

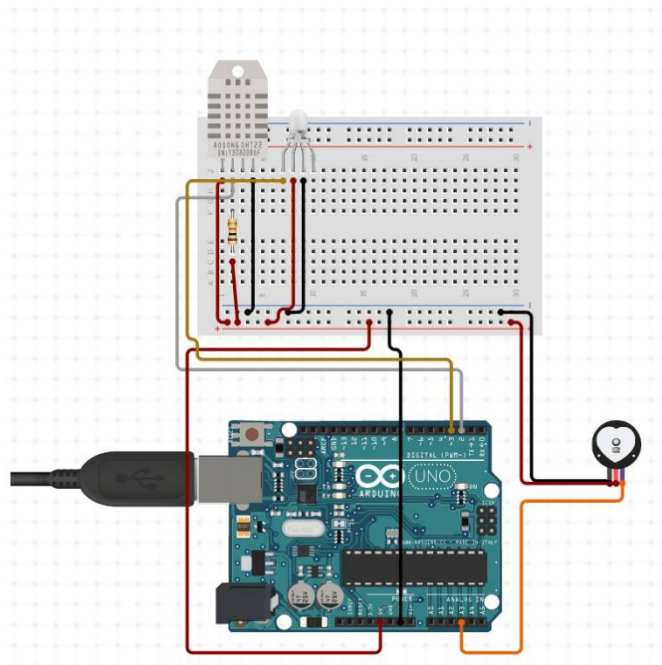
ARDUINO POLYGRAPH MACHINE

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OVERVIEW

1. Project Background and Description

This project measures and records 3 physiological indices (pulse rate, body temperature and skin humidity), attempting to identify physical reactions associated with lying. Sensors are used to read physiological responses while a person is asked a series of questions and the collected data is analyzed in order to determine if the answers are deceptive or not. The project is implemented using Arduino IDE for data harvesting and LabView for data analysis and interpretation.

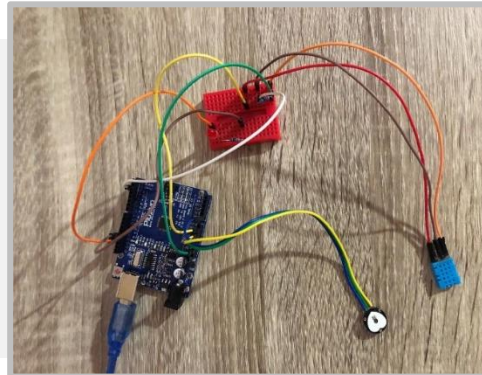


2. Project Scope

- Apply basic lie detection techniques to analyze physiological indicators
- Acquire data from sensors and process it through Arduino
- Create a LabView interface to visualize sensor data and build a virtual polygraph machine

3. Components

- *Arduino UNO*
- *Breadboard*
- *Pulse Sensor*
- *DHT11 Temperature and Humidity Sensor*
- *LED*
- *2 x 330 Ω Resistors*
- *3 female-male wires*
- *5 male-male wires*



4. Functionality

We hear about lie detectors all the time in police investigations and interviews for sensitive government employees such as FBI or CIA agents. The goal of the polygraph is to see if the person is telling the truth or lying when answering certain questions.

This project is based on the most widely used test format for subjects in criminal incident investigations: **The Control Question Test** (CQT). The CQT compares responses to "relevant" questions (e.g., "*Did you kill your wife?*"), with those of "control" questions (e.g., "*Have you ever betrayed anyone who trusted you?*"). When the polygraph test starts, the questioner asks three or four simple questions to establish the norms for the person's signals. Then the real questions being tested by the polygraph are asked.

The interface provided in this project offers the "investigator" the ability to ask a question and visualize the subject's physiological response, thus establishing a baseline for his reactions. Once a baseline is created, the "investigator" can enter the reference data into the control fields. If the "ask question" button is hit and the controls are inserted, the virtual polygraph will determine if the subject's answer is deceptive or not.

