Lambton College In Toronto

EMBT-ESE 4009

Recognize and synthesize an embedded software engineering design problem

Topic:Health monitoring device using IOT -connected headphone.

Group:2

Instructor:Mike Aleshams

Group Members	Student ID
Christy Rachel Philip	C0765535
Fahad Rahman	C0769871
James M Chacko	C0777192
Premil Presannan	C0777191

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Topics Covered

- Introduction
- Design Requirements
- Conclusion
- Reference

Introduction

- Embedded systems in many cases must be optimized for life-cycle and business-driven factors rather than for maximum computing throughput

- Our project must guarantee real time operation reactive to external events, conform to size and weight limits, budget power and cooling consumption, satisfy safety and reliability requirements, meet tight cost targets, ensure end-product utility, control physical systems, and manage power.

In this, we are discussing four of these. They are,

1. Real time operation reactive to external events
2. End-product utility
3. Safety and reliability requirements
4. Tight cost targets

Concept

- The topic of our project is “Health monitoring device using IOT-connected headphone.”
- Our Project is an IoT-connected health care device, which is connected as a part of Bluetooth headphones. It consists of surface electrodes, temperature sensors, GPS, etc., to obtain various health-related data such as heartbeat rate, temperature, and EKG. We can use multiple EKG and PPG sensors to get the vital information we need to monitor.
- The device can be connected to a mobile phone through IoT. The user's information such as height, weight and previous history should be saved in the application. Using this, the family doctor can access it directly to monitor the patient's condition every day and communicate with them.

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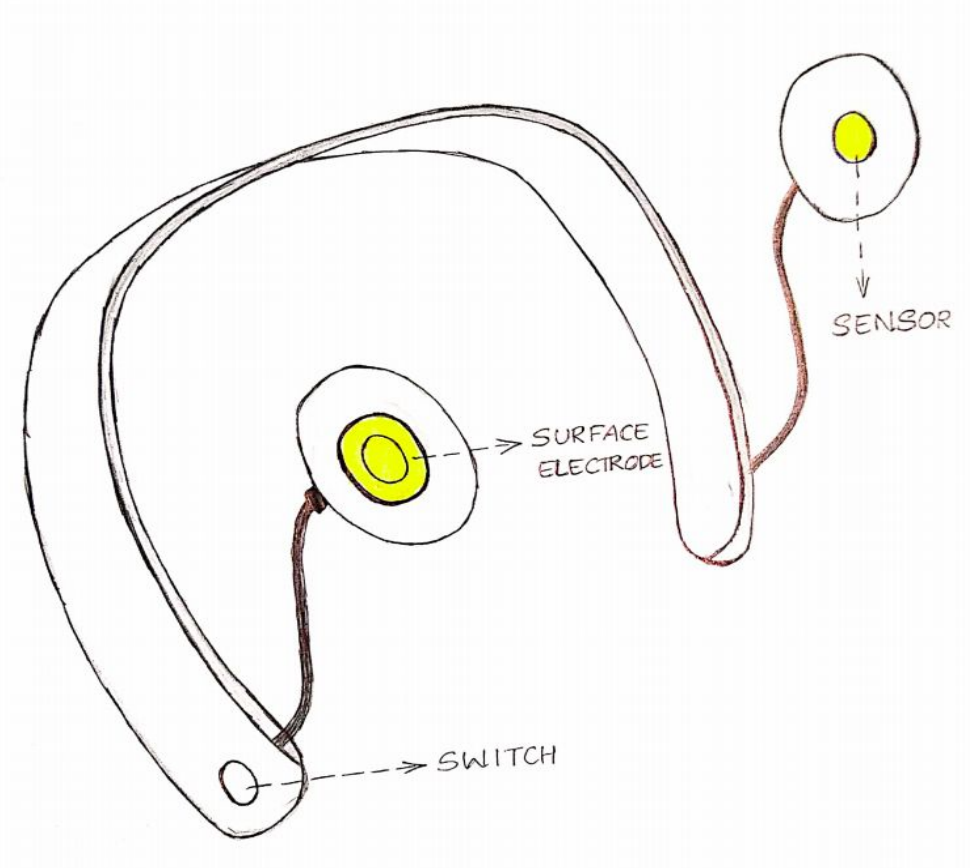
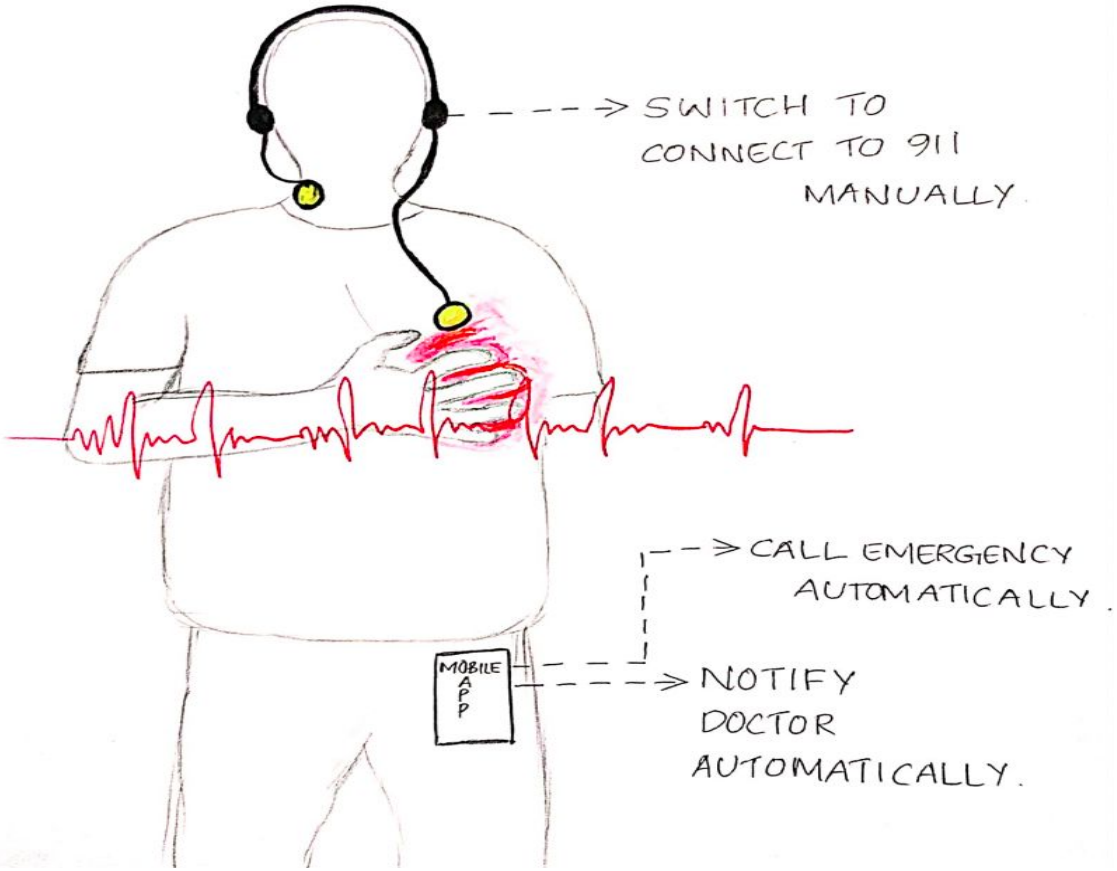
Conceptual Diagram





1. Real time/reactive Operation

- Real time system operation means that the correctness of a computation depends, in part, on the time at which it is delivered
- Our project is an example of real time operating system.The vital data input from the body like EKG,Temperature,GPS location,etc… are take from the body and transferred to the smartphone simultaneously using IOT.
- The user can see all the information on the smartphone in real time without any delay
- By adding a GSM module, the officials can receive notification and location of the user even if there is no internet available.

- Reactive computation means that the software executes in response to external events.
- Our project have an algorithm that sense the similarities in the reading from the sensor. There will be a average or threshold value for all data. All these data are continuously monitored.
- If there is a abruptive change in the data from the threshold value an interrupt will be turned on which notify the user as well as the officials.
- Thus the software algorithm is designed for response to external events

2. End Product Utility

Heart disease usually happens when there is reduced blood flow to the heart. According to a survey, heart disease is the second leading cause of death and hospitalization in Canada.

How many Canadians live with heart disease? (prevalence) (Government of Canada, 2017)

- According to the most recent data from 2012/13, about 2.4 million (8.5%) Canadian adults aged 20 years and older live with diagnosed ischemic heart disease, including 578,000 (2.1%) with a history of a heart attack.
- About 669,600 (3.6%) Canadian adults aged 40 years and older live with diagnosed heart failure.

