

Remote diagnosis of patients with a smart device and mobile application for the prevention of Coronavirus (COVID - 19)

¹Nasser Mohamed Hassan Alassar

Lecture Assistant in October High Institute of Engineering and Technology, Cairo, Egypt

Email: aalassar.nasser@yahoo.com

Mohamed Ahmed Mohamed Elshafiye

Member in MTI University, Cairo, Egypt

Abstract: The electronic device aims to protect the doctor remotely as it is contacted with an application program through the mobile that examines patients remotely to discover and prevent the Virus Corona 19 with the aim of not transmitting the virus through the air to the doctor and the patient, which will help the doctor to diagnose the medical condition accurately for the patient remotely and determine the extent of the presence of the virus within the human body and determine the percentage of immunity in the body using modern technological techniques.

Keywords: Smart mask - smart phone - modern technologies - modern technological means - application programs, covid -19, Coronavirus.

Introduction:

Technology plays a pivotal role in combating the spread of new coronavirus (known scientifically as COFED-19) with its rapid capabilities to identify infected persons and contribute to their rapid isolation, as well as the ability to secure ways to reduce communication and friction between people, by Using robots and drones, either in connection services or in performing sterilization and diagnostic operations, or in their role to understand how the disease arose and the mechanism for the emergence and spread of new mutations of virus

Robotics and plane planes Several Chinese companies have worked to develop technologies that contribute to the delivery of materials and food delivery operations and implement sterilization procedures in hospitals, roads and public places, as well as carrying out basic diagnostics that contribute to patient identification.

Potential, and get to know them quickly, all through the use of various robots enhanced with different technologies that enable them to implement these tasks.

Doctors around the world face a major professional and ethical challenge of differentiating patients with coronavirus "Covid-19" to choose who will receive the priority treatment on ventilator. This challenge is not new. It is similar to the differentiation system for patients who need organ transplants, but the large number of patients increases this burden and makes it more like the situation in times of war.

Whether in light of the spread of the Corona "Covid-19" epidemic or before, doctors at the hospital's resuscitation department bear the burden of differentiation among patients, to choose which of them will be placed on respirators. But the current epidemic will force them to "screen" patients widely, which raises ethical questions.

¹ Corresponding author

Italian doctors fighting the fight against the Corona virus in the country say they have to choose between those receiving treatment first to save their lives and those who are deprived of it because of the high number of infected people.

As the number of new HIV infections continues to increase daily, Italy is making every effort to deal with enough hospital beds to treat patients, an unprecedented step in peacetime.

"If a person is between 80 and 95 years old and suffers from severe respiratory distress, he is unlikely to get," Christian Salaroli, head of the intensive care unit at a hospital in Bergamo, in the northern region of Lombardy, told the Corriere della Sera newspaper. Therapy, these are very difficult words, but unfortunately, they are true. We are not in a position to experience so-called miracles. "

