger Problem" link to go to screen contains some ways to overcome this problem and similarly for "Stress Problem". Figure 24 shows example for student guidance to overcome Anger Problem.

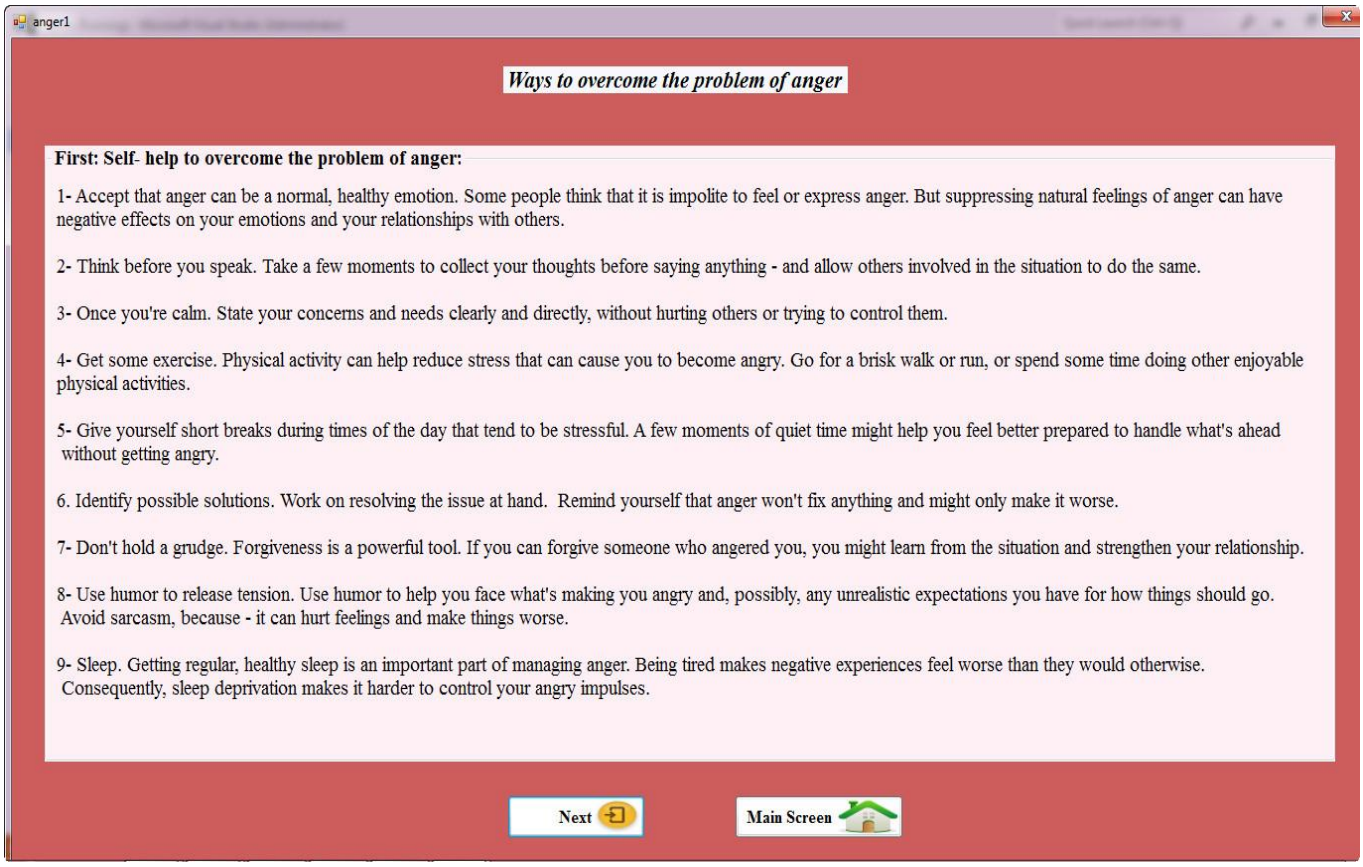


Fig 24: Example for student guidance to overcome Anger Problem

D. Experimental Results

- **Experimental Results for Facial Expressions Part**

A comparison among three human experts was made for performance evaluation of the proposed facial expressions part. This was done using proposed multi confusion matrix as shown in figure 25. The comparison was applied on 50 facial expression images. These images represented the five facial expression categories equally. Figure 26 shows multi confusion matrix graphical user interface for facial expressions part performance evaluation.

