The International Journal Of Engineering And Science (IJES)
|| Volume || 5 || Issue || 6 || Pages || PP -110-115|| 2016 ||
ISSN (e): 2319 – 1813 ISSN (p): 2319 – 1805

The Analysis of Men's Emotional State from Heart Rate Using Daq & Labview

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----------ABSTRACT----------

The purpose of this project is to develop a system for men to assess the emotional states with the help of pulsometry. The system design comprises the hardware realization of signal detection, data recording and analysis. In this project two signals were selected for the analysis – pulse wave and facial video. In pulse wave, the threshold level is constant in between the range of 70 to 100. With the help of DAQmx library of LabVIEW environment, the data was recorded in LabVIEW NI USB-6008 device, which in turn connected to the pulse wave sensor, has been implemented. Facial video image capture and video analysis can be done in LabVIEW environment. For facial video, vision acquisition and vision assistant libraries are used. The advantages of LabVIEW are well observed in terms of the synchronous recording and analysis of the different types of signals. This project is the concern of the physicians, engineers of medical equipment and professionals occupied in the areas of human activity where the information about the men's emotional state increases the work safety. In future, it can be enhanced with the help of facial expressions.

Keywords: *Heart Rate Variability, DAQ, LabVIEW, Facial Video, Pulse Signal, NI USB 6008.*

Date of Submission: 17 May 2016 Date of Accepted: 01 July 2016

I. INTRODUCTION

Emotions are identical with human actions, they play a key role in influencing the way we think and behave. An emotion is consisting of three essential parts: a subjective constituent that describes how we experience the emotion, a physiological part that match up to how our bodies react to the emotion, and an expressive component that pertains to how we behave in response to the emotion. Every basic function such as decision making, learning, perception etc., is deeply subjective by emotions either directly or indirectly. Human communication would seem rather out of depth without emotional expression. It is this feature of human beings to express, perceive and understand complex emotions that separates us from the rest of the species.

In recent decades, many researchers in the field of normal physiology, safety in transport and industrial facilities have been resolving a number of scientific issues on estimating human emotional responses to a number of environmental exposures and society. These include issues of stress management, evaluation of emotional perception of different kinds of info, the study of psycho-physiological mechanisms underlying the formation of human emotional behavior and a lot of other issues, related to psycho-emotional state of a human.

II. SCOPE OF THE PROJECT

The development of the system consists of pulse signal analysis and facial video, which fundamentally differs in the ways of recording and processing that required the applicable specialist software. In this project, two signals were selected for the analysis- pulse wave and facial video of test person. For the pulse wave recording the pulse wave sensor has been developed. The signal from the sensor is supplied to a data acquisition device NI USB 6008 which was integrated with personal computer. For the facial video the web camera is used.

III. PROPOSED WORK

The whole scientific discipline, associated to the study of emotional perception of the person at exposing to him of different types of stimulus (heart rate, facial video) was developed. The system design comprises the hardware realization of signal detection, data recording and analysis. The advantages of LabVIEW are well observed in terms of the synchronous recording and analysis of the various types of signals, such as pulse and facial video. The Sequence Of Virtual Instrument Structure For Recording The Pulse Wave Using A Daq Device Ni Usb-6008. In This Case, Before, After Or At The Time Of Stimulus Source, The Objective Or Subjective Estimation Of Various Parameters And Reactions Of The Man Is Being Performed

3.1 **General Characteristics Of The Developed System**

The goal of the current work is to develop an automated system that implements synchronous recording of human physiological parameters, together with observing audiovisual stimulus and subsequent assessment of emotional perception of the information provided to human. In such kind of studies, there is a change of affective states (affects) of the human. Affect is a psycho-physiological process of interior activity regulation and reflects the unconscious subjective assessment of the current situation. Its distinctive features are short duration and high intensity, coupled with intense demonstrations in behavior and work of internal organs. (R. Picard, E. Vyzas, and J. Healey).

It is important that affects have a strong influence on physiological parameters, in specific on the heart rate. In response to the emotional, impact there is an abrupt change in heart rate (E. Broek). The development of the system includes pulse signal analysis, which fundamentally varies in the ways of recording and processing that requires the relevant specialized software.

