POLYGRAPH

THE LIE DETECTOR MACHINE

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PROJECT: ZIEG

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INTRODUCTION

Polygraph, popularly known as **lie detector machine,** is a device that senses physiological changes that happen in human body when examinee tells a lie. The changes include:

1. Change in blood pressure
2. Change in pulse rate
3. Change in respiration pattern
4. Change in skin conductivity

All the above parameters generally increase above the initially measured readings (base level) when an examinee tells a lie.
Aim of the project is to make a portable and affordable Polygraph machine using the knowledge of electronics and programming.

SOME MORE THOUGHTS

- With minor modifications, the device can also be used to alert doctors/nurses about changes in above parameters of an immobile patient which can be life saving in certain cases.

- Also, people who have dream anxiety disorder can be clinically observed with ease at their home and alerts can be used to wake them up if critical changes are observed.

- We also stress on the point that the actual value of the above parameters are not of much importance. What is important is the relative change in the value of these parameters.

- It is also to be noted that the sampling rate is not going to be limitation since the changes are not very rapid and, therefore, Arduino should be sufficient for our purposes.

- What is going to be most important in determining the success of the project is the accuracy of the measurements of changes we will be able to make.

DETAILS

❖ Electronics

- Skin Conductivity Measurement:

Two clips on each hand will be used to measure the skin conductivity. Each clip will have one electrode, hence two finger per hand to make the circuit complete. The change in skin conductivity will be measured with respect to initial base measurements taken before questioning. These changes would be sampled by ADC.

- Pulse Measurement:

This will be done by averaging the values obtained by TCRT1000 sensors installed on clips of both hands. These reading will be sampled with the help of ADC.

- Blood Pressure Measurement:

This will be achieved by the readings obtained from blood pressure measuring device. This will me made using pressure cuffs attached to valves which are further attached on sensors (ASDX). The pressure in these will be maintained with the help of a DC motor pump (3-5V), a dump valve will also be included for air pressure management. Readings from ASDX will be sampled by ADC.

- Respiration Measurement:

Two elastic straps will be used, one around the chest and other around the stomach of the examinee. These will have strain gauge, installed on them. Changes in frequency of breathing (which are marked by extreme stretch points) will be measured with respect to the initial base readings. These will sampled using ADC.

❖ Programming

- Data Sampling:

External ADCs as well as Analog-Read function of Arduino will be used for sampling of data and will be stored and processed by Arduino itself.

- Serial Communication:

Serial library will be used to send the data received from the ADCs over serial which will be received by the Computer through USB cables.

- Graph Plotting:

A Java program will be used to get data from Serial (RxTx library) and Processing Development Environment will be used to plot graphs.

- Change Alert System

Algorithm for peak detection and wave frequency will be used to measure the rate and amplitude of the above mentioned parameters. These will be stored for later use as well as live comparision to observe changes in the four parameters. On observing a significant change from base level, program will alert the examiner.

PLAN OF ACTION

Week 1: Skin Conductivity measurement device, its working with Arduino. Start coding for the GUI. Data Collection on 4 parameters in parallel.

Week 2: Pulse rate measurement device, its working with Arduino. Finish code for Serial communication. Data Collection on 4 parameters in parallel.

Week 3: Blood pressure measurement device reading up and making, its working with Arduino. Graph plotting of all the devices made up to this point. Data Collection on 4 parameters in parallel.

Week 4: Respiratory rate measurement device, its working with Arduino. Finish code for alert system and other features.

Week 5: Integration, testing, debugging and improvement of the device. (Buffer week, if needed.)

COMPONENTS REQUIRED

Skin conductivity measurement device

- ADC (in-built in Arduino)
- Finger clips (quantity: 2)

Pulse rate measurement device

- ADC (in-built in Arduino) // initial 4 reduced to 2
- TCRT1000(quantity: 12)
- Finger clips (quantity: 6)

Blood pressure measurement device

- Blood pressure cuff (quantity: 1)
- 4 way valve (quantity: 1)
- 3 way valve (quantity: 1)
- ADC (in-built in Arduino)
- Dump valve (quantity: 1)
- DC motor pump (3 - 5V) (quantity: 1)
- Honeywell ASDX pressure transducer

Respiratory measurement device

- ADC (in-built in Arduino)
- Elastic stretchable straps (quantity: 2)
- Strain gauge (quantity: 2)

Others

- Arduinos and cables (quantity: 3)
- Op-amps
- Resistors
- Capacitors

ESTIMATED COST

Component Name	**Quantity**	**Cost Per Unit**	**Total Cost**
Pressure sensor	1	3000	3000
Strain gauge	2	300	600
Arduino	2	600	1200
TCRT1000	12	60	720
DC Motor Pump 5V	1	500	500
Others	-	-	2500
TOTAL	**-**	**-**	**~9000**

LEARNING

- How the Polygraph test is conducted.

- How the four parameters are measured and analysed.
- How to make circuits more accurate assuming other parameters in the environment constant (like temperature, pressure).

PRIMARY CHALLENGES

- Very high accuracy of resistance measurement to observe comparatively minute changes in body resistance (say a change of 300 ohm per 100,000 ohms). Digital potentiometer of arduino and accurate ADCs will be of great help.
- Getting accurate changes in light reflection and sensing from TCRT1000. Measures to prevent any change in ambience external light is must. Clips will be specially designed to meet those needs.
- In blood pressure measurement, it is very important that motor generates the right amount of pressure. Applying sufficient voltage and keeping air inside tube well isolated from the surrounding is important.

USEFUL LINKS

1. http://www.radio-electronics.com/info/t_and_m/digital-multimeter/how-a-dmm-works-operation.php
2. http://www.analog.com/en/digital-to-analog-converters/digital-potentiometers/ad5241/products/product.html
3. http://hackaday.com/2012/09/13/measuring-a-pulse-with-infrared-light/
4. http://www.vishay.com/docs/83752/tcrt1000.pdf
5. http://www.digikey.com/us/en/ph/Honeywell/asdx.html
6. http://www.analog.com/media/en/technical-documentation/data-sheets/AD620.pdf
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