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SEN
Intelligent Sensors

**Commissioning Heartbeat Sensor and Comparison
Against Oximeter**

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1 Project

The aim of this project is to commissioning a heart beat sensor whereby a few measurements are done, which are later compared to results of a valid device - oximeter. Prof. Ing., Dipl.-Ing. Martin Drahanský, Ph.D¹ is the project supervisor.

2 Abstract

The goal of this project is to demonstrate a method of heart beat measurement via infrared light. The next sections below, will describe further details, which were required to be done to the right functionality. The results of measurement were compared with a valid heart beat sensor, which measured heart beat in other way than the infrared method.

3 Introduction

The infrared light has a key role in this project. The infrared LED represents a main source of infrared rays which are sent in a direction to phototransistor. These rays may be affected by any kind of object in the way to the phototransistor that represents a blockade. Using a finger as a rays blockade, the rays are affected not only by the finger itself, but also by the blood in the finger. As the heart is pulsing inside of the person's body, the blood pressure is different inside of the finger's veins, which has also a great impact on the rays. The emitted rays from the finger are detected by the phototransistor that produce a precise values. Based on these values, there is a possibility to detect heart beat. This method of measurement is shown in Figure 1.

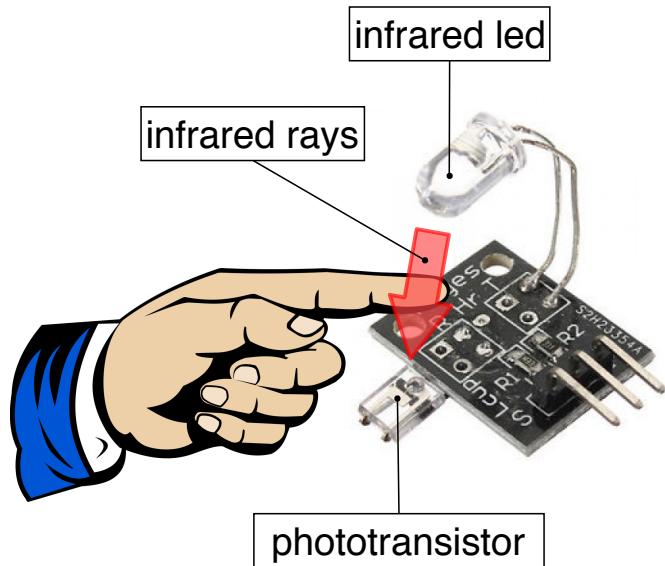


Figure 1: Method of infrared heart beat measurement.

The necessary facilities for the implementation of the project were:

- Device shown in Figure 2.

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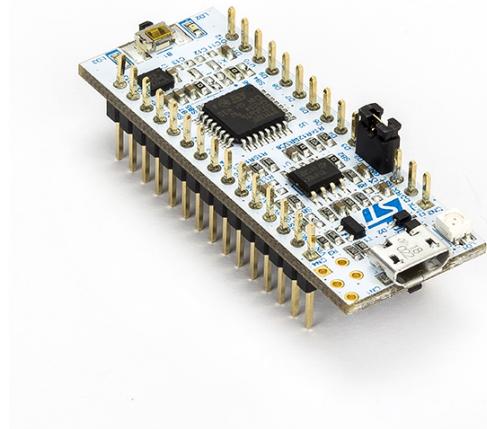


Figure 2: STM32 Nucleo board [4].

- Sensor shown in Figure 3.

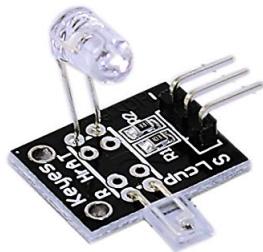


Figure 3: Keyes KY-039 Finger Heartbeat Detection Sensor [1].

- Three female-to-female jumper wires.

After, as we received the devices, we were facing to many problems. The main device representing the basic platform was not working properly so we had to ask for a new one. Later, the main device (shown in Figure 2) was replaced to a new one (see Figure 4) due to wrong functionality by the technical assistant of the project - Ing. Tomáš Goldmann².

