Stress and Anxiety Measuring Device

Summary report for the project in the Computerized Equipment Design course -LabVIEW

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Theoretical background:

In this experiment we used a skin conductivity sensor and a blood pressure sensor. The skin conductivity sensor is particularly useful because it reflects the activity of the sympathetic system. When the sympathetic system is activated, the sweat glands begin to produce sweat which increases the conductivity of the skin. These changes can be measured before the appearance of sweat outside the skin. The sensor we used emits a constant current and measures the voltage that develops between the two electrodes. The electrodes are placed on two fingers in the middle sectionbecause there the density of the sweat glands is .particularly high.

The second sensor emits a green light and picks up its return which changes as a result of swallowing in the red range of the blood. Swallowing will be maximal at the peak of the systole when the blood vessels are wide and filled with red blood. In this way the measured return depends directly on the blood pressure. From this measure over time it is possible to deduce the difference between points of maximum pressure and calculate the heart rate as a function of time. The heart rate is also linked to the activity of the sympathetic system activation of this system causes the release of epinephrine which increases the heart rate. So .basically both sensors report the activity of the sympathetic system

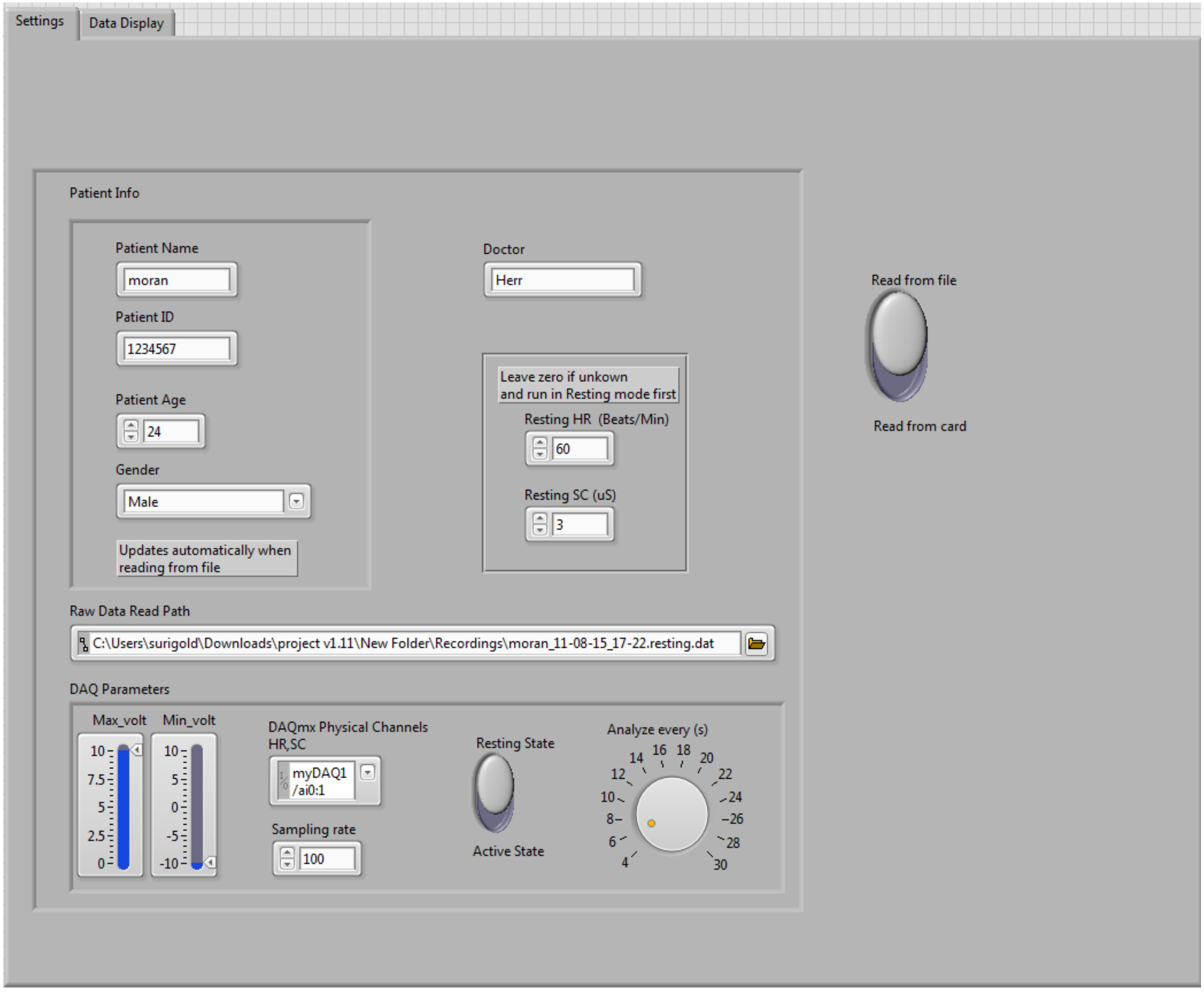
The purpose of the system

Sometimes children are in various distress and anxiety situations throughout their lives, and their parents are not even aware of it. Our proposal is to provide children with a bracelet or ring that will carry a simple number of sensors, and monitor biological signals that are affected by the sympathetic system.

In situations of distress and anxiety, the system will detect an abnormality in the child's resting state (hereinafter: the subject), and report this to his parents or a psychologist who monitors him.

System description:

Settings screen:



The user interface is divided into two tabs. In the tabsettings The patient data as well as the purchase data (DAQ) can be recorded. Beyond that there is the option to read from a card or a cache. In case you are reading from a file the software updates all the data according to what is stored in the file.

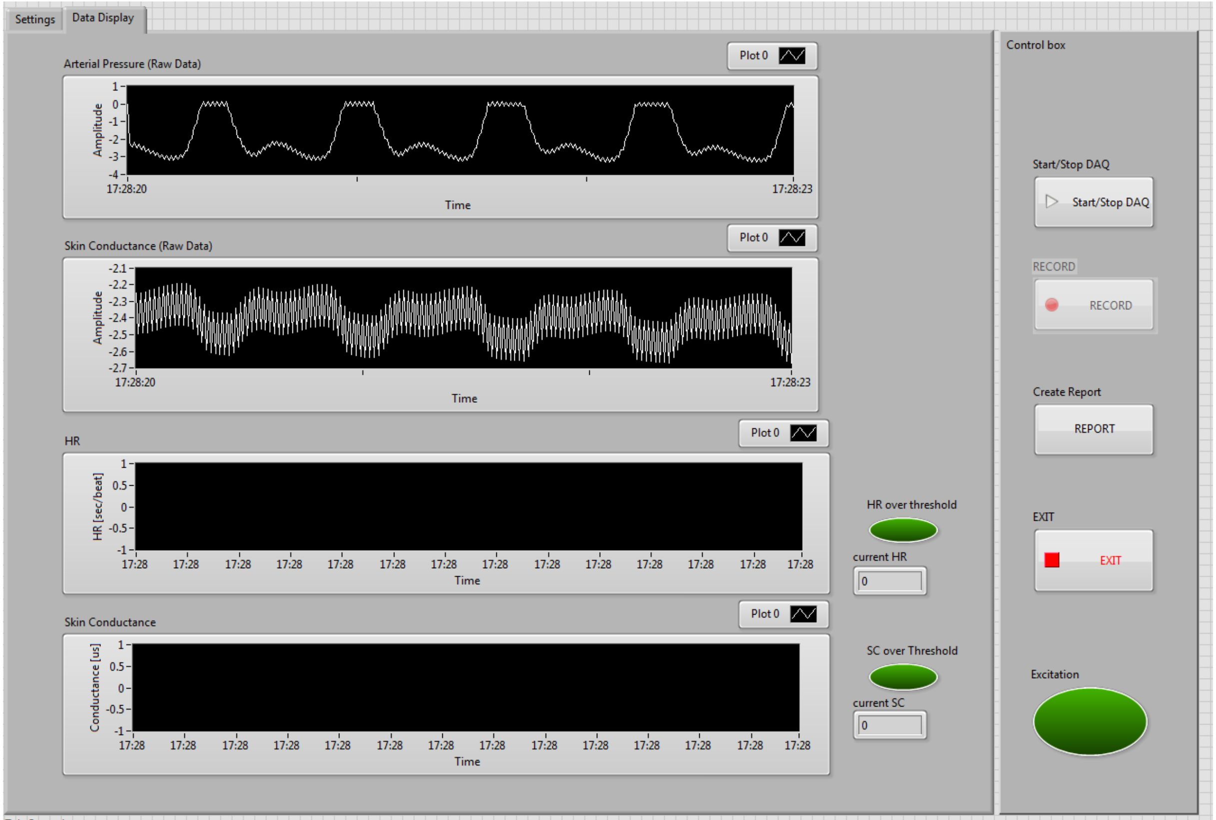
The software runs in two modes, Resting and Active.