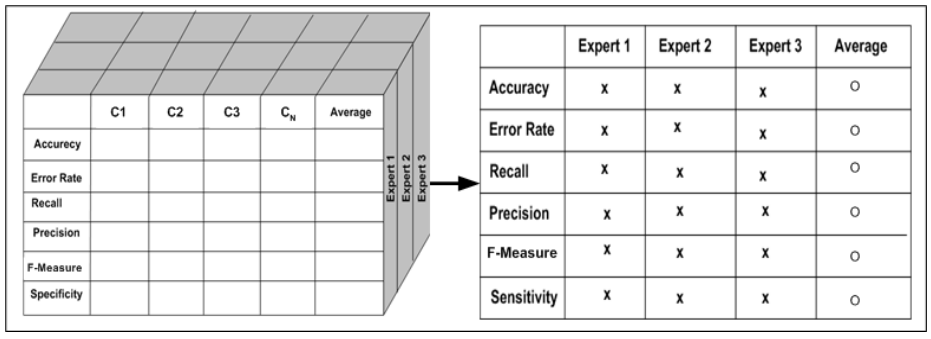


Fig 25: The proposed multi confusion matrix

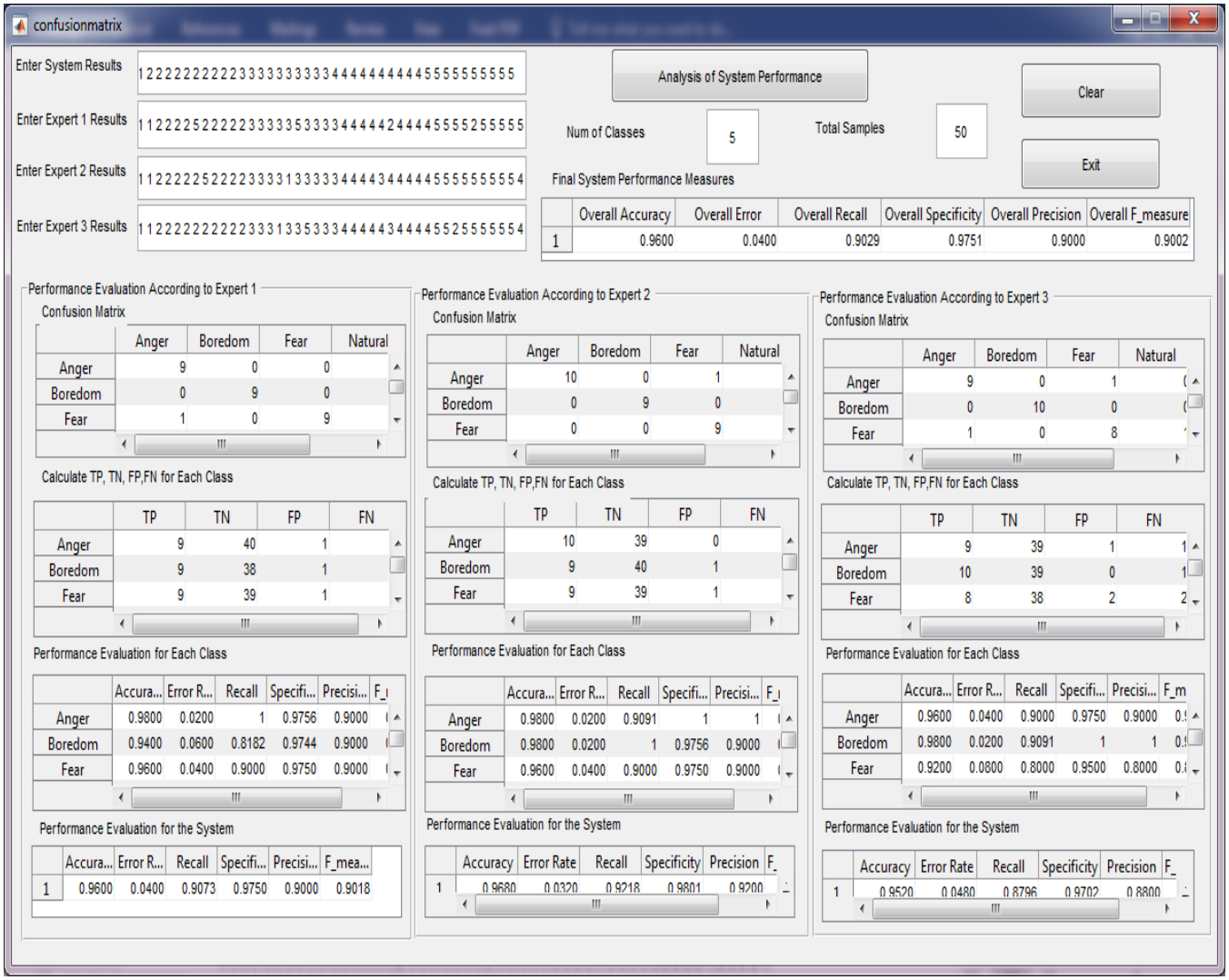


Fig 26: Multi confusion matrix graphical user interface for facial expressions part performance evaluation

From previous figure, the average accuracy for the proposed facial expressions part is 96% according to the three human experts.

- **Experimental Results for Speech Emotions Part**

A comparison among three human experts was made for performance evaluation of the proposed speech emotions part. This was done using the proposed multi confusion matrix. The comparison was applied on 50 sounds. These sounds represented the five speech emotional categories equally. Figure 27 shows multi confusion matrix graphical user interface for speech emotions part performance evaluation.