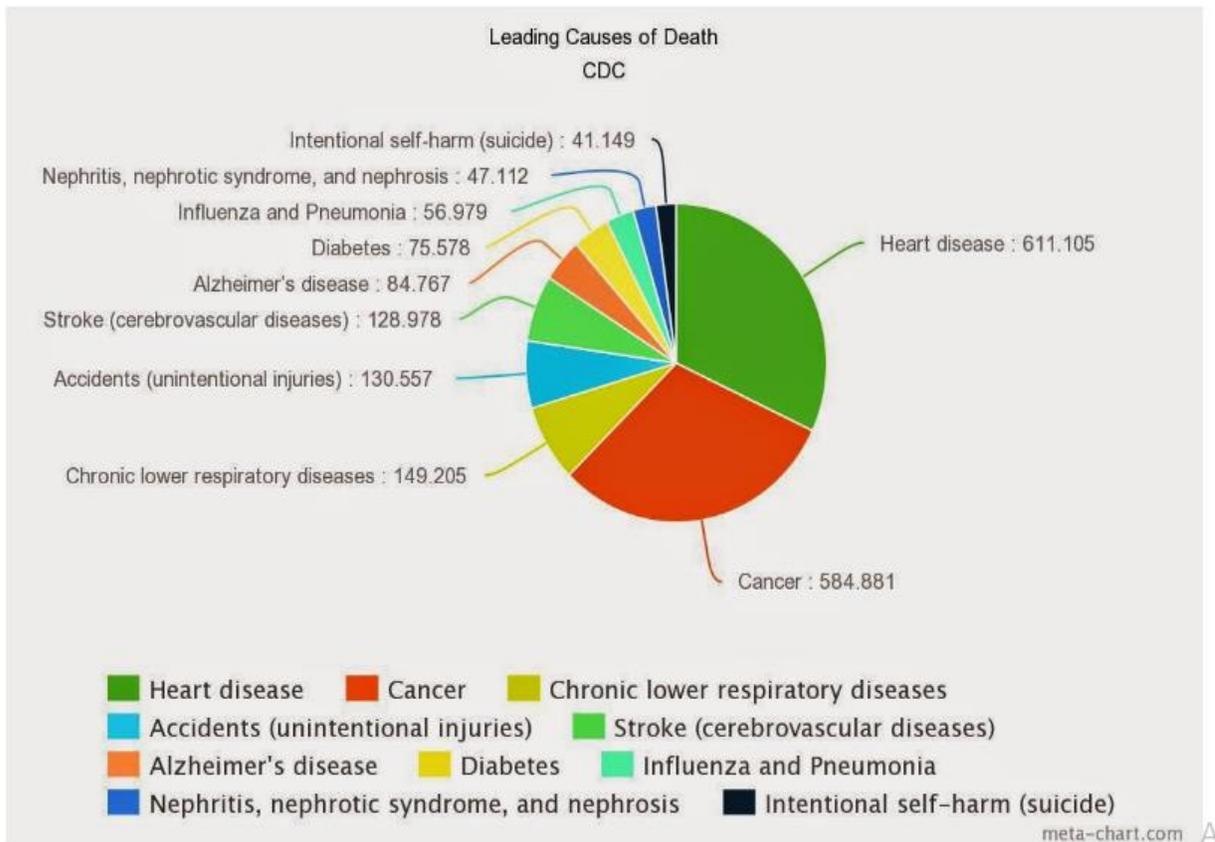
But what made the outbreak in Italy determine the necessary decisions related to life or death?

"Difficult choices"

Corona virus proved to be a fatal disease in Italy in particular, after it caused about 1809 deaths out of 24,747 cases as of Monday, equivalent to about one third of deaths recorded in China as a result of infection with the virus (MIT Technology Review Arabia).

Reasons for implementing the device:

High number of injuries and deaths according to the World Health Organization in hospitals, according to a statistical research conducted by the Centers for Disease Control and Prevention (CDC). The main cause of death was corona disease, low respiratory rate, and high



lung and heart diseases, while Italy occupied the rate of coronavirus infection, then Spain. Some causes of death share the same thing, they are completely unexpected.

Fig 1: pie chart for leading causes of deaths

Vital signs are measurements of the body's most basic functions. The four main vital signs routinely monitored by medical professionals and health care providers include the following:

Body Temperature:

Normal human body temperature, also known as normothermia or eutheria, depends upon the place in the body at which the measurement is made, the time of day, as well as the activity level of the person. Nevertheless, commonly mentioned typical values are: Normal human body temperature, also known as normothermia or eutheria, depends upon the place in the body at which the measurement is made, the time of day, as well as the activity level of the person. Nevertheless, commonly mentioned typical values are: Oral (under the tongue):

$36.8^{\circ} \pm 0.4^{\circ} \text{C}$ ($98.2^{\circ} \pm 0.7^{\circ} \text{F}$) Internal (rectal): 37.0°C (98.6°F)

Building a DIY temperature sensor: Temperature Sensor Tutorial

Pulse Rate:

Heart rate, or heart pulse, is the speed of the heartbeat measured by the number of poundings of the heart per unit of time — typically beats per minute (bpm). The heart rate can vary according to the body's physical needs, including the need to absorb oxygen and excrete carbon dioxide. Activities that can provoke change include physical exercise, sleep, anxiety, stress, illness, ingesting, and drugs.

The normal resting adult human heart rate ranges from 60–100 bpm. Bradycardia is a slow heart rate, defined as below 60 bpm. Tachycardia is a fast heart rate, defined as above 100 bpm at rest. When the heart is not beating in a regular pattern, this is referred to as an arrhythmia. These abnormalities of heart rate sometimes indicate disease. A DIY pulse monitor design from make magazine: Infrared Pulse Sensor

My written article on making a DIY arduino pulse monitor: Homebrew Arduino Pulse Monitor

Respiration Rate:

I have no plans for making a sensor for this. (Out of scope)

Blood Pressure:

Blood pressure" usually refers to the arterial pressure of the systemic circulation, usually measured at a person's upper arm. A person's blood pressure is usually expressed in terms of the systolic (maximum) pressure over diastolic (minimum) pressure and is measured in millimeters of mercury (mm Hg). Normal resting blood pressure for an adult is approximately 120/80 mm Hg.

Make Magazine's DIY Sphygmomanometer: DIY Blood Pressure Monitor

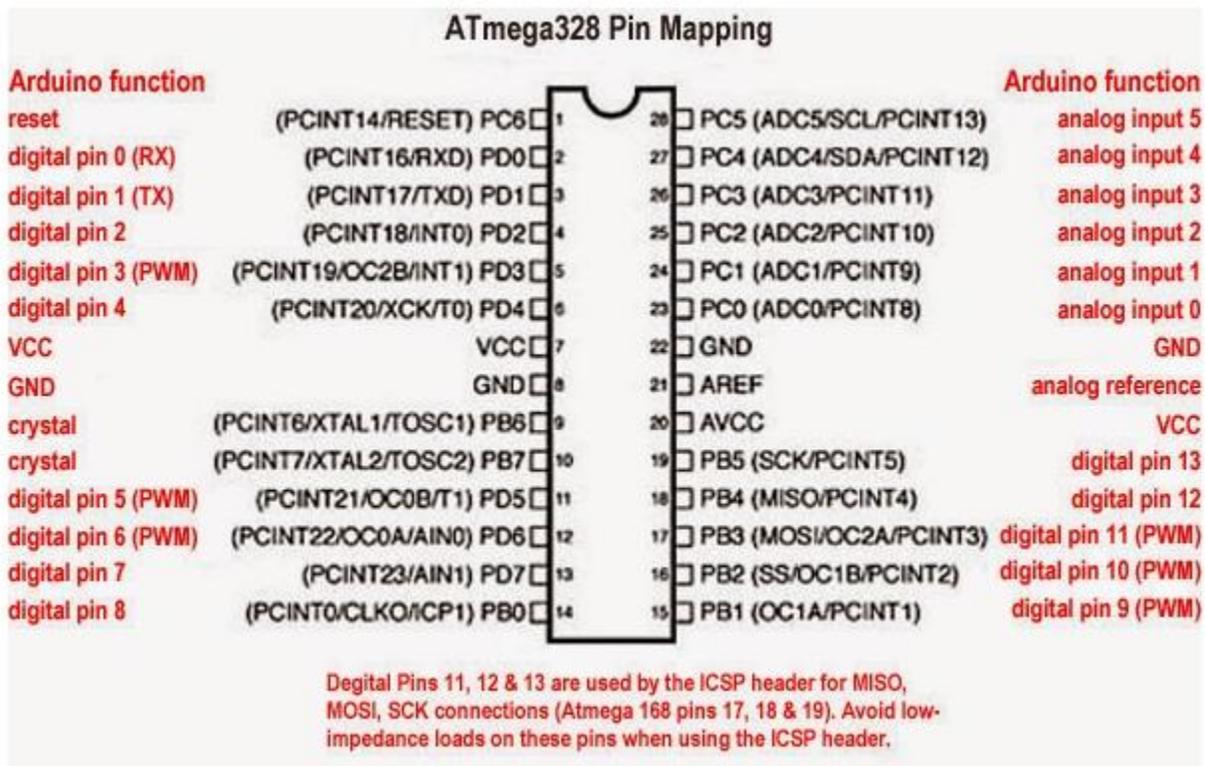
The massive ability of the space shuttle to take payload has become NASA providing astronauts with greater medical equipment. Medical equipment consists of two boxes: a first aid kit and ties, and a medical emergency box. The EMK first aid kit and bundles contain medicinal capsules (drug pills, drug capsules), bonding tapes and topical treatments; the MBK emergency

kit contains injections, simple surgical instruments, for diagnosis / treatment, and a microbiological examination box.

John Glen - the first American astronaut orbiting the Earth - returned at the age of 77 to take part in the STS-95 mission to meet the physical challenges that prevent long journeys into space: from loss of bone density, muscle weakness, suffering from imbalance, and lack of sleep, Changes in cardiovascular function, and weak immune system - all of which are symptoms of older people and of astronauts. John Glenn has made a great, historic effort with regard to space exploration, but this time he is providing the results of medical research in the field of aging treatment as well.