At rest, the patient's heart rate and skin conductivity are measured at rest, and the software .updates this data in the tab setting.

In the Active mode, measure the same data as the patient goes on with his life and compare the data live to what we measured at rest. The software reports by lighting a light bulb when the heart rate increases by 20% at rest and when the conductivity of the skin increases by 10% relative to the resting state. When both parameters show excitation the software turns on another light bulb and keeps track of the date and time of the excitation and the length of time the excitation lasted.

If the resting values of the pulse and the skin conductivity of the patient are known, they can be entered manually in the appropriate box, and switched directly to the position active.

Operating screen:



In the controls box (control box) You can start and stop purchasing data, save data in a binary file together with the data of the Settings tab in the binary file, create a report in Word and stop the software.

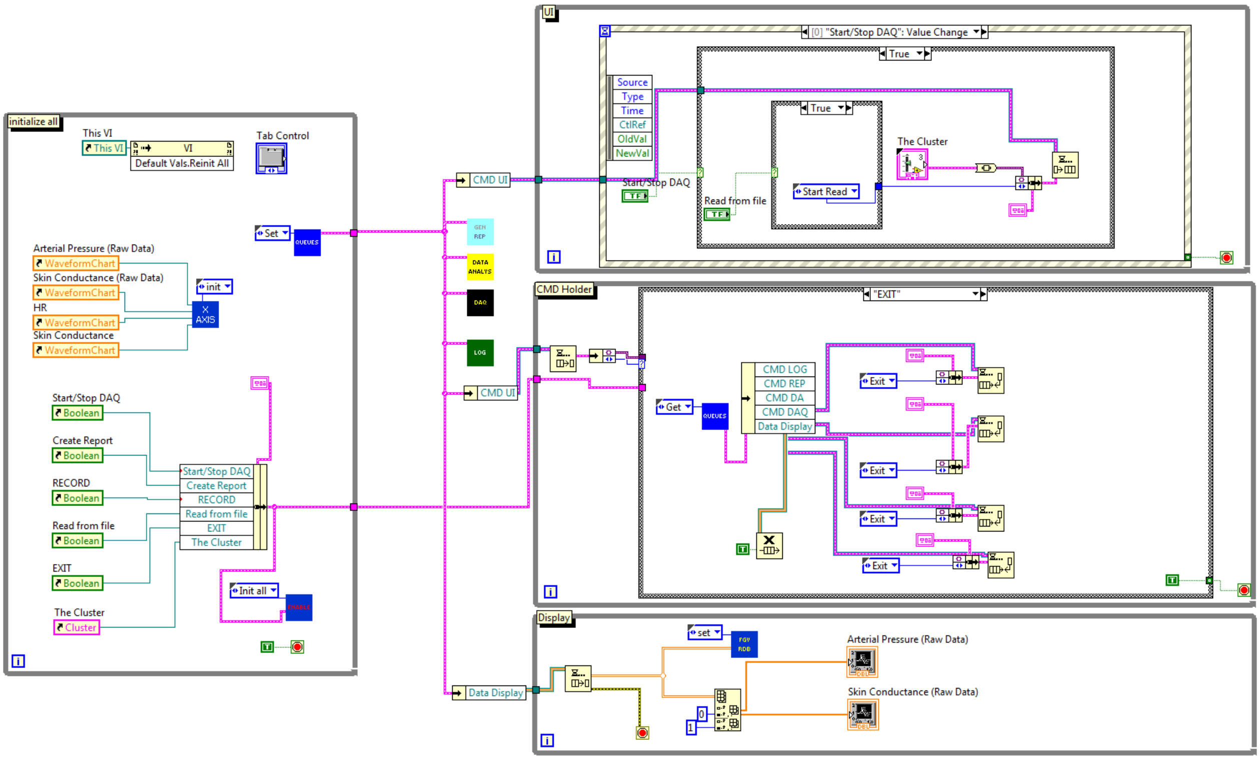
In the tab "data display", the data that comes in real time from the sample card or file, as well as the analyzed information is displayed. In the upper two graphs, the data is displayed as it comes from the card, and in the lower two graphs, the data appears after an analysis that includes a filter for lowering noise and calculating the heart rate from blood pressure. Also shows the current heart rate and the current conductivity value.

It is important to note that on this screen the function is the same both in the sample mode from the card and in the mode of reading from a file. At the end of the use of the software it can be stopped from here with the help of the button Exit.

Also on this screen are three control lights that light up when the subject is in excitation, as described above.

Code description

MAIN



This model has several components:

Initialize all - a loop that ran once before running the software and initializes various things such as default values on the user screen, and creating the queues for use in the program.

Loop UI waits to receive events from the user in the UI window and passes them command holder. The loop contains a mode suitable for each of the buttons on the operating screen.

Loopcommand holder reads commands from the command queue and passes them to the relevant modules. Also with the help of the Enable function we determine which buttons will be active and which will be off in the user interface, depending on the current running mode.

Conditions:

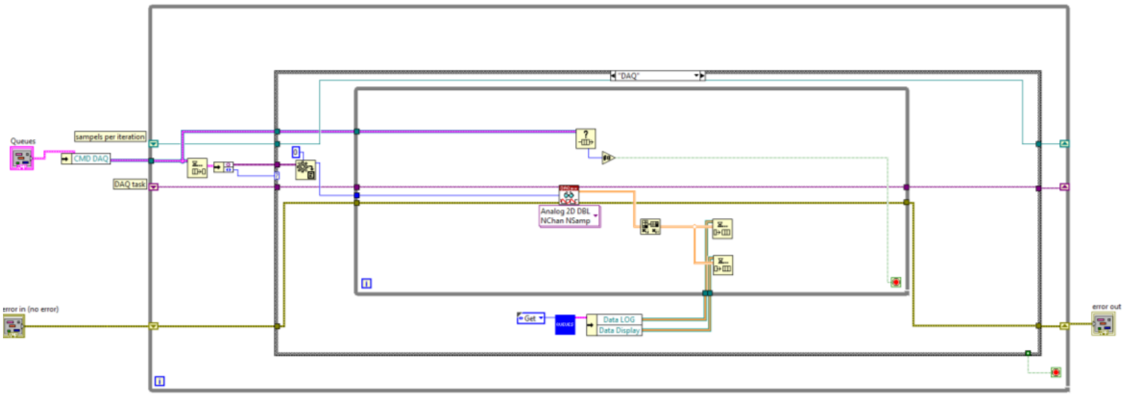
- Start DAQ- Start sampling from a card. A corresponding command is sent to the DAQ model and analysis module. The graphs are also calibrated to display the timeline correctly.
- Start Read- Start reading from a file. A corresponding command is sent to the DAQ model and analysis module. The graphs are also calibrated to display the timeline correctly.
- LOG- The beginning of saving data is sampled to a file. A corresponding command is sent to the LOG model.
- Stop LOG. A corresponding command is sent to the LOG model.
- Stop DAQ- Stop sampling from a card. A corresponding command is sent to the DAQ model and analysis module.