IV. SYSTEM DESIGN

The objective of the present work is to improve an automatic system that implements synchronous recording of human physiological parameters, together with viewing visual scenes of stimulus and subsequent assessment of emotional perception of the information provided to the test persons. The most important in settling the task is to find the characteristic features in pulse signal, its results and facial video, which indicates the change in emotional reactions to the stimulus and their time correlation with graphic scenes of the delivered material. To conduct such an experiment, the research system was fixed, which consist of hardware and software and contain components that implement:

- Record of physiological signal
- Video view;
- Analysis of the recorded signals

4.1 System Configuration

The following is the software and hardware configuration required for this project.

4.1.1 Software Requirements

OS : Windows, OS X, Linux
Simulator : LabVIEW Version 12.0

4.1.2 Hardware Requirements

- USB 6008 DAQ
- Pulse wave sensor
- USB
- Personal computer
- Web camera

4.2 System Architecture Design

The improvement of the system contains pulse signal analysis and facial video, which fundamentally differs in the ways of recording and processing that required the significant specialized software. The structure of the proposed system is shown in Fig. 4.1.

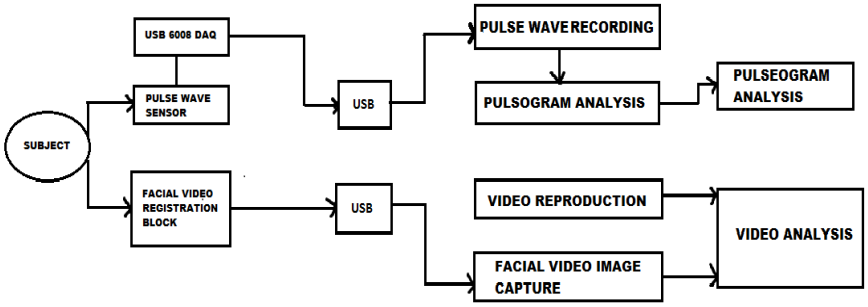

Figure 4.1 Architecture Of The Proposed System

Test person is considering as a subject. The facial video recording block is the web camera fixed on top of the monitor, which reproduced the proposed video segment. To enable the video capture from web camera synchronized with DAQ and it is able to capture real time image of the face of the test person. The facial image of the test person indicates the modification in the emotional perception of the video, the important feature in realization of this task is the synchronous playback and data recording. It permitted to carry out in future single frame analysis of the recorded data and provided stimulus. Facial video image capture and video analysis can be done in LabVIEW environment. The hardware set up of proposed system as shown in Fig 4.2

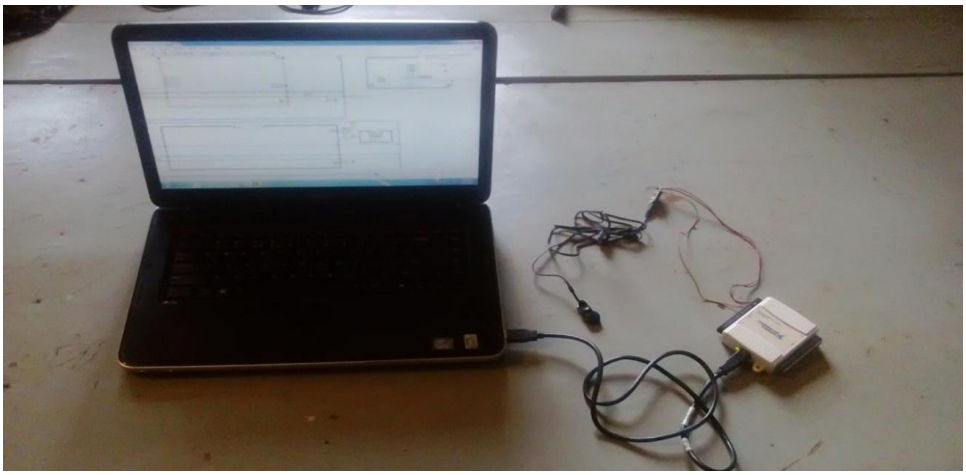

Figure 4.2 Hardware Set Up

4.2.1 Pulse Rate Recording

The automated system is used to record the physiological parameters of the test person during the study such as heart rate. To determine the pulse rate and their accumulation in pulsogram, the pulse rate record of test person is required. For this purpose, besides the development hardware, it is required to create the program code in LabVIEW, implementing the record and display the pulse rate in front panel. The structure of the architecture design is shown in Fig 4.3.

