**EE2301: Final mini project**

**Theme: Building a heartbeat monitor [75 points]**

Start date: **1st Nov 2022**

Deadline for submission of lab-report: **22nd Nov 2022 [Hard deadline] Last week reserved for evaluations/viva.**

**Total marks: 50 + 15 (bonus)**

You will be graded on:

1. Quality of implementation: Design of parameters and corresponding circuit.
2. Quality of documentation: Can someone reading your document replicate your design.

**Note**: Please click images for setups and measurements (on DSO) and include them in your report. Hand-written reports **will not** be graded. Only pdf reports typed in Latex or Word are permissible.

1. **Task:**

* Implement a Photoplethysmogram (PPG) device for measuring your heart rate and blood pressure. PPG a simple and low-cost non-invasive optical technique that can be used to detect blood volume changes in the microvascular bed of tissue. During one cardiac cycle, the blood pressure varies in the artery from systolic (max pressure) to diastolic (min pressure). This is sensed as change in reflected optical signal due to change in optical absorption in the blood vessel/tissue.
* Used in fit-bits, apple watches etc.
* If the sensor is not tightly pressed against the skin, a pressure wave associated with the blood flow is also seen as a secondary peak in addition to the systolic and diastolic peaks. Pressing the TCRT5000 too hard with your finger might lead to lesser volume variation in the artery and hence small amplitude variation in the PPG signal.

**Methodology:**

* You will be given an IR (infrared) LED (light emitting diode)-phototransistor pair **TCRT5000** to detect the PPG signal. Please read the data sheet to understand how to bias this IC and maximum current to be flown through the collector.

**Serious Health warning about using the IR Sensor:**

***Your eyes cannot see IR light. Do not stare into the LED, as large IR power may damage your eyes. To test whether the IR LED is working, you may use your camera phone.***

***Make sure you limit the current before switching on the power. This is to protect eyes - yours, as well as those of everyone around you. And to protect the TCRT5000 from damage as well!***

* The phototransistor output signal will be then appropriately conditioned by subsequent circuit stages (amplifier+ band pass filter of appropriate frequency).
* Then you need to sample this enhanced signal and digitise it with a A to D convertor. There are two options for you

(a) **Easy option:** Use the Arduino board to implement this part of this circuit or

(b) **Challenging Option:** Build the sampler and A/D converter (at least 3 bits) using discrete components OPAMPs etc. for 15 bonus points.

Timeline

Description automatically generatedSuggested block Diagram: