DEPARTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING

SHREE L. R. TIWARI COLLEGE OF ENGINEERING,

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UNIVERSITY OF MUMBAI

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Project Report on

HEARTBEAT RATE DETECTOR

SUBMITTED BY

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UNDER GUIDANCE OF

***PROF*. Hemangi Satam**

SHREE L.R. TIWARI
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CERTIFICATE

This is to certify that the requirements for the project entitled "**HEARTBEAT RATE DETECTOR**" have been successfully completed by following T.E. EXTC students.

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in partial fulfillment of Mumbai University in the Department of Electronics & Telecommunication Engineering, Shree L. R. Tiwari College of Engineering, Mira Road (E), Thane–401107 for Academic year 2015-2016.

Internal Examiner **External Examiner**

H.O.D
Department of Electronics & Telecommunication Engineering

ACKNOWLEGDEMENT

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We would also like to express our gratitude towards our **HOD Prof. Ravish Singh** for giving us such attention and time and also constant supervision as well as for providing necessary technical information regarding the project and also for his support in completing the project.

Our special thanks and appreciations also goes to our project supervisor **Prof.Mrs. Hemangi Satam** who has willingly helped us out with her abilities which helped us in our project presentation. We would like to extend our sincere thanks to her.

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INTRODUCTION

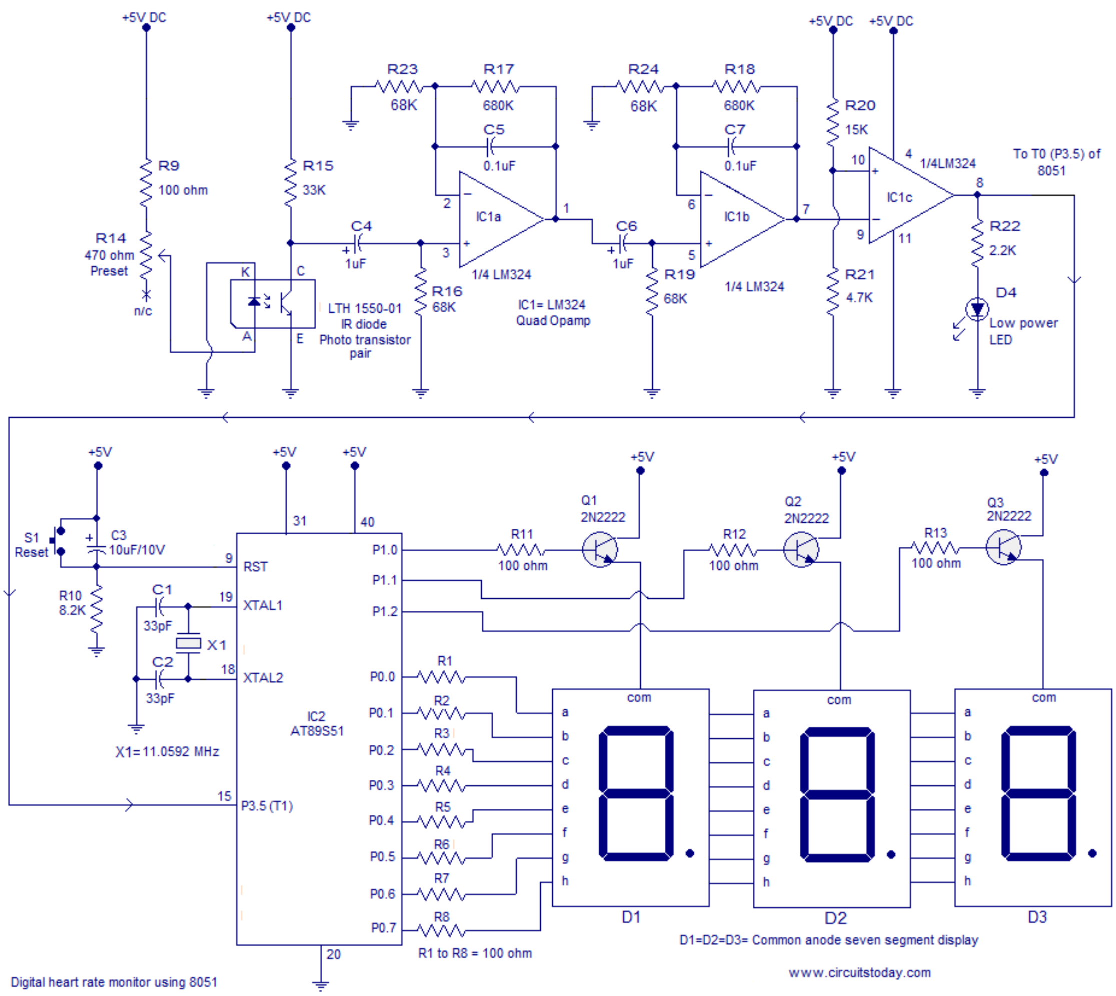
ABSTRACT