²www.fit.vutbr.cz/~igoldmann

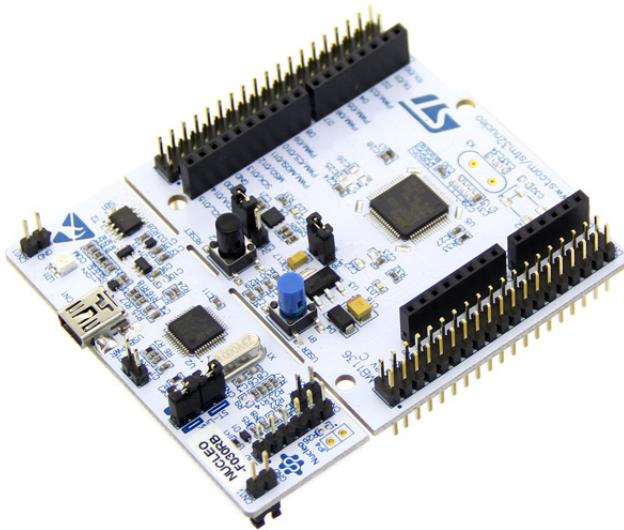


Figure 4: STM32 Nucleo board [2].

The device shown in Figure 4 - NUCLEO-F030R8 [6], was the main platform for the project. The device was equipped with a STM32F030R8 [7] microcontroller unit (MCU), which was designed and made to be suitable for a wide range of applications. MCU includes a set of peripherals through which it communicates with other devices such as the sensor shown in Figure 3. To create a communication pipeline, these units must be connected to each other via jumper wires. Wires provide a connection between the pins of units and so the pins have to be configured correctly.

4 Setup

Firstly, the components must be connected to each other in a right way. Sensor, as a slave component shown in Figure 6, is connected to the main device (master component). These two units are connected via 3 jumper wires to the corresponding pins. The Figure 5 and 6 have three common marked pins: *GND* (orange), *5V* (yellow), *PA0* and *S* (green); by which they are connected together. *PA0* indicates an analog input pin to the master component. A precise description of all the necessary pins is shown in Figure 7.

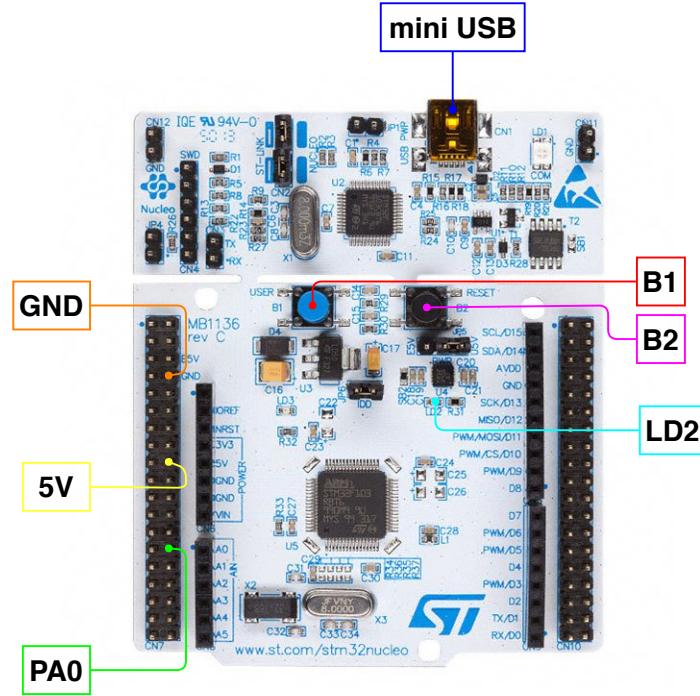


Figure 5: NUCLEO-F030R8 [3] connection scheme.

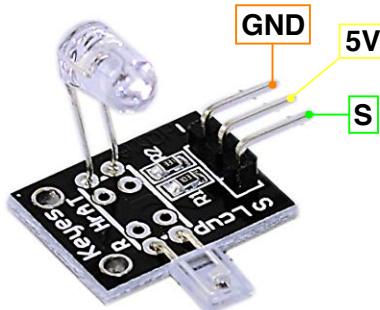


Figure 6: Keyes KY-039 [1] connection scheme relating to Figure 5.

S	sensor output
B1	button 1
B2	button 2
LD2	LED 2
GND	ground
5V	5 volt voltage supply
PA0	pin PA0
mini USB	mini USB port

Figure 7: Explanatory notes.

A connection scheme of the devices is shown in Figure 8. After the devices were correctly connected and attached to the computer via mini USB port (see Figure 9), they were ready to be programmed.