- Stop Read - Stop reading from a file. A corresponding command is sent to the DAQ model and analysis module.
- Create report- A command is sent to the report module to create a report.
- EXIT- Sent appropriate command to all modules. We will also delete the display queue to exit the display loop.
- Init all -This situation was never sent incommand UI queue so nothing needs to be done.
- Update patient info- When we read data from a file, we will update the settings screen according to the data in the file.
- Update analyzed- This command is sent after the analysis is completed. In this mode we will update the operating screen to display the data obtained in the analysis.

Loopdisplay is responsible for reading and displaying the unprocessed data on a regular basis. In addition the data is transferred to FGV DAB for further processing.

Also in the modelMAIN All sub-modules of the program (DAQ, Analysis, Log, Report) are activated.

DAQ

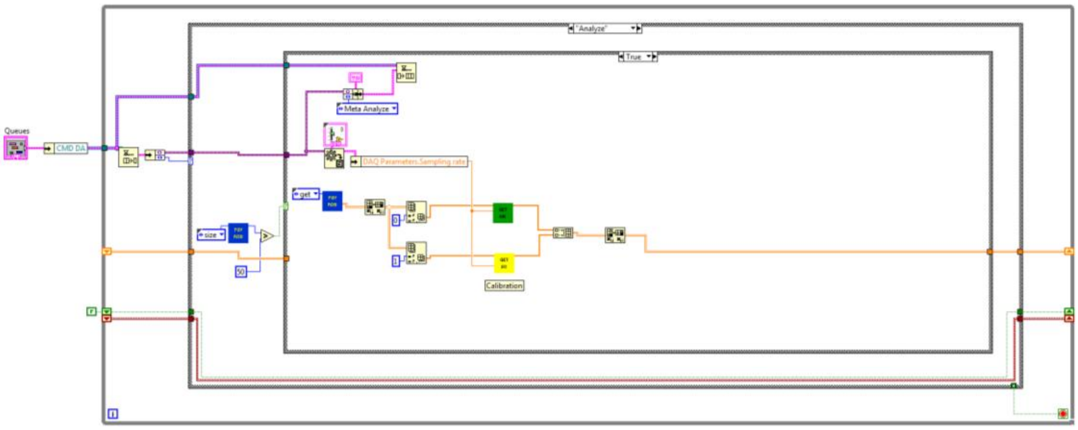


In this model we sample the data from the card or file, and transfer it toqueues of display and save.

The module has several modes:

- Start reading + reading + pause from card
- Start reading + reading + pause from file
- Output

Data Analysis



In this model, an analysis is performed on the unprocessed data obtained from the card (or from the file).

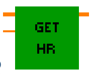
Conditions:

- waiting
- analysis
- Meta-analysis
- stop
- Output

The model is instructed to perform an analysis as soon as sampling begins. Analysis will be performed only accumulated inFGV RDB enough data to analyze it. If there is not enough data we will return to standby mode.

In standby mode we wait a few seconds for a number of pulse peaks to accumulate, from " which we can analyze the pulse. Waiting time taken from switchanalyze every (s) "in the continuation of the user's settings.

If there is enough data we will perform an analysis. The analysis is performed on each channel :individually

- GET HR 

Uses an LPF to reduce noise, then finds peaks coming and calculates the time that passes between peaks and peaks and translates it to the pulse rate.

- GET SC 

Uses an LPF for noise reduction in the resulting signal. (In this model we need to add a calibration that performs a translation from the voltage provided by the sensor to true conductivity values, but the calibration information is not available to us). The values are also averaged.