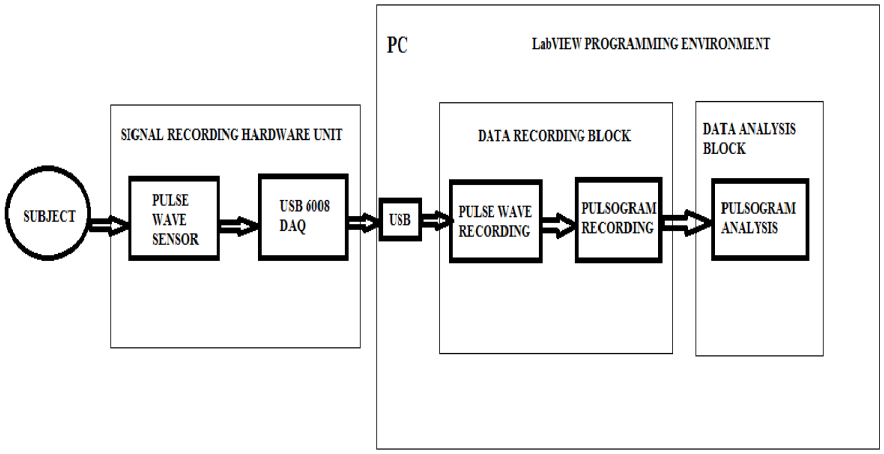

Figure 4.3 Block Diagram of Pulse Rate Recording

Further the test person, the system consists of three main parts: the hardware block of signals recording, data record and data analysis blocks. Signal recording hardware covers devices to take off all the required human physiological parameters.

Data record block is carrying out on the basis of software development by collecting and saving in memory of Personal Computer (PC) information, recorded from the test person. The data analysis block is processing data and graphical representation of the information, formerly recorded in data record block. The design of pulse rate record in LabVIEW is as shown in Fig 4.4.

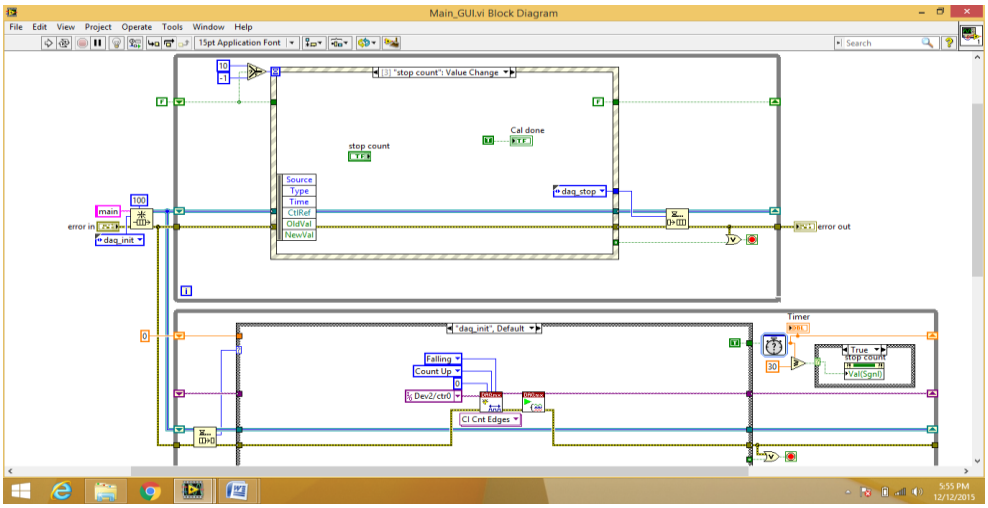

Figure 4.4 Design Of Pulse Rate Record in LabVIEW

With the support of DAQmx library of LabVIEW environment, data record in LabVIEW from NI USB-6008 device, which was in turn connected to the pulse wave sensor, has been implemented. The automated system development for the assessment of emotional states of men on the basis of pulse measuring and analyzed the characteristics of the recorded signals. The output of pulse rate record as shown in Fig 4.5.