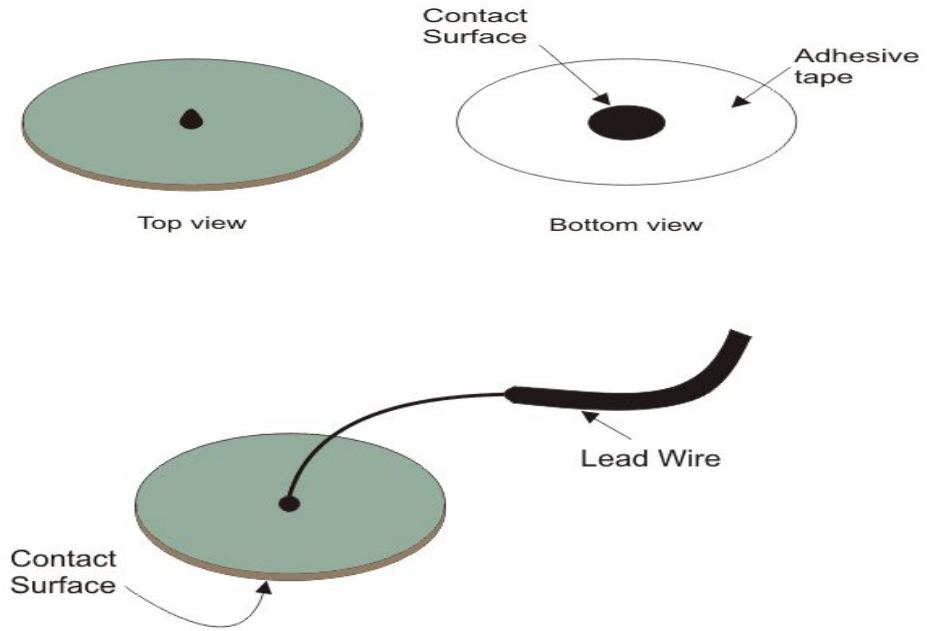
How many Canadians are newly diagnosed with heart disease each year? (incidence)

- About 158,700 (6.1 per 1,000) Canadian adults aged 20 years and older received a new diagnosis of ischemic heart disease. Specifically, about 63,200 (2.3 per 1,000) adults had a first heart attack.
- Approximately 92,900 (5.2 per 1,000) Canadian adults aged 40 years and older received a new diagnosis of heart failure

- Embedded products are typically sold on the basis of capabilities, features, and system cost rather than which CPU is used in them or cost/performance of that CPU
- The product is designed for specific kind of people but its application is not limited to some people
- Everyone in the world who need to get their vital information can use this product and this will be more helpful to people who are diagnosed with health related problems and elderly people.
- Moreover this product can be used in this pandemic
- With additional feature of temperature sensor we can identify if a person have fever or not.
- The oxygen level i the blood can be identified using sp02 sensor and can be used to identify the condition of lungs

3. Safe and reliable

- As a health tracking device, we use surface electrode sensors to implement the device on the subject. It is pasted on the skin of the subject(no need for surgeries or injections)

