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## Preface

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## PREFACE

On behalf of the Committee, I would like to thank you for your participation in The 4<sup>th</sup> International Seminar on Sensors, Instrumentation, Measurement and Metrology (ISSIMM 2019) which has been held at Universitas Negeri Padang (UNP) in Padang, West Sumatera, Indonesia, November 14<sup>th</sup>, 2019.

This 4<sup>th</sup> ISSIMM is organized by the Physics Department, Faculty of Mathematic and Natural Science, Universitas Negeri Padang. It is jointly organized by Universitas Indonesia (UI), Universitas Brawijaya (UB), Universitas Gadjah Mada (UGM), Institut Teknologi Bandung (ITB), Institut Teknologi Sepuluh Nopember (ITS), Universitas Airlangga (UNAIR) and Universitas Negeri Padang (UNP). Moreover, Physical Society of Indonesia (PSI), Instrumentation and Metrology (Puslit KIM-LIPI) and ISASS will provide technical supports to this seminar. The ISSIMM conference is a fusion of International Conference on Sensor, Sensor System and Actuator (ICSSSA) and International Seminar on Instrumentation, Measurement and Metrology. Prominent researchers and scientists from around the world will join together in the seminar to share their latest research results and exchange their ideas. In addition, direct contacts among the researchers and scientists will therefore promote international research networking as well as collaboration in the future. The seminar will include plenary speeches, invited presentations, and contributed presentations.

I would like to express my sincere appreciation to all the participants, financial sponsors, exhibitors, supporting organizations and all the committee members who has made 4<sup>th</sup> ISSIMM successful. With these strong support, we are sure ISSIMM 2019 will be beneficial to all the participants.

We are looking forward to meeting you in the next ISSIMM.



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## Development of ECG sensor using arduino uno and e-health sensor platform: mood detection from heartbeat

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## 5 Development of ECG sensor using arduino uno and e-health sensor platform: mood detection from heartbeat

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**Abstract.** Many researcher said that emotion or mood can be detected from physiological changes like the heartbeat. In order to measure human heart activity, we were using tools like Electrocardiograph. The changes on human emotion or mood affect physiology. This paper is part of our research that talked about Analysis of Mood State from Heart Signal during Playing Flappy Bird. In this paper, we will explain how we design ECG tools that could measure or detect the human heartbeat especially that affect by mood changes. E-Health Sensor Platform v2.0 and Arduino Uno were used to build this system. E-Health Sensor Platform v2.0 contains several sensors that can measure the biological state of humans such as heart rate, breathing, skin conductance and many others. This device can operate when connected with Arduino Uno as a microcontroller. Arduino uno role as a liaison between the Platform and the PC via a serial port. We were using C programming language on Arduino Uno. 100 Hz were sett in programming code so we can read all data from ECG sensor clearly. To visualize the heartbeat signals we were using KSTPlot. This system has successfully read the heart signals of 20 participants. Although there is signal noise but it does not affect the data. The noise can also be removed with a filter. In our next study, the raw data will be analyzed using the HRV method, but this will be discussed in another paper.

### 1. Introduction

In recent years several researchers have examined the relationship between Emotion and human health. The research is developing due to the rapid advancement of computing technology. In the biomedical engineering field, researchers are trying to study the effects of emotions on the human body. In other fields such as affective computing [3], they are trying to make technology that can recognize the emotional state of every human in real time and even try to instill artificial emotions into the computer over the cloud computing [1]. At first we wanted to study and develop a system that could recognize a person's emotional state through his heartbeat [2]. We do this research by provoking someone's emotions



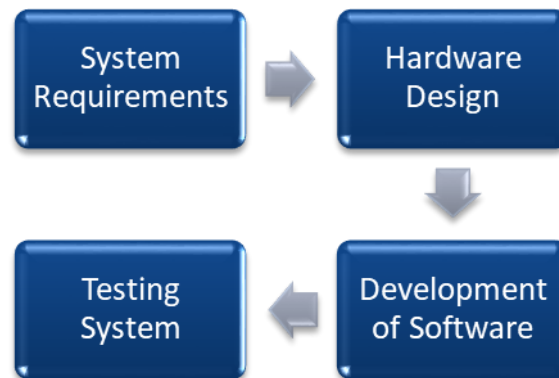
through video [4][5][6]. We evaluate the results of heart records through ECG with HRV and classify them by machine learning. Some researchers use faces as emotional references.