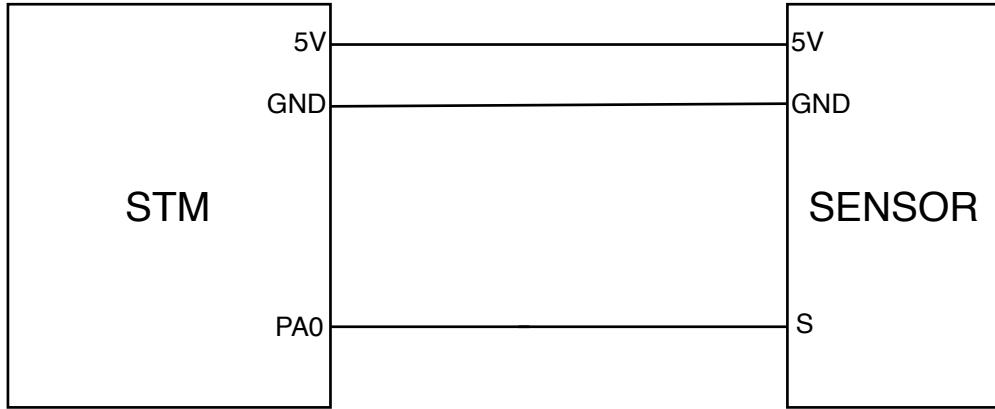


Figure 8: Device connection scheme.

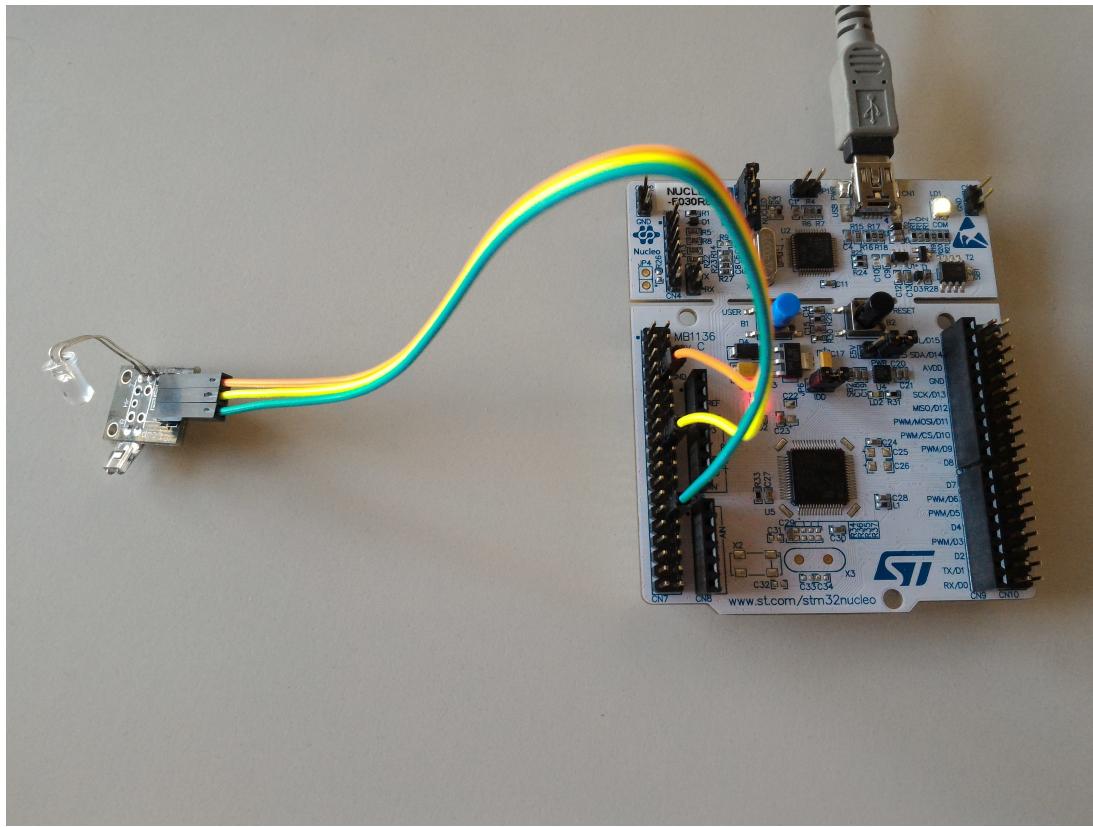


Figure 9: Correct connection of devices.

As we were working on the implementation part of the project, there was a measurement anomaly. The results were affected by different input voltage on the pin. We asked for an advice from the technical assistant. He has recommended to us a different device connection which is shown in Figure 10. It required to use a protoboard with two $10k\Omega$ resistors and a few additional connection wires.