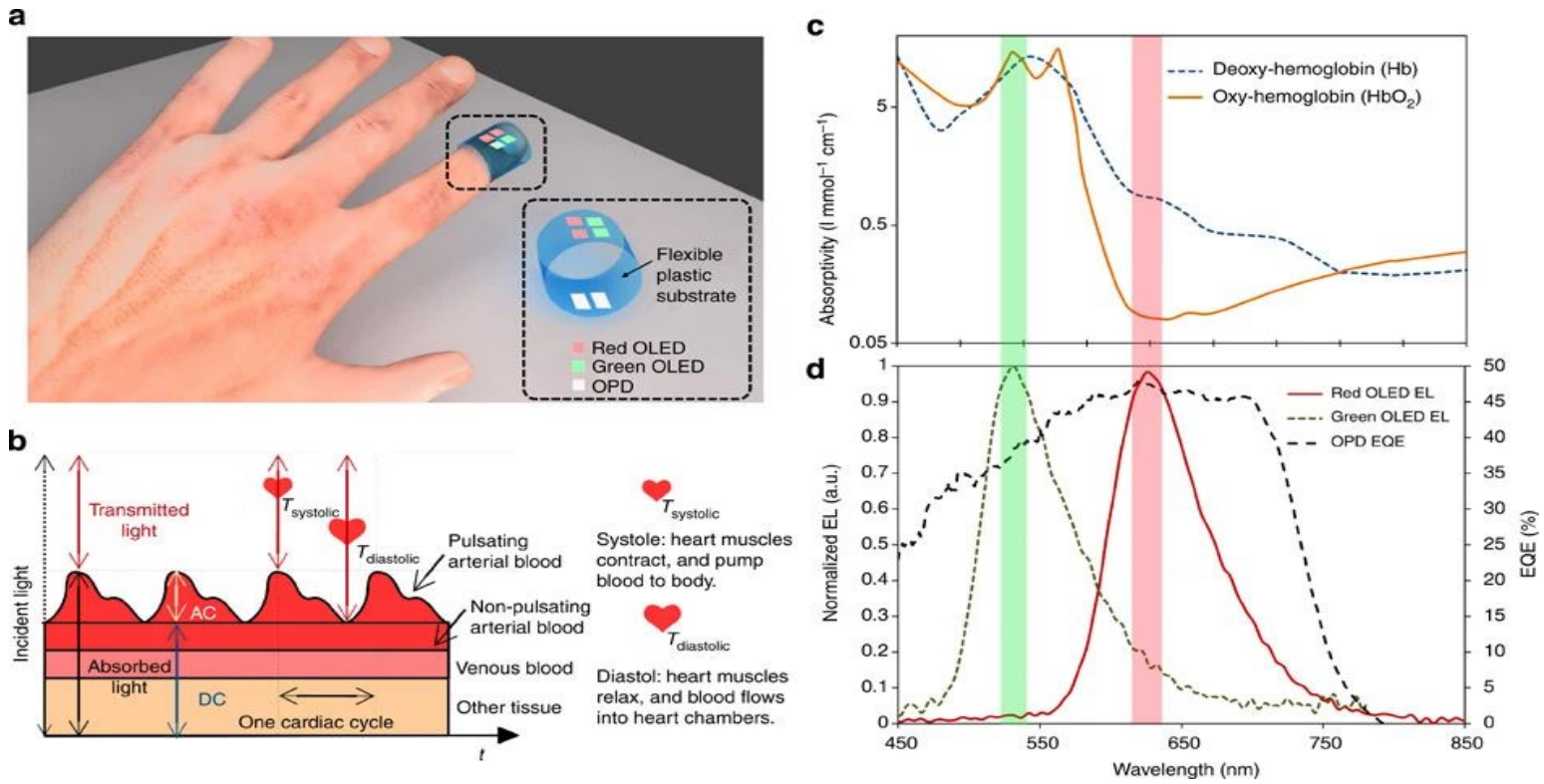


- Our health monitoring device requires a very low amount of power and it is also well insulated.

- However, many embedded systems that could cause personal or property damage cannot tolerate the added cost of redundancy in hardware or processing capacity needed for traditional fault tolerance techniques.

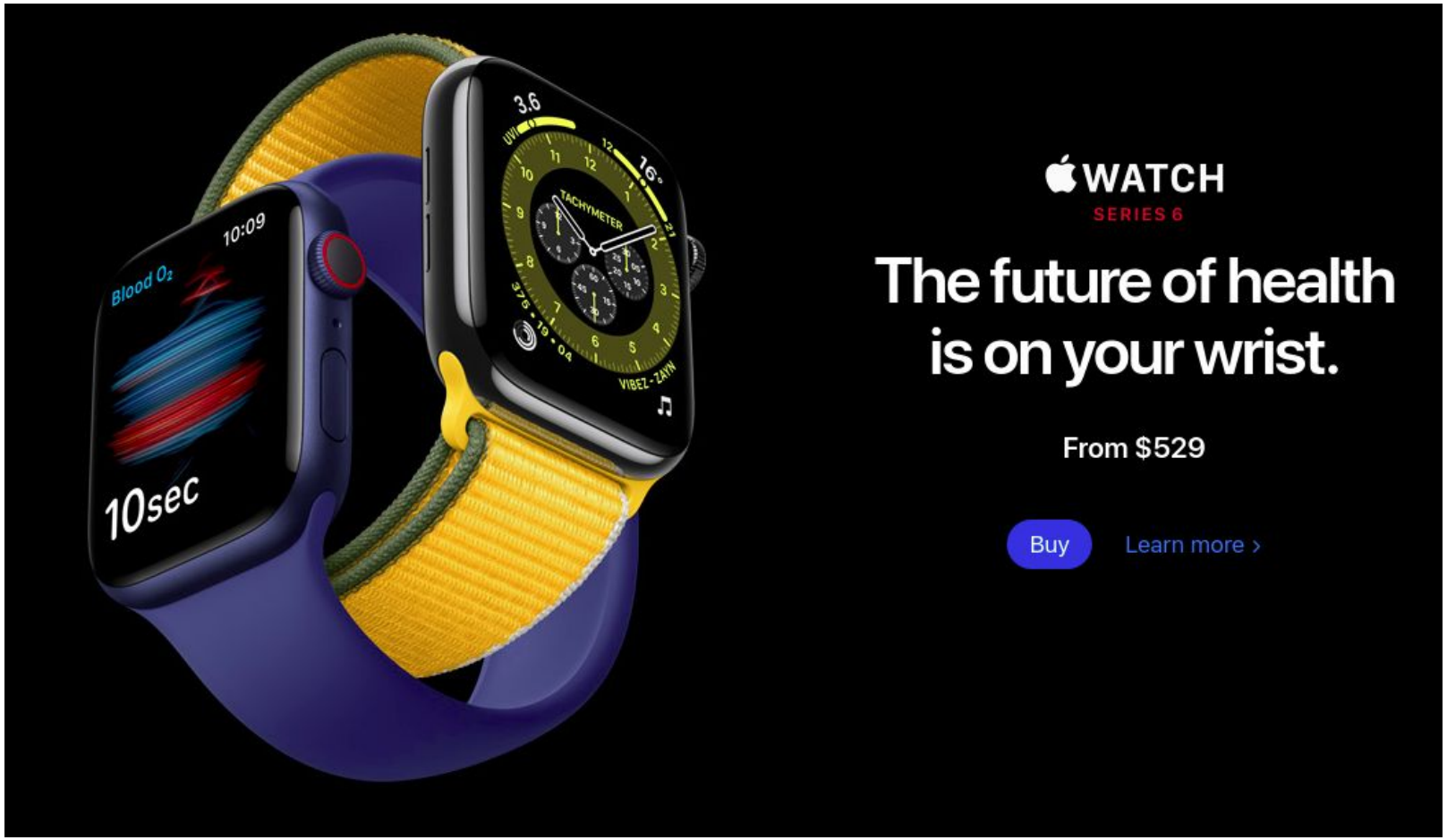
- The health monitoring device is highly reliable as we can easily replace any component or sensor on this system in case of any damage. No need of changing the entire device for a component failure.

