

Hwa Chong Institution

Project Work

Category 3 Inventions Log Book

Title of Project: The Heart Beat Monitor Hat
Group Name: The Heart Beat Monitor Hat
Group Members: 1) Seah Yuheng, 1A1(Leader) 2) Isaac Chua Jun Xiang, 1A1 3) Yau Gerard Yun,1A1

Problem Finding

We identified 10 problems at the start of the year that were affecting large groups of society. From there, we narrowed down to three problems by eliminating those that were too hard for us to solve. Then, we used a decision-making matrix to select our eventual problem based on the number of people who were affected by the problem, the effectiveness of the products which is already on the market and the feasibility.

Define the Problem

In 2018, 6214 people in Singapore died from cardiovascular diseases in Singapore. This is equivalent to 29.2% of all deaths in Singapore in 2018. So, one in three deaths in Singapore is due to cardiovascular disease.

After analyzing the problem and doing some research, we have come up with a solution to solve the problem. Cardiovascular disease generally refers to a condition that involves narrowed or blocked blood vessels that can lead to a heart attack. Thus, a person who has heart diseases will have an irregular heartbeat because less blood can flow through their arteries so their heart will beat abnormally. An irregular heartbeat can be easily detected using a heartbeat monitor. However, these heartbeat monitors must be both lightweight and accurate for a person to wear it around and measure his heart rate constantly. Research has also found out that the number of people who have cardiovascular diseases and are above 80 years old is five times more than the number of people who are 40 to 50 years old and have cardiovascular diseases. Thus, we also have to make our product suitable for the elderly as most people using the product are elderly people.

We also surveyed this issue, with most of the respondents being the elderly. Firstly, we asked the public if they were concerned about heart disease cases happening all around the world. Out of the 90 people surveyed, 85.5% of the respondents were concerned about heart disease cases happening all around the world. This shows that the majority of the public is aware of the problem of heart diseases and are concerned about this matter. Secondly, we asked them if they felt that a device that can alert and constantly measure heart rate will assist them or their loved ones. 90% of the respondents felt that a device that can constantly measure heart rate will be useful. So, if we were to invent a device that can constantly measure heart rate, it would benefit the public greatly as the majority of the public felt that such a device would benefit them a lot.

Now that we know how to solve the problem, we analyzed the different heart rate monitors in the market and identified its pros and cons.

Smartwatches are the most common type of heart rate monitors. These smartwatches are portable and they are also very easy to wear and bring along. However, smartwatches have many functions so seniors might not be able to know how to operate the smartwatch. Also, the words on smartwatches tend to be quite small. Hence, seniors might not be able to read the information on the watch due to their inability to read such small words. As a result,

smartwatches are typically not suitable for the elderly to use.

Another device that can measure heart rates for the elderly is the Holter Monitor. The Holter Monitor is very accurate and can continue monitoring heart rate over a few days. However, the Holter Monitor is very expensive. One Holter Monitor costs approximately \$846.

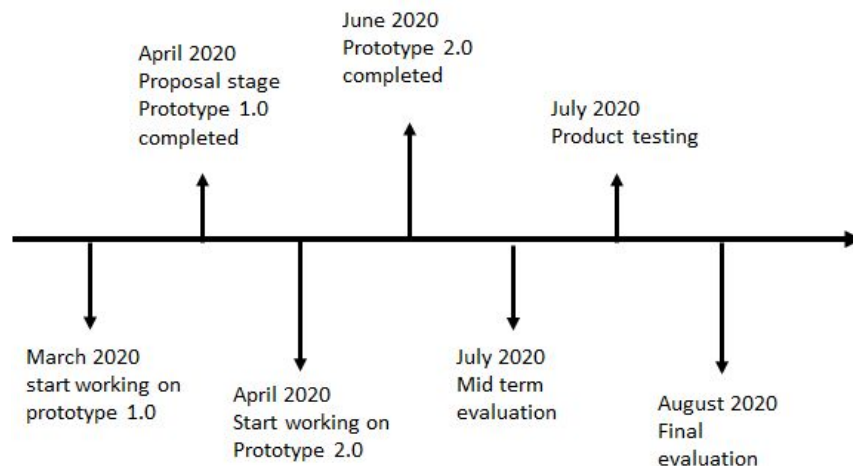
Other than these two devices that can monitor heart rates for seniors, another device that can monitor heart rates for seniors is the BodyGuardian Heart. This device is stick-on so it is very easy to use. It will monitor the wearer's heart rate in addition to activity rate, respiration rate and other vital signs. However, seniors who are not IT savvy may not know how to use it as the information collected is viewed on a mobile device.

Our BIG IDEA

Our invention is a device that can measure heart rate. This device has a heart rate sensor in it. This device is lightweight so it can be brought around. This device is versatile. It can be fitted on a wristband and worn on the wrist or attached to a hat and worn on the head. There will be a screen that will display the heart rate of the person so the wearer will be able to know his heart rate and report it to the doctor if necessary. The font size on the OLED screen is also large enough for the seniors to read. This device is also very easy to operate as it does not have unnecessary functions.

We estimated the whole sensor's cost to be around \$20, which is reasonably cheap. If heart diseases are not detected early, more money will be spent on hospital bills. This device is also very suited to seniors as the size of the fonts on the OLED screen is large enough for the seniors to read. This portable device is also straightforward to operate as it does not have unnecessary functions. As our product is cheap, accurate and suitable for seniors to use, we are confident it will benefit the seniors a lot.