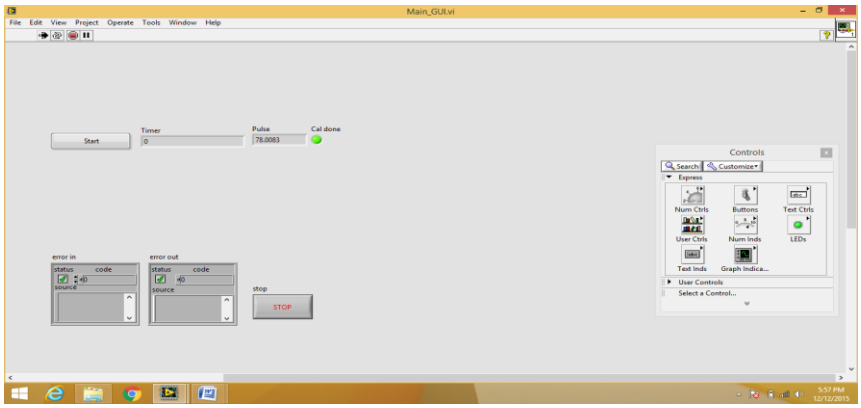

Figure 4.5 Front Panel Output of Pulse Rate Record

4.3.2 Capture Of Facial Video

To enable the video capture from web camera synchronized with pulse wave record, several types of drivers included into LabVIEW were considered. This web camera is a small sized digital video camera fixed top of the monitor and able to capture real image of the face of the test person. The block diagram of proposed system is as shown in Fig 4.6.

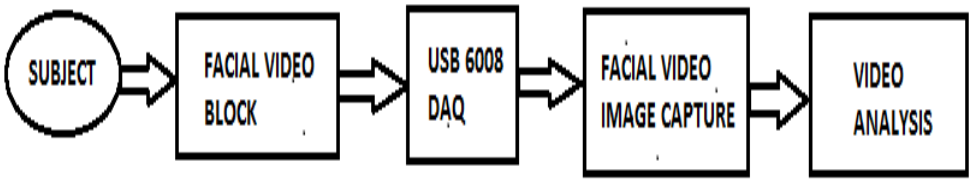

Figure 4.6 Block Diagram of Facial Video

To conduct the experiment, expect pulse wave recording and face image viewing, review of specific video, which will be started and after setting by him all the required signal parameters, was required. Since the facial expressions of the test human point out the change in the emotional perception of the video, the important feature in realization of this assignment was the synchronous playback and data recording. It allowed to carry-out in future single-frame analysis of the recorded data and provided stimulus. Frame-by-frame video analysis

combined the synchronous viewing of video and video image of facial expression. In settling this issue, several possible options for its implementation in LabVIEW environment.

Driver vision assistant allows to connecting the video capture devices to data acquisition board. To connect the web-camera only vision assistant driver is suitable, which is used to solve the set task. Function IMAQdx Open Camera.vi is considered to start the video recording session. If the system had several video cameras, IMAQdx Open Camera.vi function permitted to select the preferred to user camera from the list. Property Node specifies the resolution of the recorded image. Property Nodes in LabVIEW are the features of the block-diagram, which agree to control programmatically the properties of front panel entities, such as color, visibility, and location and numbers format. Function IMAQ AVI Create allowed to setting the video frame rate and specifying the path to the file. After capturing the image from USB-camera, using the function IMAQdx Grab, it is reassigned to the recording function avi-file IMAQ AVI Write Frame. The design of facial video capture in LabVIEW as shown in Fig 4.7.