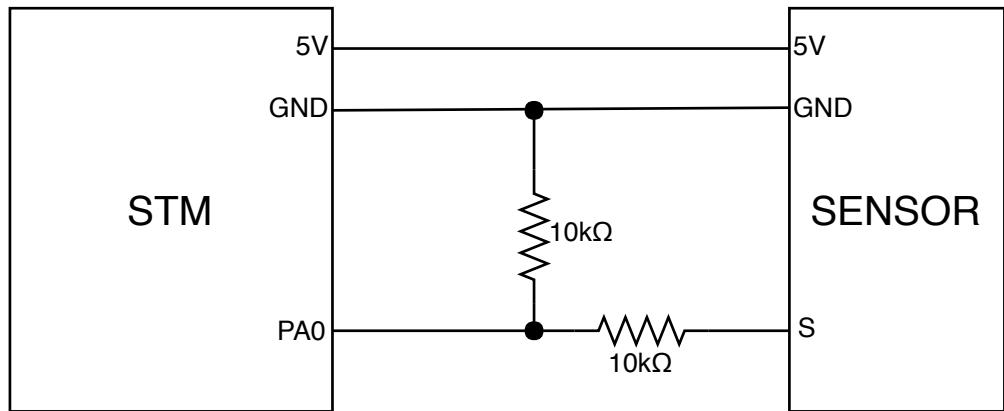


Figure 10: New device connection scheme.

The devices have been reconnected based on the given advice, which is shown in Figure 11. This setup was the proper one where the values have not been affected by voltage.

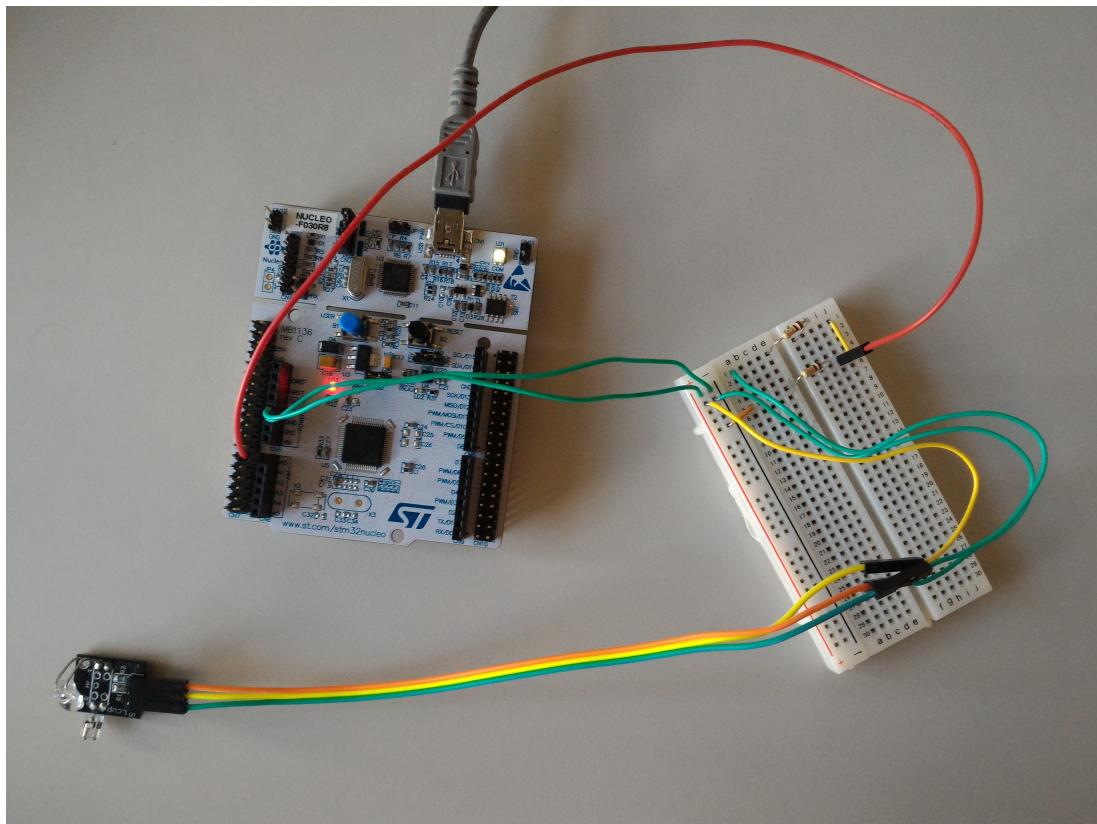


Figure 11: New connection of devices.

5 Implementation

...sensor code[5]...

6 Conclusion

...

7 Appendix

Name	Value
n1	v1
n2	v2
n3	v3

Figure 12: Table of measurements.

8 References

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