- we use spo2 sensors for detecting the blood oxygen level. Optical SpO2 sensors use red and infrared light sensors to detect your oxygen levels, sensing changes in those levels by looking at the color of your blood. There are no harmful radiations and very safe implementation.



4. Tight cost targets

- The current product available in market similar to this is apple watch series 6.
- It is a quality product, but the problem is it is not affordable for everyone.
- The following image from Apple's website is the evidence for them.



- In this case, we need a device which is affordable for everybody. So that we need to build the product in low cost.
- If we check the price of our product it would become clear.
- In our product, we are using all low cost components like temperature sensor, spo2 sensor, ekg sensor and so on.
- Our highest rate product is the Raspberry pi microcontroller board, which costs $ 64.95.
- However, if we compare with the price of apple watch, which is 529 dollars, this is very low.
- In the next slide, we have an estimated BOM (Bill of materials) for this project.

Part number	Description	Cost	Link
1811853	Raspberry Pi 3 Model A+	64.95	https://www.raspberrypi.org/products/raspberry-pi-3-model-a-plus/
MAX30101	SparkFun Photodetector Breakout - MAX30101 (Qwiic)	20.95	https://www.sparkfun.com/products/16474
A-QKY68C	Lithium Ion Battery for Raspberry pi	25.99	https://www.amazon.ca/gp/product/B08CBVNWG4/ref=ewc_pr_img_1?smid=AW1D3WUZUOTMS&psc=1
SEN0213	Analog Heart Rate Monitor Sensor	19.90	https://www.dfrobot.com/product-1510.html
DS18B20	One Wire Digital Temperature Sensor - DS18B20	3.95	https://www.sparkfun.com/products/245
MCP3008	8-Channel 10-Bit ADC With SPI Interface	3.75	https://www.adafruit.com/product/856
Total amount:			139.49 CAD

- So from the Bill of Materials, it is clear that, it will costs almost $140.
- As in embedded systems we have stringent requirements, cost is almost always an issue, although the sensitivity to cost changes can vary dramatically. So in this case, our product is completely satisfying.
- Especially, when we compare the cost with the Apple's watch cost, it is less than one third, which is great difference.
- Since it is less price, it is comparatively affordable for more people, especially for heart patients.
- Thus we can conclude that our product is cost effective.

Conclusion

- In order to define an embedded system design problem, we considered factors such as real time operation reactive to external events,safety and reliability requirements, tight cost targets and, end-product utility.

- To summarize our product Health monitoring device using IOT-connected headphone does have all the design requirements needed for a good embedded system

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Thank you