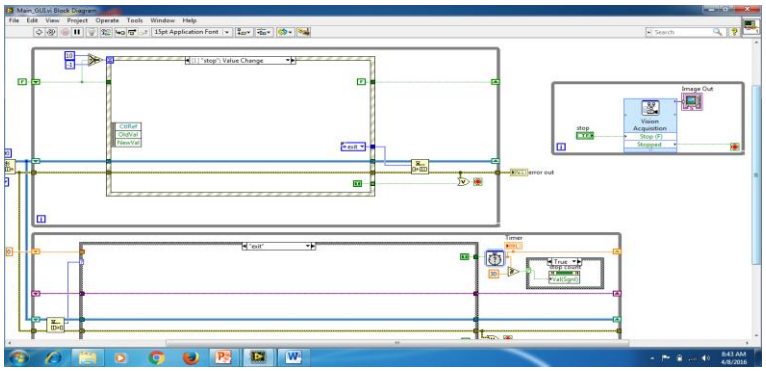

Figure 4.7 Design of Facial Video Capture in LabVIEW

Technical feature of resolving the frame-by frame analysis, allow to minimizing the program code and synchronizing the analyzed data. The advantage of this framework, together with a continuous cycle by the condition of While Loop, it can be implemented by the developer code, in response to a variety of events. Code is executed only when the event happened, as opposed to cycle on a condition that runs throughout the entire program. The implementation of data analysis block includes simultaneous analysis of pulsometry and video material. The IMAQ AVI palette of function was chosen as basic. As it was noted, the application of IMAQ AVI functions does not have quick response time. Front panel output of heart rate and facial video is shown in Fig. 4.8.

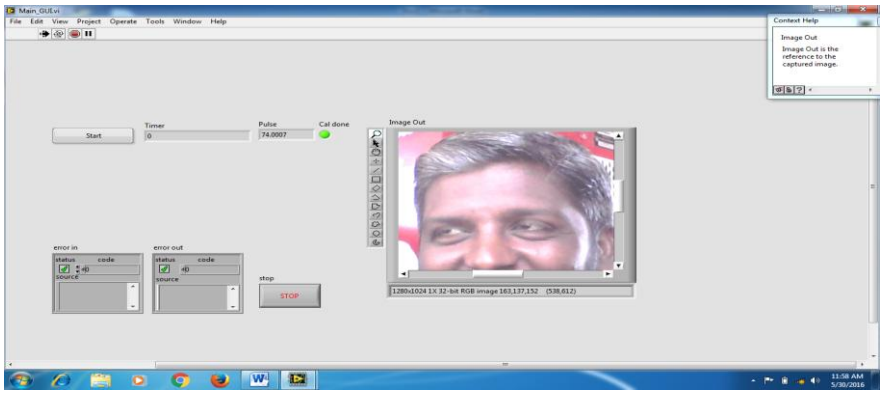

Figure 4.8 Front Panel Outputs of Heart Rate and Facial Video

The pulse rate threshold value is as shown in table 4.1.

Table 4.1 Pulse Rate Threshold Value

Heart Rate Value	Descriptions
Timer = 60s	
<70	Low stress level
70<80	Normal stress level
80<100	Medium stress level
100<	High stress level

Technical parameters of recorded signal as shown in table 4.2.

Table 4.2 Parameters of the Recorded Signal

Type of signal	**Technical parameters of signals**			
Pulse wave	Sample frequency-60Hz	ADC resolution – 10 bit	Full scale measurement	Type of signal record file- txt
Video facial	Frame frequency-30 fps	Max resolution – 1280*720	Focus mode-manual	Type of video record file- avi

V. Conclusion And Future Work

The conclusion of the proposed work is the automated system development for the assessment of emotional states of men on the basis of pulse measuring and analyzed the characteristics of the recorded signals. Here the parameters are analyzed for various stress level for particular threshold range and also the facial video can be observed with the help of front panel display. However, the use of LabVIEW program development environment, owing to a wide range of drivers, libraries, templates, programming, and support tools permitted to minimize the number of participants engaged in the creation of the target system. In future work there is a possibility of facial expression by using video with sound. The most significant in settling the assignment is to find the characteristic features in facial expression.

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