In our next research we want to study the activities of the human heart that are being stimulated by the game. Our main research now is to collect a database of heart activity when induced with the Flappy Bird Game. We hope the Flappy Bird game can arouse people's angry moods. In this paper we will discuss specifically the hardware used to capture human heart signals. We use ECG sensors with 3 wires. This sensor is embedded in the E-Health Sensor Platform V2.0 produced by Libellium [8]. This platform is connected to the Arduino Uno microcontroller so that data can be read on a PC. Data capture via USB port and COOLTERM application. We use C++ programming language and a sampling rate of 100 Hz. We tested this tool with 10 participants and captured their heart signal data while they were playing games. Visualization of data captured by the ECG sensor is processed by KSTPlot.

Our next study is to process the data using HRV method and then will be processed by the machine learning method. But this will be discussed in another paper.

## 2. Methods

The method we used to develop this hardware is shown in the figure 1.



**Figure 1.** Research Flow Diagram

### 2.1. System Requirements

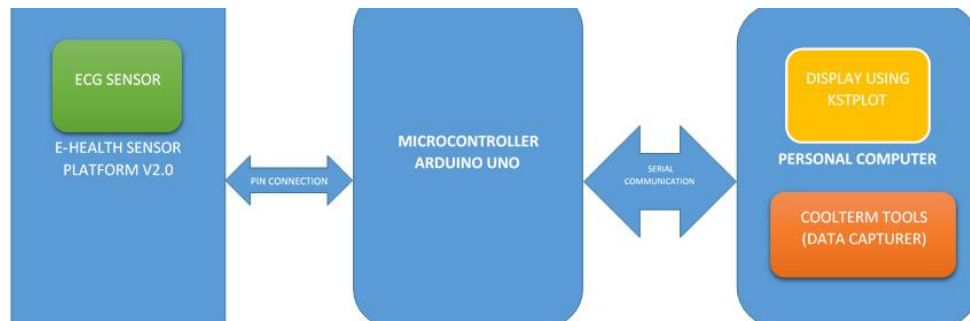
To develop a tool, specifications and some constraints must be identify in this research. An ECG sensor is needed to capture heart signals. There are several types of ECG that are often used by medical teams. This tool is certainly very expensive and not mobile. We need a cheap and mobile ECG. We also need a system that can connect with a PC or micro PC like Raspberry Pi. We did some hardware checking on the internet and found a system that was suitable for our research. E-Health Sensor Platform v2.0 is a system that contains several biosensors such as Electrocardiography (ECG), Electromyography (EMG), Galvanic Skin Response (GSR), Blood Pressure, Pulsioximeter and several other sensors (Fig.2)[8]. We decided to use this tool for our further research. But of course this tool needs development to fit our research goals.



**Figure 2.** E-Health Sensor Platform V2.0

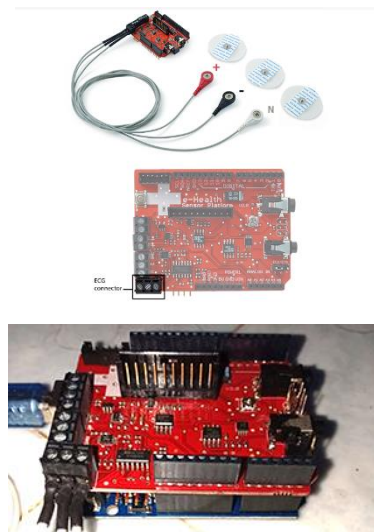
## 2.2. Hardware Design

The block diagram of this design is shown in Fig 3.



**Figure 3.** Block Diagram

The ECG embedded in the E-Health Sensor Platform system is a 3-wire type. The ECG has 3 nodes installed in the human chest as shown in Figure 4. ECG nodes are positive (red), negative (white) and neutral (black). Libellium has made this tool compatible with the Arduino Uno microcontroller, so it is not difficult to pair the device. The Arduino Uno and Platform connections via the Pin are shown in Figure 4. The USB cable is used for arduino uno and PC connections. Later on PC's side we were using 2 different Software such as Coolterm for capturing data through serial port and the other was KSTPlat to visualize the data stream.