5. Hardware

The **heart rate sensor** is connected by an analog input pin to the Arduino board. The sensor is powered using Vcc and ground pins and it operates at +5V. The LED on the front side of the sensor should be placed directly over a vein, so data can be read by placing a finger on top of it and applying slight pressure.

The **DHT11 Temperature and Humidity sensor** has 4 pins: one unused, 2 pins for Vcc (the leftmost one) and ground (the rightmost one) and one pin for data, which is connected to one of the digital pins on the Arduino board. It measures temperature in Celsius and humidity in %. Data is read by placing a finger on top of the sensor. Given that the DHT11 is a low-cost sensor, its accuracy is not great, so when using it for body temperature and humidity measurements we will consider baseline standards which are slightly lower than the real values (for example, we will use a standard of 32°C for body temperature instead of the actual value of 37°C).

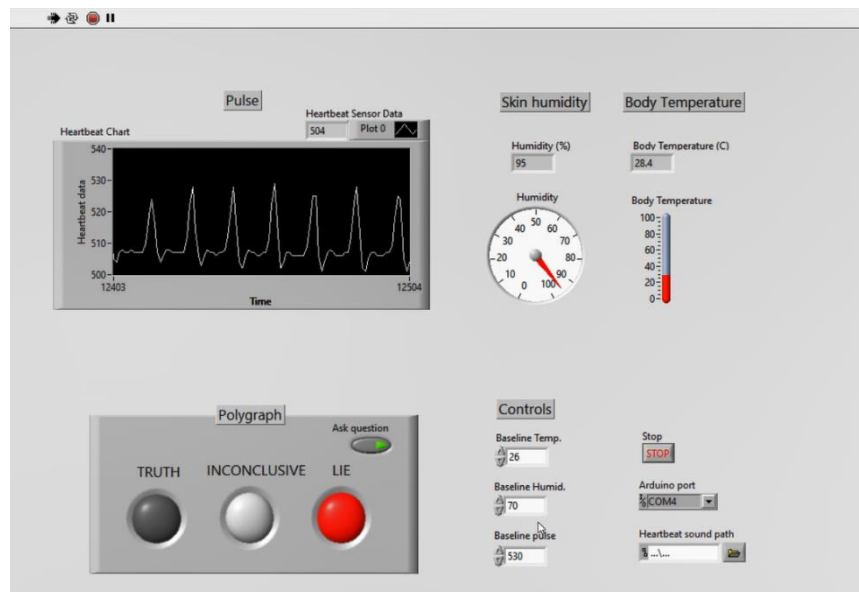
A simple **LED circuit** is included on the breadboard and synchronized with the heart rate data acquired from the sensor. Whenever a heartbeat is detected (the heart rate data surpasses a given threshold), the LED lights up.

6. Interface

The LabView interface is designed for visualizing sensor data and analyzing it based on a set of given controls. It consists of a heart rate monitor which displays the raw data received from the sensor and produces a beeping sound every time a heartbeat is detected. The heart-rate interface is synchronized with the LED on the breadboard. There are 2 other indicators: one for skin temperature and another for skin perspiration, displayed both in numeric and visual form.

Each of the 3 physiological indicators has an associated control, where the user (“the investigator”) can input reference data determined by monitoring the person’s normal reactions and responses.

The “polygraph” works by comparing data received from the sensors with the controls provided by the user. Its implementation is rudimentary - once the “ask question” button is activated, there are 3 possible scenarios: if more than 2 of the physical factors surpass their control values, the response is considered a lie; if at least one factor surpasses its control value, the response is considered inconclusive; if no factor surpasses its control value, the response is considered to be the truth.



7. Bibliography

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- [2]. <https://forums.ni.com/t5/Community-Documents/myLieDetector-Low-cost-Polygraph-Testing/tap/3504230?profile.language=en>
- [3]. <https://create.arduino.cc/projecthub/electropeak/arduino-polygraph-machine-lie-detector-7d8b10>
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