Make Magazine's DIY Sphygmomanometer: DIY Blood Pressure Monitor DIY ATMEGA ARDUINO

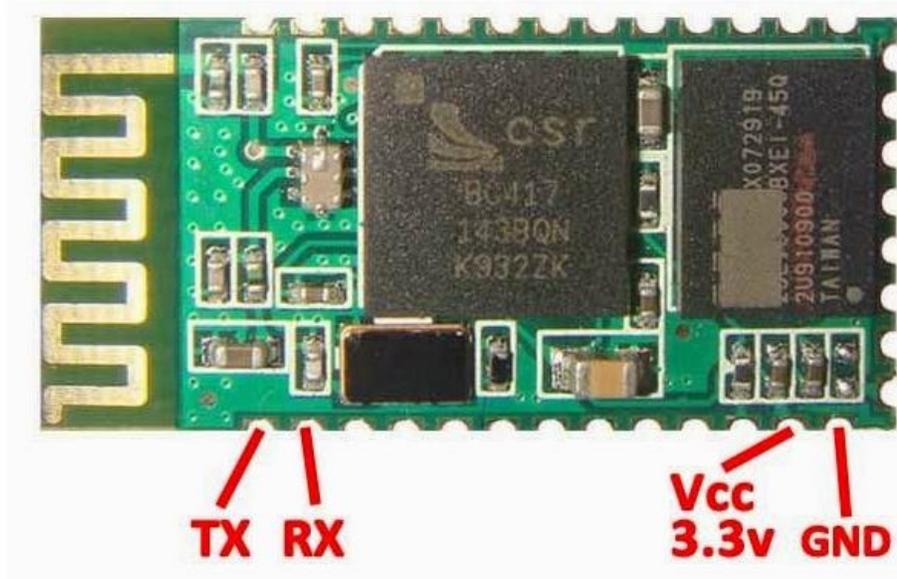
The diagrams below illustrates an ATmega chip acting as a standalone Arduino.



Atmel Datasheet: ATmega328

The DIP package ATmega 328 serves as an ideal MCU for building a rough steampunk style prototype.

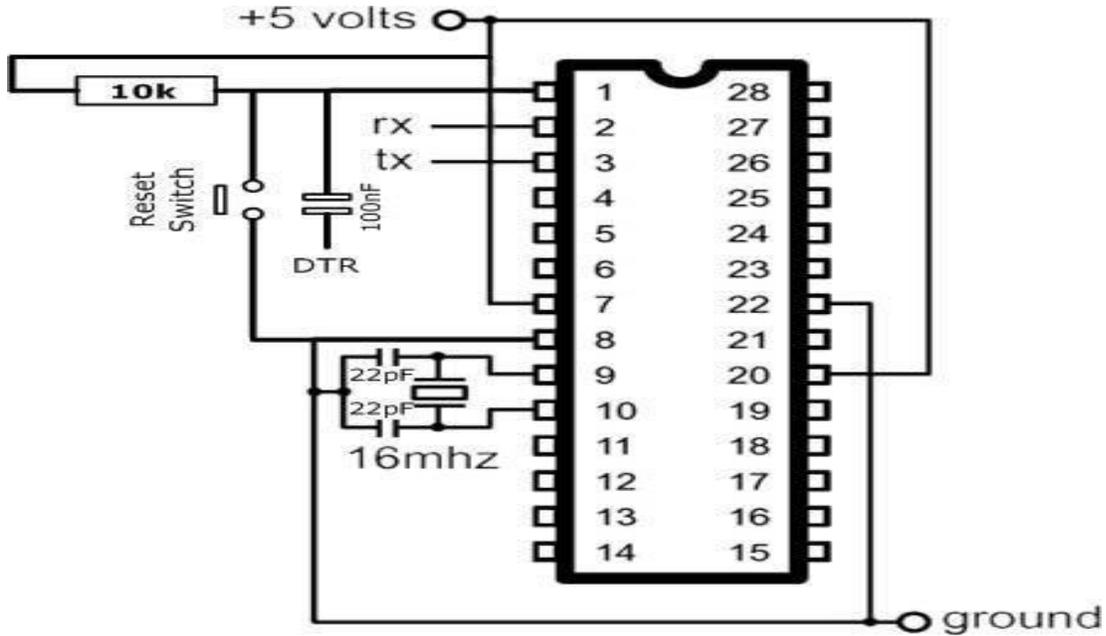
BLUETOOTH MODULE



HC-05 Bluetooth Datasheet: HC-05 Embedded Bluetooth Serial Communication Module
The Bluetooth module that I have chosen to use is the famous HC-05, a module that communicates by sending serial values.