**Figure 4.** Electrode of ECG Sensor from Platform (upper), Platform and Arduino (lower)

## 2.3. Development of Software

To get a clean signal, we use 100 Hz as the sampling rate. Sampling rate is related to noise, so we tried some of the best values. The program code is written in the arduino editor in C ++ (Fig 5). The program code has actually been provided on the cockinghack website and editable as needed.

```
#include <eHealth.h>

int cont = 0;
float hz = 0.25;

void setup() {
  Serial.begin(115200); }

void loop() {

  float ECG = eHealth.getECG();

  Serial.print(ECG, 2);
  Serial.print("\n");
```

**Figure 5.** C Code for data Sampling

This program code is uploaded to Arduino Uno to read and captured the data from the ECG sensor by a PC.

#### 2.4. Testing System

During the system trial phase, we asked 10 participants to try this tool. Because our main research study is about heart reactions to games, we have tested the tool with game stimuli to participants. Participants were asked to read informed consent and agree through the consent form. They will be fitted with 3 ECG electrodes, We are assisted by university medical personnel to install ECG Electrodes (Fig.6).



**Figure 6.** Electrodes Placement

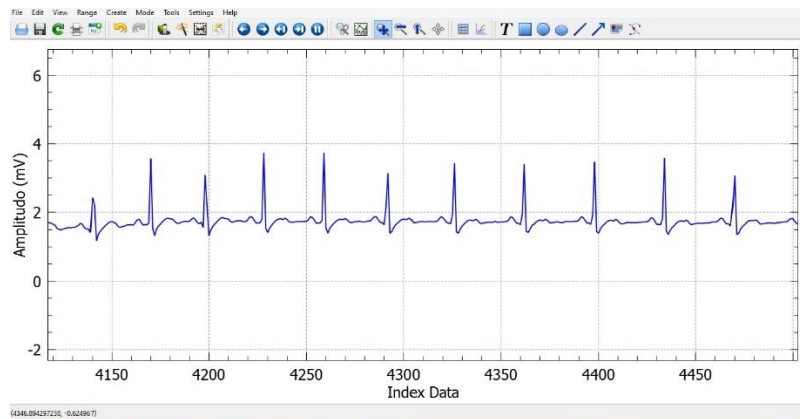
The ECG is connected to the E-Health Sensor Platform and Arduino Uno. The Program Code has previously been uploaded to the Arduino Uno chip. The USB cable is connected to Arduino Uno then through Coolterm the data stream will be seen. To capture data, the start / stop button on Coolterm is used.

The data captured consisted of 2 phases, the baseline phase (participants did nothing) and the stimuli phase (participants playing the flappy bird game). The baseline phase is 5 minutes and the stimulation phase is 10 minutes. All data captured is a number that refers to the value of the sensor voltage. The

Value Range is 1V - 3.5V. Data is stored in \*.csv and also in \*.txt format. For visualization, data is accessed by the KSTPlot application so that the PQRST signal form is visible on the monitor.

### 3. Results and Discussion

The results of the trial using participants were seen in the signal generated by the KSTPlot application. Signals on the monitor are like ECG signals or PQRST signals shown on fig.7.



**Figure 7.** Visualization result

The shown ECG signal is the result of 15 minutes of data flow capture. By using a sampling rate of 100Hz, you will get a small noise. Errors that often occur in data capture are: Incorrect Baudrate setting which results in data error, incorrect COM option, incorrect sampling rate setting.

The most important thing is how to make the system work without using other third applications. We hope that in the future the system can be made with just one simple controller application. In the future we want to create a raspberry pi based system. By adding a monitor and creating a stand-alone program using a free application such as Scilab. The main goal of this research is to create a system that can read heart rates without disturbing users (non-intrusive). Some researchers have made their own ecg machines, some are even more portable [9] so it can be monitored in real time.

### 4. Conclusion

We can conclude that the system development was successful. The system can capture data flow perfectly. Data flow on the serial port can be read properly. The visualization results on KSTPlot generate the ECG signal perfectly.

### Acknowledgements

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