Heart rate is a very vital health parameter that is directly related to the soundness of the human cardiovascular system. This project describes a technique of measuring the heart rate through a fingertip using a PIC microcontroller. While the heart is beating, it is actually pumping blood throughout the body, and that makes the blood volume inside the finger artery to change too. The reflected signal is detected by photodiode sensor. This fluctuation of blood can be detected through an optical sensing mechanism placed around the fingertip. The signal can be amplified further for the microcontroller to count the rate of fluctuation, which is actually the heart rate.

Therefore, a two stage high gain, active low pass filter is designed using two operational amplifiers to filter and amplify the signal to appropriate voltage level so that pulses can counted by microcontroller. The heart rate is than displayed on a 3 digit seven segment display. The microcontroller used in this project is PIC16F628A

HARDWARE DETAILS

CIRCUIT DIAGRAM



CIRCUIT DIAGRAM DESCRIPTION

This project describes a microcontroller based heart rate measurement system that uses optical sensors to measure the alteration in blood volume at fingertip with each heartbeat. The sensor unit consists of an infrared light-emitting-diode (IR LED) and a photodiode, placed side by side as shown below. The IR diode transmits an infrared light into the fingertip (placed over the sensor unit), and the photodiode senses the portion of the light that is r Heart rate is the number of heartbeats per unit of time and is usually expressed in beats per minute (bpm). In adults, a normal heart beats about 60 to 100 times a minute during resting condition. The resting heart rate is directly related to the health and fitness of a person and hence is important to know. You can measure heart rate at any spot on the body where you can feel a pulse with your fingers. The most common places are wrist and neck. You can count the number of pulses within a certain interval (say 15 sec), and easily determine the heart rate in bpm.