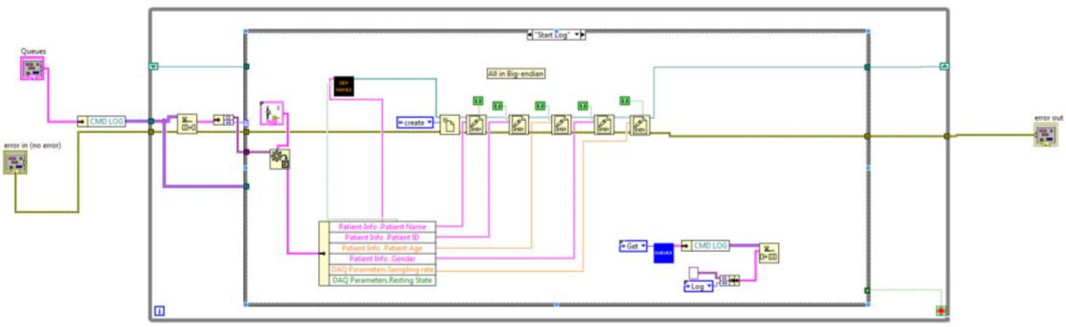
A meta-analysis mode is performed after the analysis. In this situation we will decide whether the subject is in excitation, according to the average of the e valuesThe last HR and SC measured, relative to baseline. An event where both the HR and the SC are above the set threshold will be defined as an excitation event. A clock is stored that measures the duration of the excitation, and is transmitted to the report model using the FGV report. (In resting mode there is no meaning to excitation and therefore the value will not be reported).

In the current implementation a meta-analysis is performed each time an analysis is performed, however in the final implementation this setting can be changed and averaged over a longer time, such as a few minutes to an hour.

After meta-analysis return to standby mode.

Stop mode occurs when eDAQ is discontinued. In this mode clear the memory and wait for a new command.

LOG

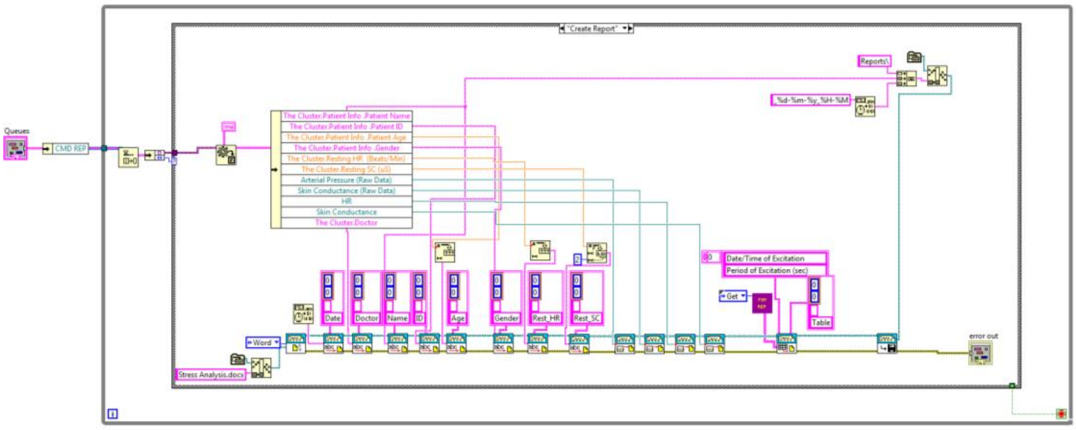


.In this module, the file of the details of the subject and the sampled data is saved

:Conditions

- Start - creating a file and saving the subject's information
- LOG- Saving the sampled data continuously.
- Stop - Closes the file
- Output

Report



:In this module a report is created on the test results so far. The report will include

- date and time
- Details of the patient and the doctor
- A table with information about excitation events (start time + duration of excitation) that are takenFGV Report
- Samples of the graphs currently infront panel.

The file name is automatically determined by the test parameters and saved to the folder reports.

The module has two modes:

- Create a report
- Output

The experiment

the purpose of the expirement:

Examine the program we created with real sensors

We will compare the values measured to the values from the digits

Course of the experiment:

First of all we checked the activity of the software itself. We connected the sensors to a volunteer subject and turned on the system. To test the system in active mode, we set fairly low manual thresholds (HR 60, and SC 2.4) and we ran the software.