Our proposed Timeline



Construction Process

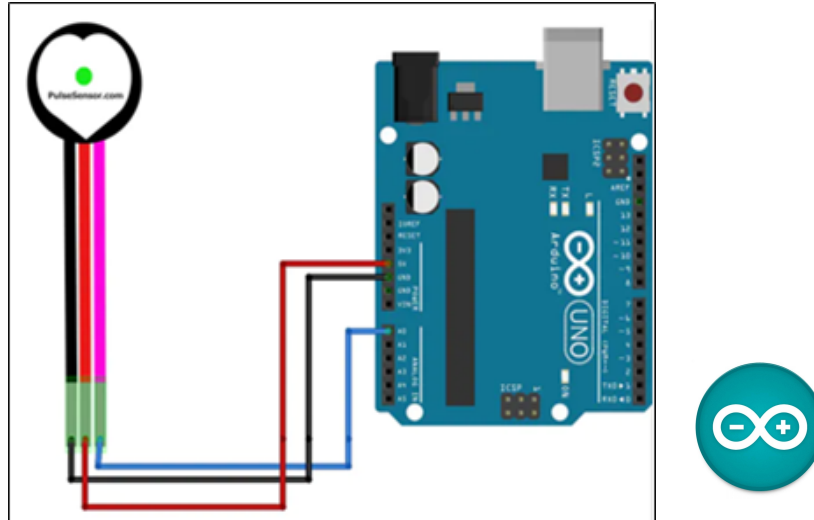
Prototype 1.0

1. Heart Rate Sensor



During this phase, we chose the infrared pulse sensor to measure the heart rate. It can measure reliable and accurate pulse readings. The pulse sensor works with either a 3V or 5V voltage. As seen in the diagram above, this sensor has three pins - signal, which is connected to the analogue pin 0 (the purple wire), GND (the red wire) & power (the black wire). The sensor has a LED that emits infrared light. The infrared light passes through the skin and is reflected by the blood vessels. The amount of infrared light reflected depends on the amount of blood in the vessels. There will be more blood in the blood vessels when the heart beats compared to when the heart pauses. Hence, by measuring the amount of blood in the blood vessels, the heart rate monitor can effectively measure one's heart rate.

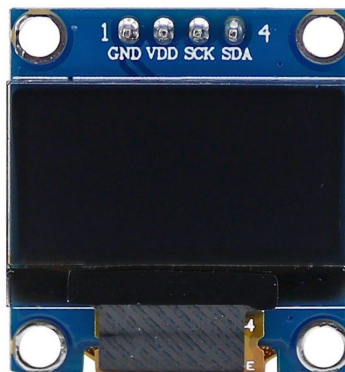
2. Assembly Of Parts



In this stage, we only added a heart rate sensor and the Arduino board. The output of the heart rate sensor will be viewed on the serial plotter of the Arduino software. We completed this prototype on 20 April 2020.

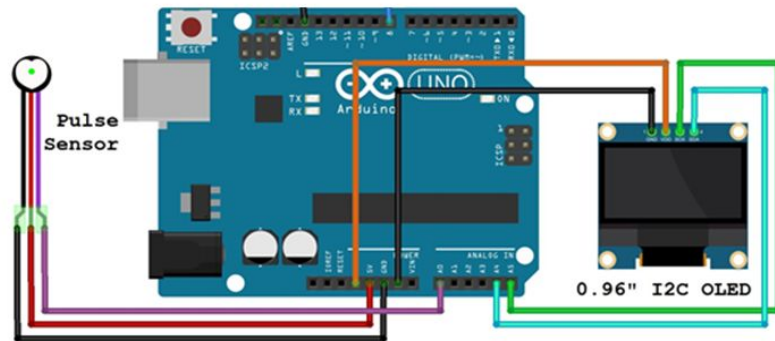
Prototype 2.0

1. OLED Screen



During this phase, we added the OLED screen to our device. The OLED screen is a monochrome OLED display module with a 32x64 resolution dot matrix and an I²C interface. The screen operates on a type of technology called I²C, with two connection pins labelled as SCK and SDA. These two pins receive the information as to which pixels to switch on. The microcontroller on the Arduino can use this communication method to “talk” to the OLED screen. The OLED screen has 4 pins - GND, VDD (connected to a power output of 5V), SCK (connected to the signal pin A5) and SDA (connected to the signal pin A4). We chose it because it has several advantages such as high brightness, self-emission, high contrast ratio, wide viewing angle, wide temperature range, and low power consumption.

2. Assembly Of Parts



After choosing the parts we want to use, we hooked all the parts up on a breadboard as seen in the diagram above. We used the Arduino Nano board instead of the Arduino UNO board which we used previously as the Arduino Nano board was lighter and smaller so it was more convenient to bring along. On 20 May, we completed prototype 2.0 :) .

Modification and Evaluation

Product testing:

Test Iteration:	Tick			Solution
Heart Rate Sensor				
Test Date: 16 July 2020	Pass	Fail	Potential Failure	
Accurate (Same results as medical heart rate monitor)	✓			
Repeatability	✓		Heart rate sensor short circuits without anyone realising.	Wrap the sensor in water-resistive tape (must be transparent).
Portability	✓			

References

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