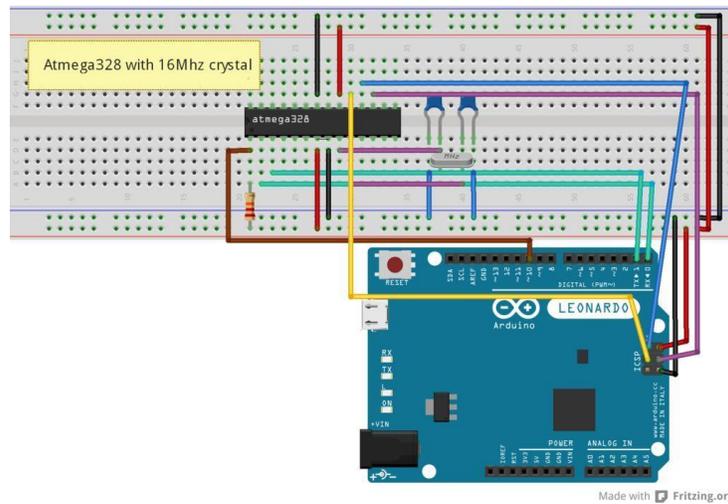
- Finding a Sufficient and Reliable Power Source :

I chose to use a 3.7v (1,000mAh) Lithium battery which I salvaged from a working phone battery. It should last a day or two, powering an ATmega MCU and some peripherals. The voltage was quite low and some of the components needed a minimum of 5v so I added a boost-up regulator with a built in lithium charger. I got one from a powerbank.

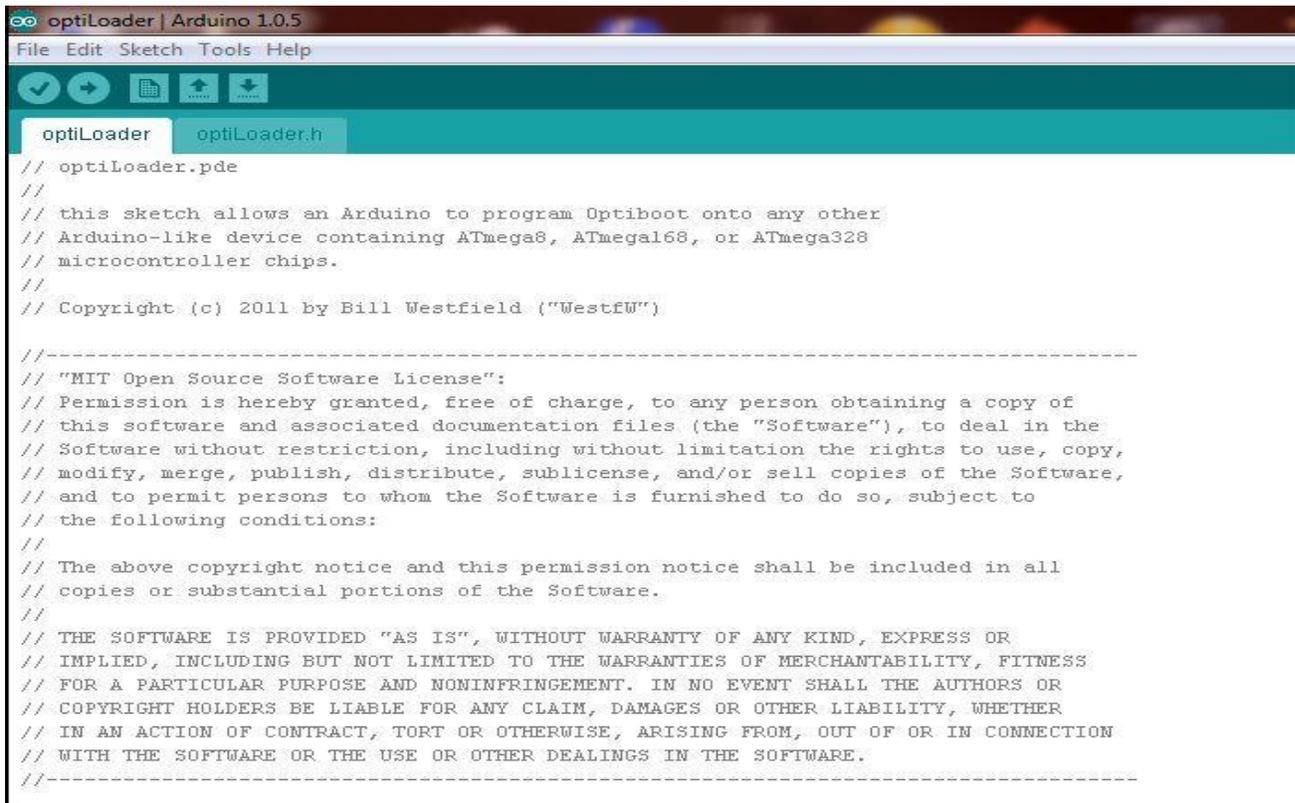


I was supposed to use a Flexible PCB design but there are no services that offered to fabricate those in our country so I decided to build a freestyle (steampunk) standalone Arduino using Atmel's ATmega328 MCU chip. (datasheet found at research page