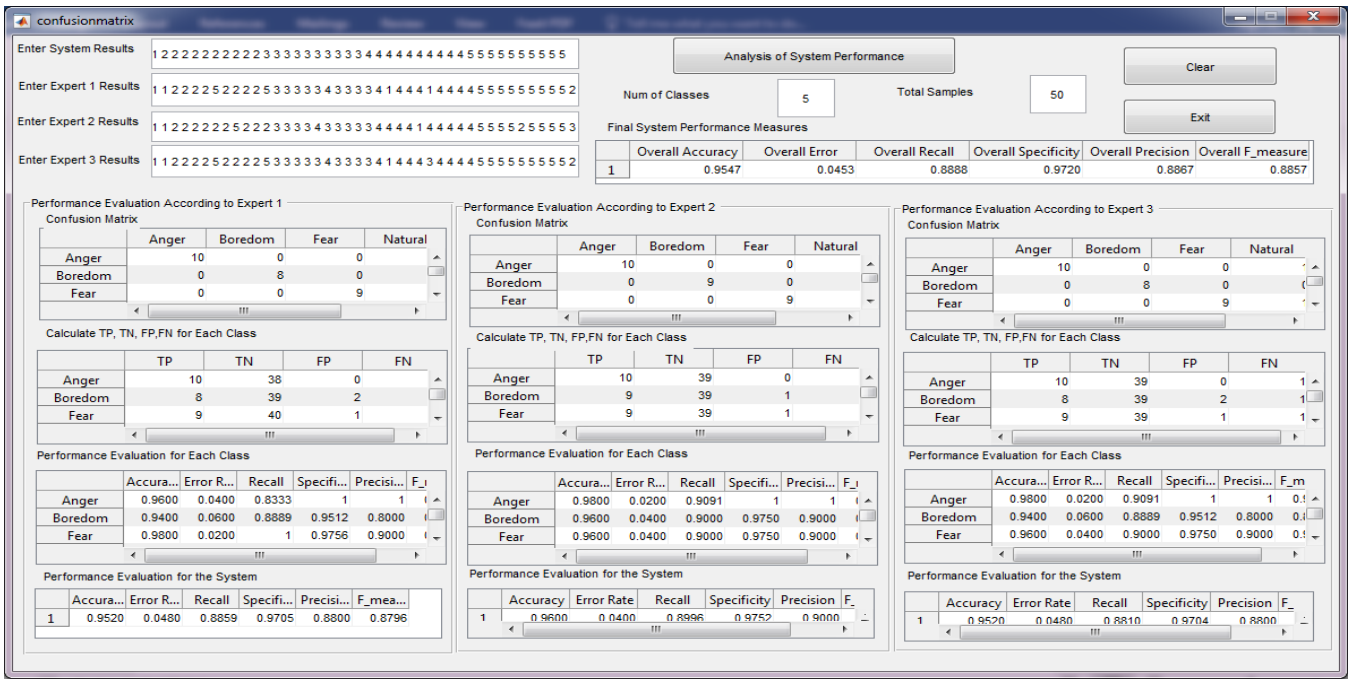


Fig 27: Multi confusion matrix graphical user interface for speech emotions part performance evaluation

From previous figure, the average accuracy for the proposed speech emotions part is 95.4% according to the three human experts.

- **The Final Experimental Results for the Proposed System**

To ascertain the effectiveness of the whole proposed system in reducing the problems for students in the main sample of the study, "T Test" for paired groups was used. The following table shows the value of (T) for paired groups for the mean degrees of the experimental group for the pre and post diagnostic test.

Table 13. The value of (T) for the paired groups for the mean degrees of the experimental group for the pre and post diagnostic test

Problem	Groups	Mean	N	Std. Deviation	T	η 2 %	Sig.
Anger	PreTotal	73.5745	47	6.69765	27.234	94.16%	0.000
	PosTotal	37.1489		8.38731			
Boredom	PreTotal	49.9388	49	4.51114	24.384	92.53%	0.000
	PosTotal	26.2857		6.02771			
Fear	PreTotal	71.3103	29	6.05984	29.060	96.79%	0.000
	PosTotal	33.2759		6.63269			
Sadness	PreTotal	69.1765	17	6.16680	15.485	93.74.%	0.000
	PosTotal	36.2353		6.74101			

Problem	Groups	Mean	N	Std. Deviation	T	η 2 %	Sig.
Generalized anxiety	PreTotal	70.6111	18	5.24840	19.465	95.71.%	0.000
	PosTotal	39.4444		4.91363			
Internet addiction	PreTotal	68.3636	11	5.31550	14.988	95.75.%	0.000
	PosTotal	32.8182		6.27404			
Mood swings	PreTotal	71.6471	17	4.60897	25.535	97.6.%	0.000
	PosTotal	45.6471		5.94707			
Sleep problems	PreTotal	45.8214	28	4.10107	10.966	81.66.%	0.000
	PosTotal	26.2143		8.86674			
Stress	PreTotal	64.0588	17	6.94146	21.705	96.72.%	0.000
	PosTotal	43.1765		5.93965			
Test anxiety	PreTotal	72.6377	69	6.32216	35.510	94.8%	0.000
	PosTotal	37.4348		6.38352			

The results indicate that there are statistical significant differences between mean degrees of the experimental group in both pre and post measurements of the diagnostic test in favor of the post measurement which prove the high accuracy of the proposed system.

VI. CONCLUSIONS AND FUTURE STUDIES

There is an urgent need to treat basic psychological problems that prevail among university students which may lead to complicated problems, if not treated at early stage. This paper proposes an advisory system for diagnosis and treatment of ten common problems which can serve a wide range of university students. Six of these problems depend only on questionnaire result and the other four problems depend on results from facial expressions, speech emotions in addition to questionnaire. Results show that the proposed system is an efficient for diagnosis and guidance of psychological problems. In future work the proposed system will be applied on different platforms such as mobiles and tablets.

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