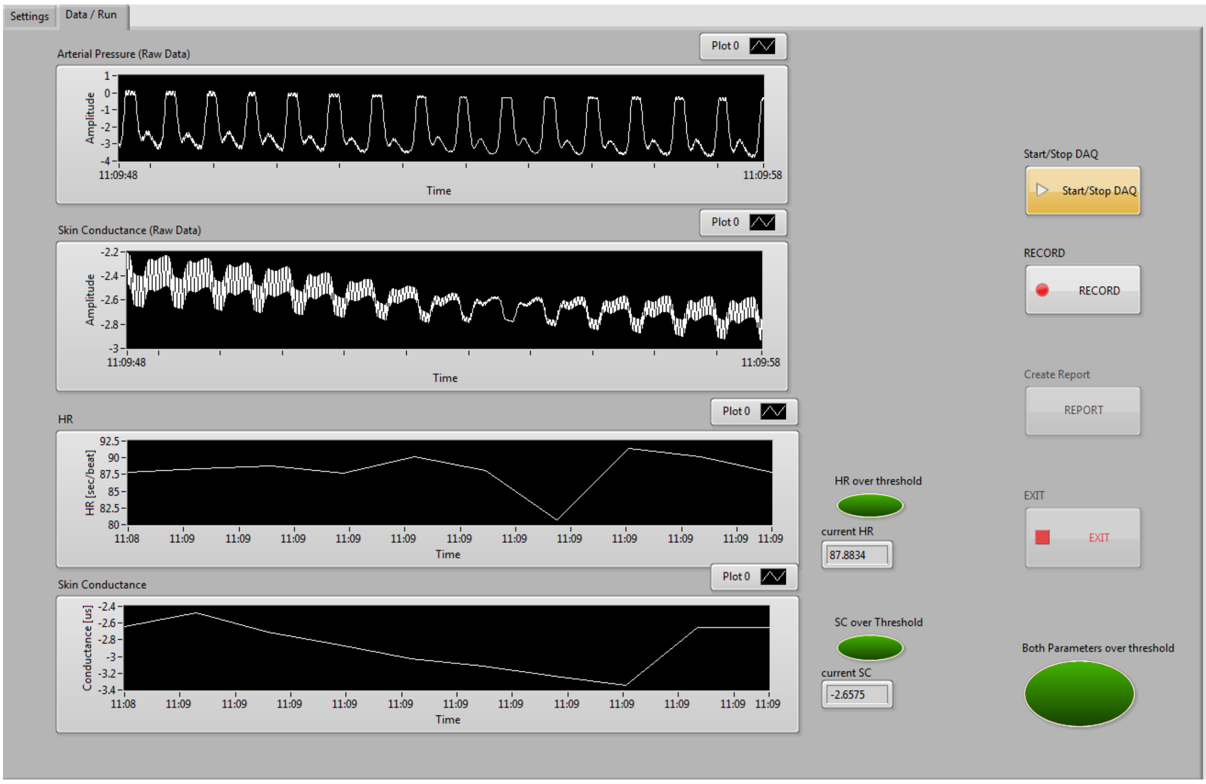
After checking that the lights are on and the data is being saved as desired, we ran the software in idle mode to get the values in idle mode appropriate for the subject.

After that we ran the software in modeActive. And we showed the subject videos that include parts with loud music and violent scenes.

Results:

-Rest mode

We measured the values of heart rate in skin conductivity when the subject was sitting in front of the computer.