5-Buning the Bootloader and Uploading the Program;



Name	Date modified	Type	Size
 optiLoader	6/7/2013 3:26 PM	C/C++ Header	1 KB
 optiLoader	6/7/2013 3:26 PM	Arduino file	25 KB



```

optiLoader | Arduino 1.0.5
File Edit Sketch Tools Help
optiLoader optiLoader.h
// optiLoader.pde
//
// this sketch allows an Arduino to program Optiboot onto any other
// Arduino-like device containing ATmega8, ATmega168, or ATmega328
// microcontroller chips.
//
// Copyright (c) 2011 by Bill Westfield ("WestfW")

//-----
// "MIT Open Source Software License":
// Permission is hereby granted, free of charge, to any person obtaining a copy of
// this software and associated documentation files (the "Software"), to deal in the
// Software without restriction, including without limitation the rights to use, copy,
// modify, merge, publish, distribute, sublicense, and/or sell copies of the Software,
// and to permit persons to whom the Software is furnished to do so, subject to
// the following conditions:
//
// The above copyright notice and this permission notice shall be included in all
// copies or substantial portions of the Software.
//
// THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR
// IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS
// FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR
// COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER
// IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION
// WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.
//-----

```

I had temporarily added some wires to burn the Arduino bootloader and program to the standalone Arduino. Here's a tutorial made by a fellow Instructable member: Standalone Arduino / ATmega chip on breadboard

6- Making Some DIY Sensors :

The project is nothing without the sensors. I've managed to make all of them from scratch.

Pulse Rate Sensor:

The pulse rate sensor was made using a photo diode and a RED ultrabright SMD LED. The amount of light reflected to the photodiode varies due to the pressure of blood flowing through the artery (when the heart pumps). The values are read using analogRead() since the sensor is connected to the Arduino's analog pin.

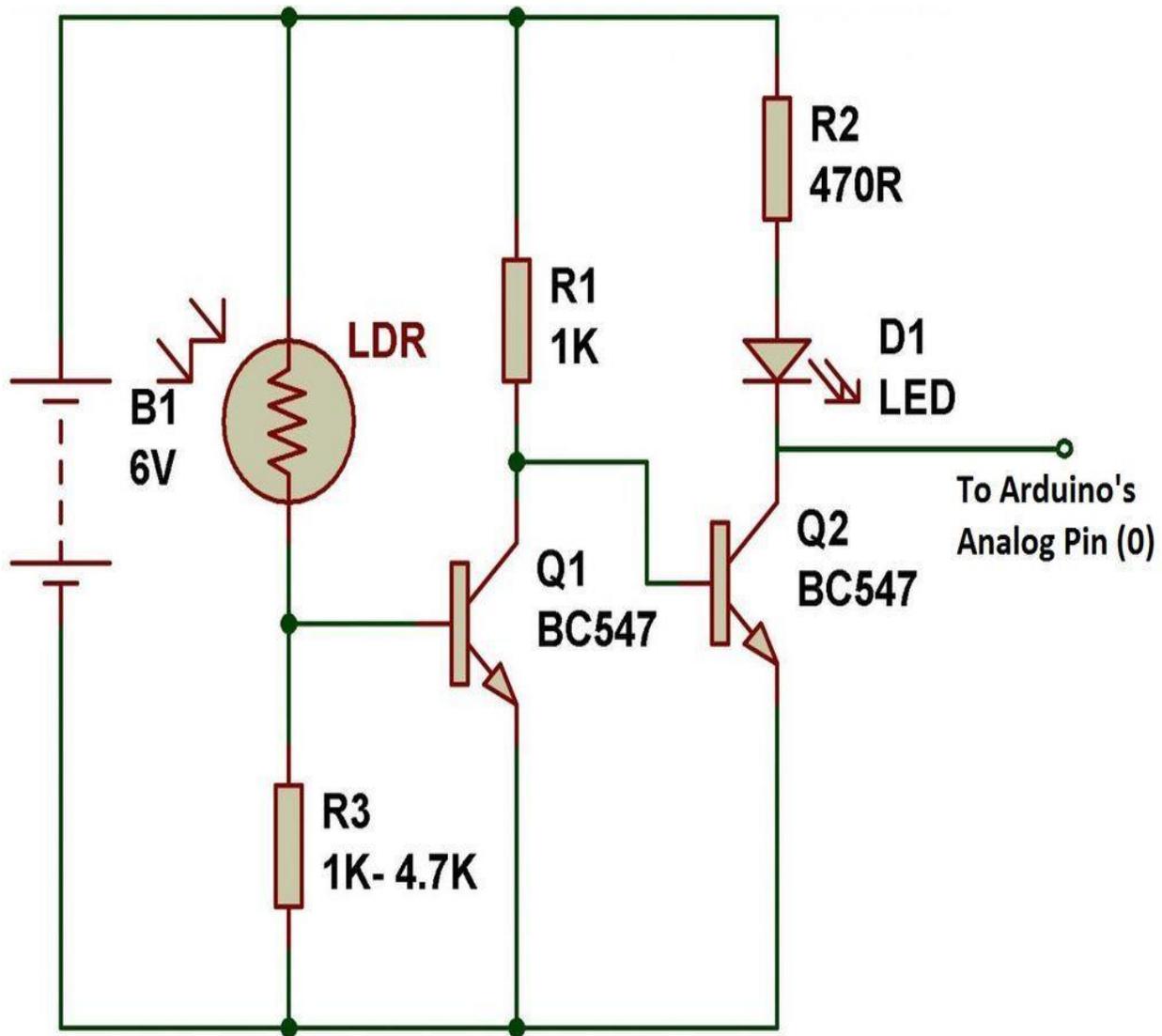
Temperature Sensor:

I've managed to salvage a temperature sensor from an armpit thermometer. The readings of the temperature sensor from the wrist was somewhat different to the ones taken at the armpit, this is due to the variation of heat points of the human body. With little calibration we were able to find

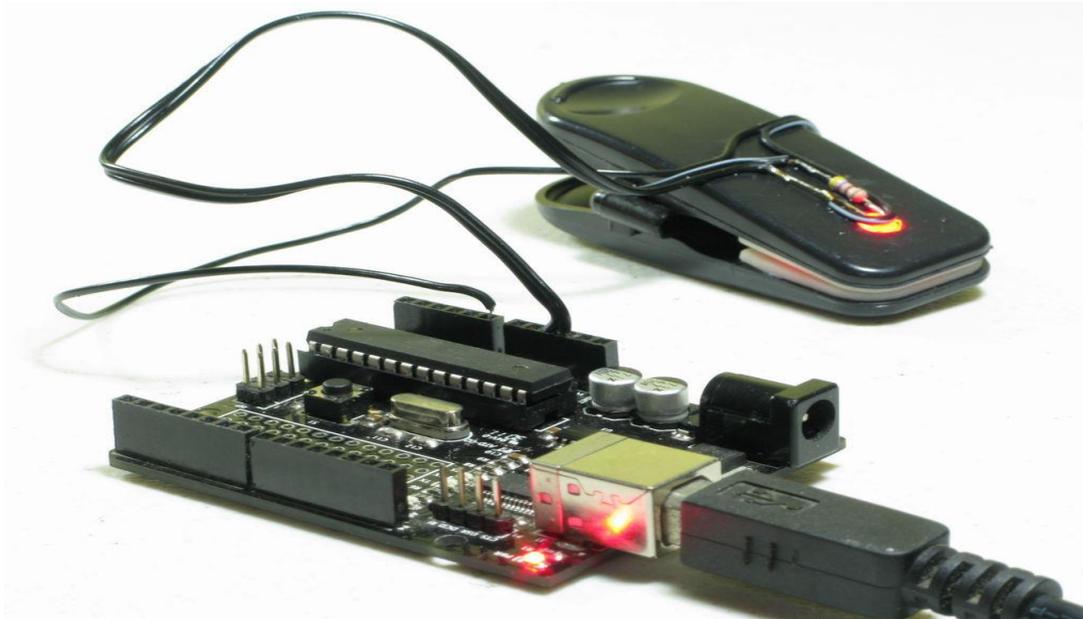
the equivalent values for the wrist temperature. (*Later on we've come to a conclusion that using the temperature sensor was for reference use only and not for alarming medical units due to the fact that it was not medically accurate.)