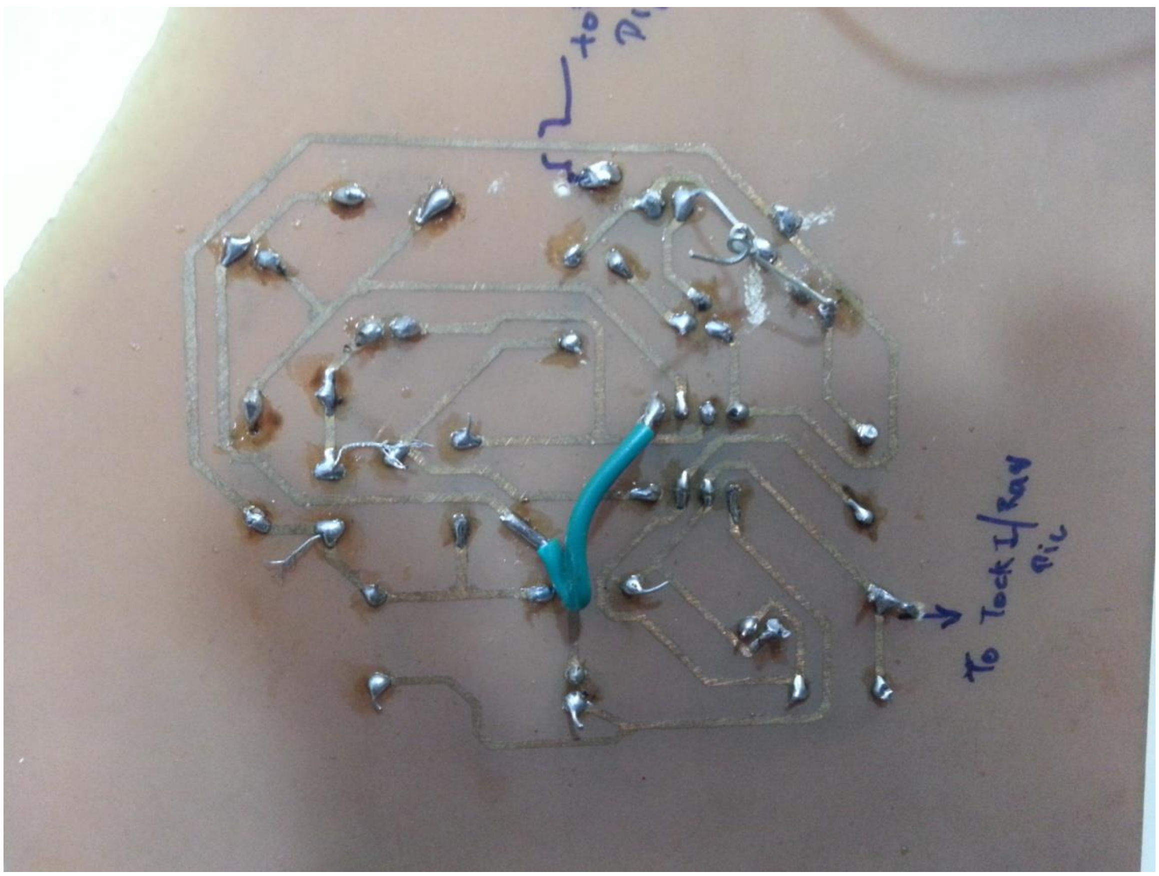
COMPONENT LIST

R	330Ω,10kΩ,680kΩ,6.8kΩ, 68kΩ.
C	0.1uf,22pf,100nf,1uf.
CRYSTAL OSCILATTOR	4MHZ
POWWR SUPPLY	5V
DIODES(2 PAIRS)	BC547
TRANSISTORS(3 PAIRS)	BC557

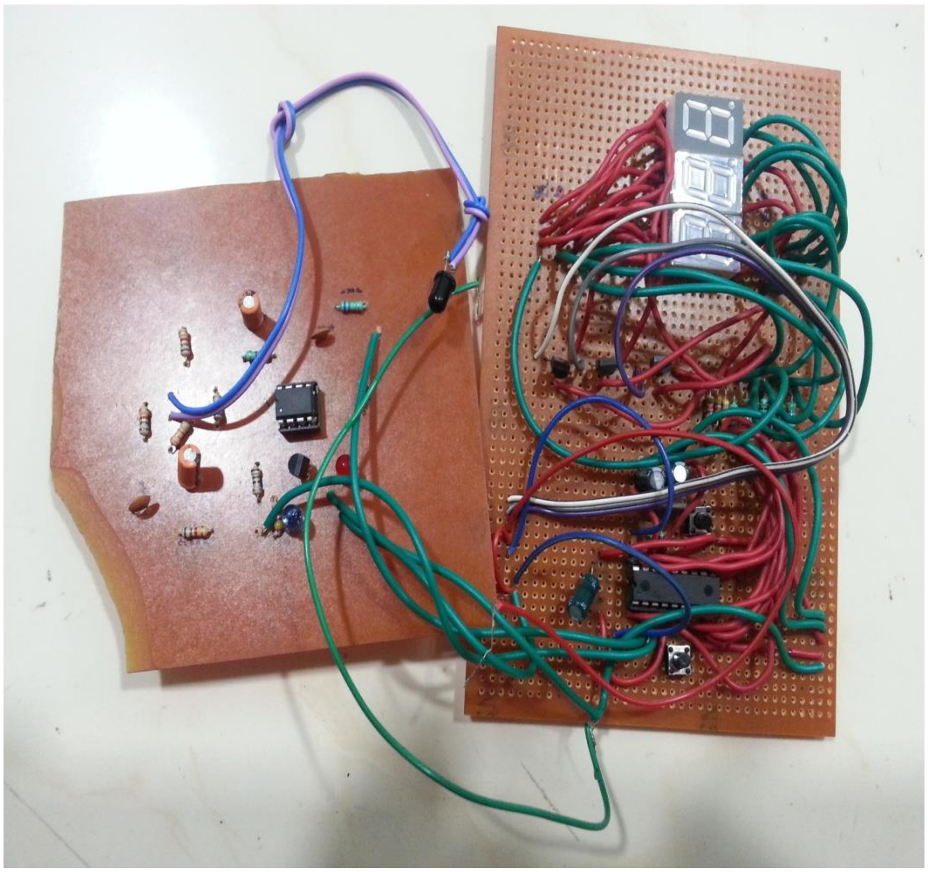
- PIC16F628A.
- 3 Digit seven segment display.
- Clock switch.
- IR diode, photodiode.
- MCP602.