Raw data

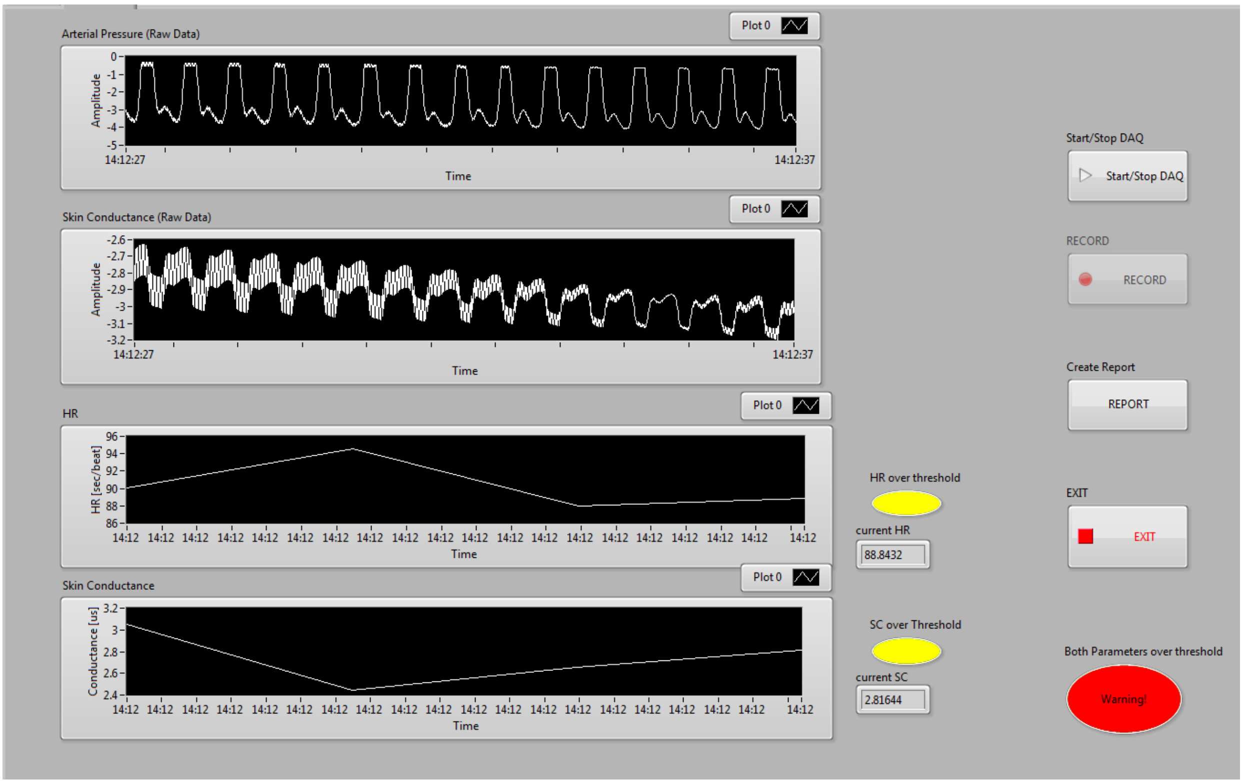
We received clear peaks showing the subject's pulse. In the unprocessed data, small fluctuations of the skin conductivity values are also seen, which correspond to what is described in the literature.

Analyzed data

At rest we were able to measure a pulse of about 90 beats per minute, which is a reasonable resting pulse. Considering that the subject was not at complete rest for a time but only sat temporarily at the computer.

We have not been able to calibrate the conductivity values, so color cannot be compared to literature.

-Active mode



In active mode we saw that if the pulse and conductivity exceed the set threshold then the bulbs are turned on, and a score of the times in the report is obtained.

A typical sample file and a report generated by the system are in foldersrecordings and reports respectively.

Conclusions

The system is able to perform what is required of it within the research conditions.

We have shown that heart rate and skin conductivity change rapidly depending on the excitation of the subject.

We found a flaw in our system related to adaptation to external stimuli. When we started to illuminate a video as described above we saw a sharp increase in both parameters and a gradual decrease after this, even while the stimulation continued. This is in line with the adaptation phenomena we know from studying biophysics

improvement suggestions

Additional metrics such as room temperature and skin temperature measurement should be .added to rule out excitation resulting from exercise or changes in weather

In addition it is advisable to calibrate the skin conductivity sensor so that we can use the software with different sensors and we can determine the value at rest independently of the .sensor

.In addition, higher-quality sensors can be used to reduce noise

Additional elements that need to be added to the system involve the transition from a stationary computer software to a wearable accessory. For example, it seems that the software will be able to identify itself what a rest state is and what an active state is (for .(example, you can set the first week as a base state and then an active state

Sources

- http://www.seeedstudio.com/depot/Grove-GSR-p-1614.html
- http://pulsesensor.com
- A Stress Sensor Based on Galvanic Skin Response (GSR Controlled by ZigBee, María Viqueira Villarejo, Begoña García Zapirain and Amaia Méndez Zorrilla
- Skin conductance responses as predictor of emotional responses to stressful life events, Mats Najstrom, Billy Jansson