CENG2030
FUNDAMENTALS OF EMBEDDED SYSTEM DESIGN

LECTURE 7: PROJECT I

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- Define the project objectives
- Project guidelines
- Submission Instructions

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PROJECT OBJECTIVES

- To build an embedded system which consists of input sensor, processing unit, and output device

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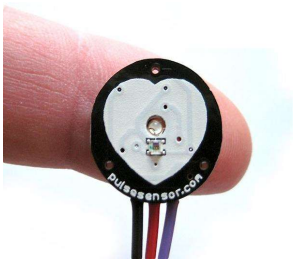
PULSE DETECTOR

- Input Sensor
  - Infra red sensor
- Processing Unit
  - Arduino UNO
- Outputs
  - LED
  - Display the estimated pulse rate on computer



- Signal Level: 368, Pulse Rate: 68
- Signal Level: 370, Pulse Rate: 68
- …

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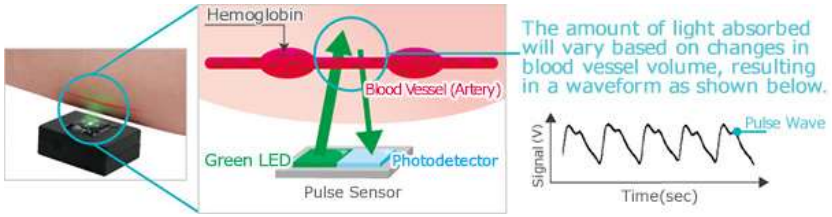
OPERATING PRINCIPLE

- Reflection-type pulse sensors (Optical Sensors for Heart Rate Monitor) emit infrared, red, or green light (~550nm) towards the body and measure the amount of light reflected using a photodiode or phototransistor.
- Oxygenated hemoglobin present in the blood of the arteries has the characteristic of absorbing incident light, so by sensing the blood flow rate (change in blood vessel volume) that changes following heart contractions over time we are able to measure the pulse wave signal.



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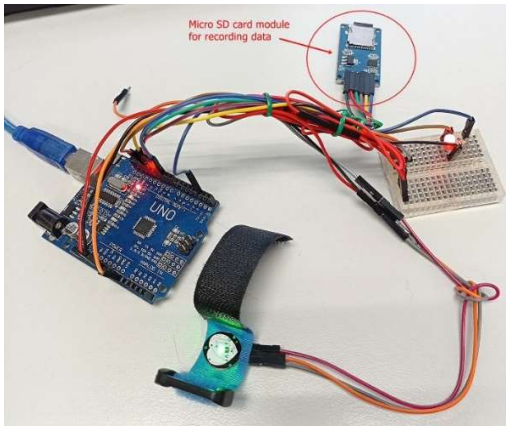
PULSE DETECTOR

- After connecting the hardware, you should get something like the one on the picture.
- SD card module is OPTIONAL.



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PULSE COUNTING

- To count the number of pulses, and estimate the pulse rate, time information is very important
- We can use the function millis() to get the number of milliseconds passed since the Arduino board begin running the current program
- So, by using this info, we can check the time passed for 1 second, 5 seconds, or 1 minutes…

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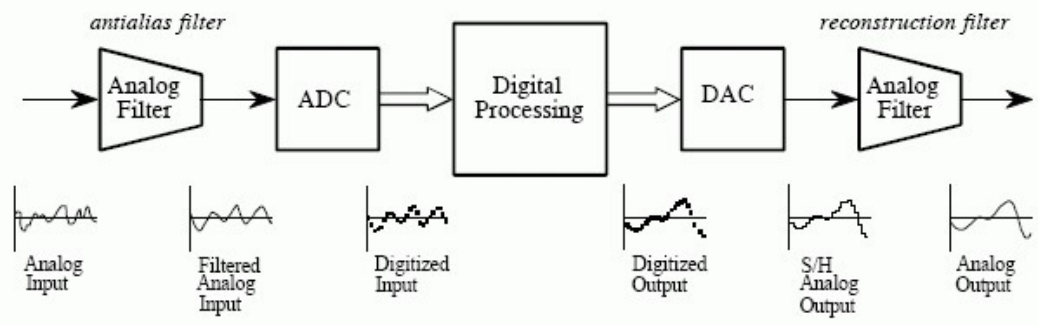
ANALOG SIGNAL FROM IR SENSOR

- In this project, we deal with analog signal input from IR sensor to Arduino for digital processing (i.e. without DAC and Analog Filter).



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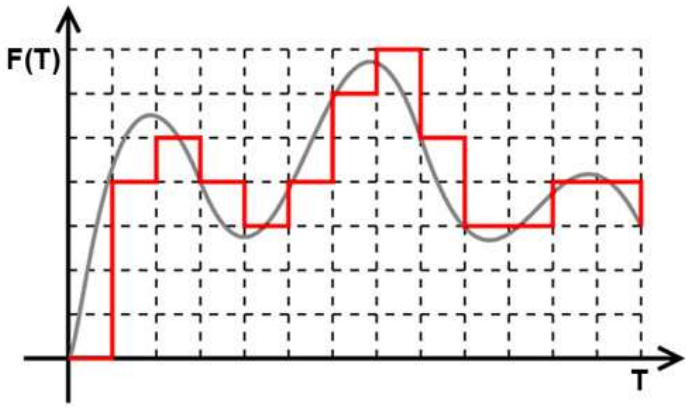
SAMPLING AND QUANTIZATION



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DATA FROM IR SENSOR

- The data from the IR sensor is analog, so we should use analog input pin on the Arduino board. Also, we should use function analogRead() to reads the value from the specified analog pin.
- Arduino boards contain a multichannel, 10-bit analog to digital converter. This means that it will map input voltages between 0 and the operating voltage (5V or 3.3V) into integer values between 0 and 1023.
- On an Arduino UNO, for example, this yields a resolution between readings of: 5 volts / 1024 units or, 0.0049 volts (4.9 mV) per unit.

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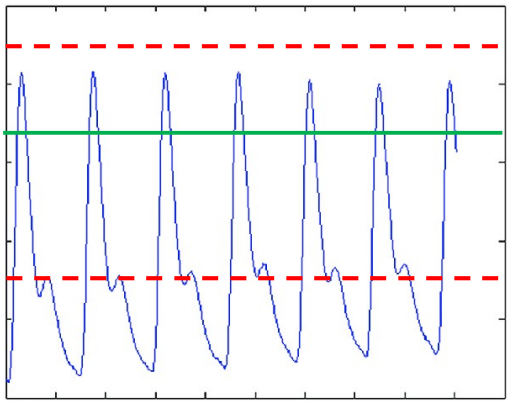
PULSE DETECTION

- The pulse waveform may look like the picture on the right.
- By setting a threshold yourself, the pulses can be defined and detected.
- By counting the number of pulse per minute, the pulse rate can be estimated.
  - Signal Level: 368, Pulse Rate: 68
  - Signal Level: 370, Pulse Rate: 68
  - …



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SUBMISSION INSTRUCTIONS

- Submit both demo video and Arduino codes to Blackboard
  - Arduino codes
  - Demo video
    - Your name and SID
    - Voice descriptions
    - Hardware setup
    - LED output
    - Real time raw data outputs, e.g. Signal Level: 368, Pulse Rate: 68
- Deadline is stated in Blackboard

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ANY QUESTIONS ?

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