PCB LAYOUT

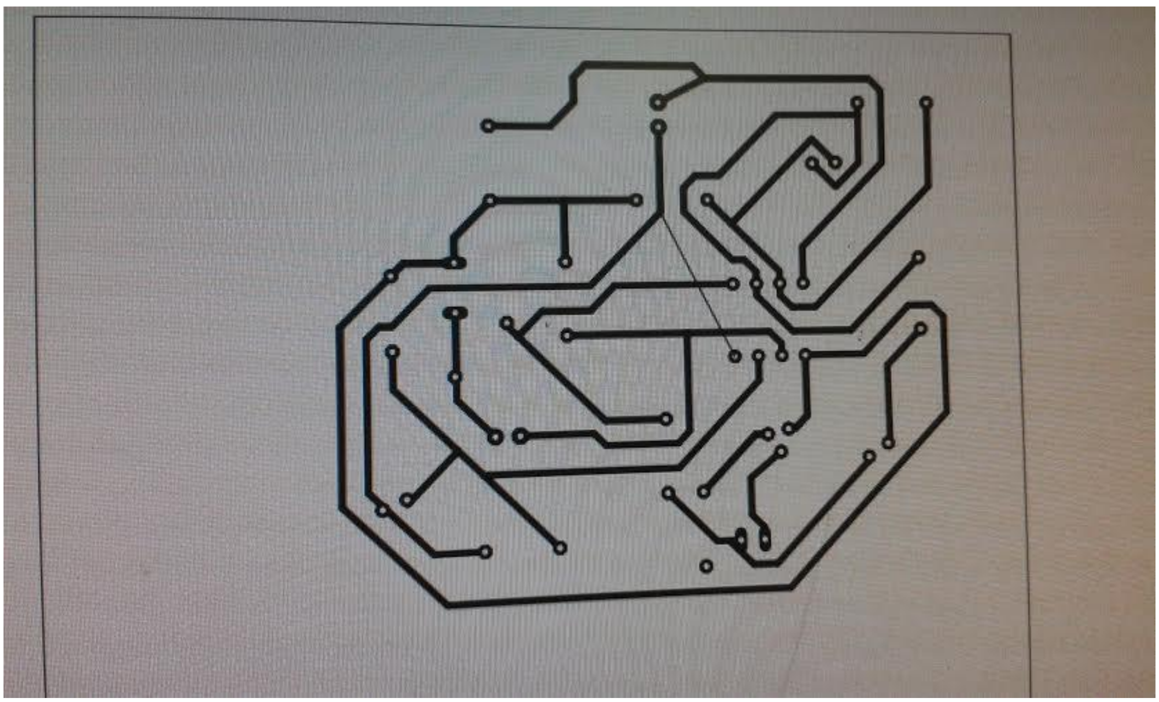
TRACK SIDE (COPPER SIDE)



COMPONENT SIDE



PCB LAYOUT



PCB DESIGNING

DESIGN:

Select your method of imprinting the circuit schematic on the copper board. You can do this either using a Sharpie for a simple circuit or a printed out version from a computer program. Only one of these is needed, so select according to your preference. Draw the circuit schematic on either graph paper or a simulation programs suchas MultiSlim or Eagle Cad. The schematic should contain a detailed description of all parts, as well as easy to follow connections. If a simulation program is being used, test the circuit thoroughly in the simulated environment. If no simulation program is used, assemble and test one or more prototypes of the circuit on a breadboard. Breadboards are very easy to use, and allow one to view the results of a circuit in real time without the need for solder or permanent etches. Make sure the circuit functions on the breadboard, or in the simulation software. Acquire a circuit board. Circuit boards are about a dollar a piece, and are simply a layer of copper over an insulator. The typical size is usually 3.5 inches (8.9 cm) by 5 inches (12.7 cm). Drawing is simple; all that is required is an indelible marker, such as a Sharpie. A ruler is also helpful. Draw out your circuit on your board with the Sharpie .Note that it's really difficult to draw out a circuit design in reallife, unlessit's as simple as a led and a battery. Keep in mind that copper cannot be between components, for example, if connecting an LED, there must be a gap in the copper between the positive and negative points of connectivity. Without a gap, the electricity would flow around the LED, as opposed to through it. Remember laws of electricity, all circuits must end at either a negative or ground, or no current will flow. Use thin lines, but lay the ink on thick, it is important that the copper is dissolved before the ink, and that there are no thin patches in the ink exposing copper.

ETCHING PROCESS:

Put on old clothes, gloves and safety goggles. Warm the ferric chloride, stored in a non-corrosive jar and sealed with a non-corrosive lid, in a bucket of warm water. Do not heat it above 115 F (46 C) to prevent toxic fumes from being released. Use plastic tongs to lay the circuit board face down on the risers in the tray. Allow 5 to 20 minutes, depending on the size of your circuit board, for the exposed copper to drop off the board as it etches away. Use the plastic tongs to agitate the board and tray to allow for faster etching if necessary. Wash all the etching equipment and the circuit board thoroughly with plenty of running water. Drill 0.03 inch (0.8 mm) lead component holes into yourcircuit board with high-speed steel or carbide drill bits. Wear safety goggles and a protective mask to protect your eyes and lungs while you drill. Scrub the board clean with a scouring pad and running water. Add your board's electrical components and solder them into place.

ASSEMBLY:

Gather the following tools:

- Hand-held Drill or Drill Press
- Various drill bits
- Soldering iron
- Solder
- Before drilling, locate all the positions of the through-hole components. Copper dust are toxic, wear a dust mask. Drill through the board with a bit wide enough to accommodate whatever part must be placed at that location. Remember not to make the hole to wide, or soldering will be very difficult.
- There are two types of components: Through hole components (have long legs) and SMDs (surface mount devices). For SMDs you don't need to drill because they are surface mounted, but through holes need holes in order for them to be soldered on. Through hole components enter the board from the opposite side of the copper.

- Place the components on to the circuit board at their designated locations. Gently bend the legs of the component against the underside of the board, to hold the part in place. Make sure parts with polarity are lined up correctly with the corresponding positive and negative. Check and double-check the location of all parts before soldering.
- Test your circuit board before installing it into its permanent location. Use a multimeter, if possible, to diagnose connection problems. A De-soldering gun can be used to make minor switches and repairs.

SOFTWARE

I. Proteus:

Proteus Virtual System Modelling (VSM) combines mixed mode SPICE circuit simulation, animated components and microprocessor models to facilitate co-simulation of complete microcontroller based designs. For the first time ever, it is possible to develop and test such designs before a physical prototype is constructed .This is possible because you can interact with the design using on screen indicators such as LED and LCD displays and actuators such as switches and buttons. The simulation takes place in real time (or near enough to it): a 1GMHz Pentium III can simulate a basic 8051 system clocking at over 12MHz. Proteus VSM also provides extensive debugging facilities including breakpoints, single stepping and variable display for both assembly code and high level language source.Proteus VSM uses our proven Schematic Capture software to provide the environment for design entry and development. Proteus capture is a long established product and combines ease of use with powerful editing tools. It is capable of supporting schematic capture for both simulation and PCB design. Designs entered in to Proteus VSM for testing can be net listed for PCB layout either with our own PCB Design products or with third party PCB layout tools. The Proteus schematic capture module also provides a very high degree of control over the drawing appearance, in terms of line widths, fill styles, fonts, etc. These capabilities are used to the full in providing the graphics necessary for circuit animation. At the heart of Proteus VSM is ProSPICE. This is an established product that combines uses a SPICE3f5 analogue simulator kernel with a fast event-driven digital simulator to provide seamless mixed-mode simulation. The use of a SPICE kernel lets you utilize any of the numerous manufacturer-supplied SPICE models now available and around 6000 of these are included with the package.Proteus VSM includes a number of virtual instruments including an Oscilloscope, Logic Analyser, Function Generator, Pattern Generator, Counter Timer and Virtual Terminal as well as simple voltmeters and ammeters.