Voltage divider:

One of our fears were if the HealthBand was to run out of batteries, it could give out false readings and we could confuse that as an indication of the patient's death. We added a voltage divider to track the current battery status, so that we could tell whether the 0 (zeros) from the app monitor is an indication of an emergency or if the 0 (zeros) were only displayed due to the low bat status. Before we move on to the app designing process, we just had to go through the pre-testing stage. The pre-testing process was done by using two Arduinos, the HealthBand and a separate Arduino Board. I used another Bluetooth Module as the slave for the HealthBand's Bluetooth (Master). The softwares I used were the Arduino IDE and



and the Processing™



The previous step was based on a project I conducted a year ago.

My: Homebrew Arduino Pulse Monitor

Some of the codes were given, but as said before we won't be giving the full version yet for some reasons.

7- Designing the Android App ;



Thomas, the guy whom I had a collaboration with is currently making a video tutorial and demo on this. I'm the hardware guy, you'll just have to wait for his words.

Results:

To test the effectiveness and reliability of the project, I compared the readings to medically certified instruments. With the help of my dad, I was able to get access to some of the hospital's medical instruments such as the EKG and the Body Temperature Monitor.

The project had some errors and misreadings. One was the body temperature. The project read it as 36.2° Celsius (wrist temp) while the medical grade thermometer read it as 36.8° Celsius (armpit temp). There was a small small discrepancy. In the end, we were able to fix it by recalibration. I found out that the temperature reading capability of the project I not medically accurate thus it could only be used for reference. The pulse monitor on the other hand was fairly accurate and was able to acquire almost the same reading in comparison to the EKG from the hospital where my dad works. I was also able to test the project while we were away from home. The app kept us updated every 30s. To avoid having data charges, we limited the live monitor to refresh every 30s.

The "summary" (refer to the photo) in the app is designed to display "low pulse rate, warning!", "high pulse rate, warning!", "low body temperature, warning!" "high body temperature, warning!" or combinations of the different warnings. We weren't able to test the "summary" since we haven't had troubles with the test subject. Removing the HealthBand wouldn't simulate death (no pulse), since we added a fail safe switch to prevent the HealthBand from giving misreadings.

Conclusion:

In conclusion, I succeeded in building a working prototype of the HealthBand while my friend was able to create a working Android app. The HealthBand was able to sync successfully to the mobile app.

The project had some errors and misreadings. One was the body temperature. The project read it as 36.2° Celsius (wrist temp) while the medical grade thermometer read it as 36.8° Celsius (armpit temp). There was a small small discrepancy. In the end, we were able to fix it by recalibrating. I found out that the temperature reading capability of the project I not medically accurate thus it could only be used for reference. The pulse monitor on the other hand was fairly accurate and was able to acquire almost the same reading in comparison to the EKG from the hospital where my dad works. In the end we were able to refine the project. We added fail-safes to prevent the project from making false readings. The project was a success and met out goal. My aim is to build a better prototype next year, equipped with sphygmomanometer for reading the blood pressure. The project has a long way to go. It must go through lots of regulations, research, testing and redesign. Though aimed to be ambitious, the concept is present and was proven to be possible by a working prototype of both hardware and software. Hospitals can build much sophisticated systems and much organized systems for monitoring outpatients. Thank you for your time!

References:

- [1] <http://www.hopkinsmedicine.org/healthlibrary/condi...>

- [2] <https://www.instructables.com/id/Homebrew-Arduino-P...>
- [3] <https://www.instructables.com/id/Homebrew-Arduino>
- [4] <https://www.instructables.com/id/Homebrew-Arduino-P...>
- [5] <http://www.cdc.gov/nchs/fastats/leading-causes-of>.
- [6] <https://www.instructables.com/id/Homebrew-Arduino-P...>
- [7] http://en.wikipedia.org/wiki/Emergency_medical_se
- [8] <https://www.instructables.com/id/Homebrew-Arduino-P...>
- [9] <http://en.wikipedia.org/wiki/Electrocardiography>
- [10] <https://www.instructables.com/id/Homebrew-Arduino-P...>
- [11] http://en.wikipedia.org/wiki/Heart_rate
- [12] <https://www.instructables.com/id/Homebrew-Arduino-P...>
- [13] <http://www.doh.gov.ph/licensing/mndrd.html>
- [14] <https://www.instructables.com/id/Homebrew-Arduino-P...>