In addition, we provide dedicated Master/Slave/Monitor mode protocol analysers for SPI and I2C - simply wire them onto the serial lines and monitor or interact with the data live during simulation. A truly invaluable (and inexpensive) way to get your communication software right prior to hardware prototyping.

II. Easily Applicable Graphical Layout Editor –EAGLE:

EAGLE, the Easy Applicable Graphical Layout Editor is a powerful PCB design software tailored to meet the needs of professional engineers, makers and those at school! For more than 25 years, EAGLE has been the PCB design tool of choice for hundreds of thousands of electronic design engineers and developers worldwide. With a large and active engineering and support community and an extensive ecosystem, EAGLE offers much more than pure circuit design. The simplicity of the software provides a fast learning curve, even for those new to PDB design. The openness of EAGLE design resources, such as its extensive and fully-open component libraries, ease the design process for all.

The software's flexibility also means EAGLE is ever growing in its capabilities and workflow compatibility, demonstrated by the hundreds of extensions (ULPs) openly available to all users and its structured XML file form.

Code of the Project in C Language:

```
sbit IR_Tx at RA3_bit;
sbit DD0_Set at RA2_bit;
sbit DD1_Set at RA1_bit;
sbit DD2_Set at RA0_bit;
sbit start at RB7_bit;
unsigned short j, DD0, DD1, DD2, DD3;
unsigned short pulserate, pulsecount;
unsigned int i;
//-------------- Function to Return mask for common anode 7-seg.
display
unsigned short mask(unsigned short num) {
 switch (num) {
 case 0 : return 0xC0;
 case 1 : return 0xF9;
 case 2 : return 0xA4;
 case 3 : return 0xB0;
 case 4 : return 0x99;
 case 5 : return 0x92;
 case 6 : return 0x82;
 case 7 : return 0xF8;
 case 8 : return 0x80;
 case 9 : return 0x90;
 } //case end
}

void delay_debounce(){
 Delay_ms(300);
}

void delay_refresh(){
 Delay_ms(5);
}

void countpulse(){
 IR_Tx = 1;
 delay_debounce();
 delay_debounce();
 TMR0=0;
 Delay_ms(15000);  // Delay 1 Sec
 IR_Tx = 0;
 pulsecount = TMR0;
 pulserate = pulsecount*4;
}

void display(){
  DD0 = pulserate%10;
  DD0 = mask(DD0);
  DD1 = (pulserate/10)%10;
  DD1 = mask(DD1);
  DD2 = pulserate/100;
  DD2 = mask(DD2);
  for (i = 0; i<=180*j; i++) {
    DD0_Set = 0;
```

```
DD1_Set = 1;

    DD2_Set = 1;
    PORTB = DD0;
    delay_refresh();
    DD0_Set = 1;
    DD1_Set = 0;
    DD2_Set = 1;
    PORTB = DD1;
    delay_refresh();
    DD0_Set = 1;
    DD1_Set = 1;
    DD2_Set = 0;
    PORTB = DD2;
    delay_refresh();
    }
  DD2_Set = 1;
}

void main() {
 CMCON = 0x07;    // Disable Comparators
 TRISA = 0b00110000; // RA4/T0CKI input, RA5 is I/P only
 TRISB = 0b10000000; // RB7 input, rest output
 OPTION_REG = 0b00101000; // Prescaler (1:1), TOCS =1 for counter mode
 pulserate = 0;
 j = 1;
 display();
 do {
  if(!start){
   delay_debounce();
   countpulse();
   j= 3;
   display();
  }
 } while(1);  // Infinite loop
}
```

APPLICATIONS

- Medical applications(ultra sound, blood pressure monitor etc)
- Android applications(mobile phones)
- During exercise

FUTURE WORK

- Prevent heart attack
- Optical HR accuracy

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