Heart beat sensor simulation in proteus

For (beginners-Part1)

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ABSTRACT

A normal resting heart rate for adults ranges from 60 to 100 beats per minute. Generally, a lower heart rate at rest implies more efficient heart function and better cardiovascular fitness. For example, a well-trained athlete might have a normal resting heart rate closer to 40 beats per minute. a heartbeat is a periodic signal generated by hardware or software to indicate normal operation or to synchronize other parts of a computer system. Usually a heartbeat is sent between machines at a regular interval in the order of seconds. If an endpoint does not receive a heartbeat for a period of time—typically a few heartbeat intervals—the machine that should have sent the heartbeat does not receive data, it is assumed to be down. Heartbeat messages are typically sent non-stop on a periodic or recurring basis from the originator's start-up until the originator's shutdown. When the destination identifies a lack of heartbeat messages during an anticipated arrival period, the destination may determine that the originator has failed, shutdown, or is generally no longer available.

1.INTRODUCTION

Your heart beat is the number of times that your heart beats in a minute. Your body automatically controls your heartbeat to match whatever you're doing or what's happening around you. That's why your heartbeat gets faster when you're active, excited or scared, and drops when you're resting, calm or comfortable. Your beat rate is an important indicator of your overall health too. When your heart rate is too fast or too slow, that can be a sign of heart or other health problems. The ability to feel your heart rate throughout your body is also a potential way for doctors to diagnose medical conditions.

This article, which is part 1 of teaching how the heart rate sensor works, has been tried to be taught in a simple way for beginners. Heartbeat sensor library is used in this project. This part of the project is simulated in Proteus, we have used the heartbeat sensor library for Proteus.

2.What is Heartbeat Sensor?

Heart rate pulse sensor amped is a such type of sensor which is mainly used for sensing heartbeat rate. Normally it is very difficult task to measure the exact heartbeat rate, but this have become so much easy with the help of this pulse sensor amped. If we talk about heartbeat, then heart beat is a periodic signal that is produced by any software or hardware system for giving intimation to normal of working of any system. For measuring this periodic intimation signal, so many sensors have been using currently in market but here we shell only talk about pulse sensor amped. This is basically plug and play heartbeat sensor and have been using by makers, athletes , game developers and students in their hardware projects. It is easily available in market or online shop. A simple heartbeat pulse sensor is shown in figure 1

Figure 1. A Simple Heartbeat Rate Pulse Sensor.

3.Pin Configuration of Heart Rate Pulse Sensor:

Every heart rate sensor consists of three pins first one is ground pin which is used for supplying ground to this sensor and it is connected to source ground pin .Second one is VCC pin which is used for power on this heart rate sensor and it is connected to source VCC pin.

This sensor is powered on at almost 3.3V to 5V dc voltages. Similarly, the last one is A0 pin which is an analogue pin and it is used for receiving analogue signal. The pin configuration of this heart rate sensor is shown in figure 2

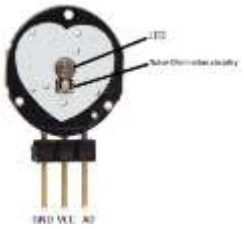
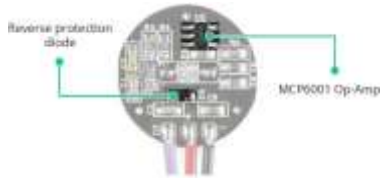


Figure 2 Pin Configuration of Heart Rate Pulse Sensor

According to figure 2 this sensor also consists of a central LED. This LED helps the sensor for detecting heartbeat rate. Beside this, there is another circuitry below LED and this circuitry is called noise elimination circuitry. This circuitry is used for eliminating the noise which effects on the reading of the heart rate pulse sensor. The front of the sensor, with the heart logo, is where you put your finger. You'll also notice a tiny circular opening through which the Kingbright's reverse mounted green LED shines. Just beneath the circular opening is a small ambient light photo sensor – APDS-9008 from Avago. This sensor is similar to the ones used in cell phones, tablets, and laptops to adjust the screen's brightness based on the ambient lighting conditions. On the back of the module are an MCP6001 Op-Amp from Microchip and a few resistors and capacitors that make up the R/C filter network. Additionally, there is a reverse protection diode to prevent damage in the event that the power leads are accidentally reversed.

1. VCC+ is simply the positive rail for a transistor circuit supplying the collector voltage for a circuit using NPN transistors.



The module requires a DC power supply ranging from 3.3 to 5V and draws less than 4mA of current.

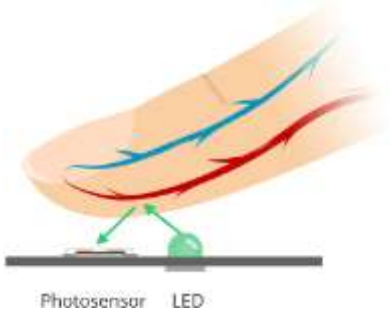
4.Technical Specifications

VCC		3.0-5.5V
Maximum Ratings	IMax (Maximum Current Draw)	< 4mA
	VOut (Output Voltage Range)	0.3V to Vcc
Wavelength	LED Output	565nm
	Sensor Input	525nm
Wavelength	L x W (PCB)	15.8mm (0.625″)
	Lead Length	20cm (7.8″)

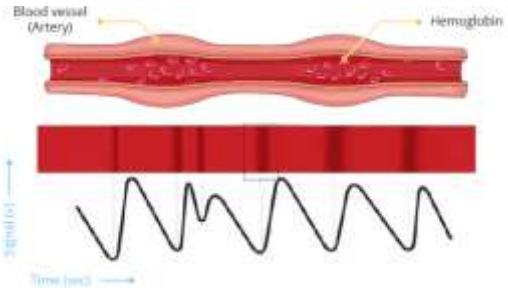
5.Working Principle of Heart Rate Pulse Sensor

The working principle of this heartbeat rate sensor is very simple. If we talk about heartbeat rate, then heartbeat rate is the ratio of time between two consecutive heartbeats. Similarly, when the human blood is circulated in human body then this blood is squeezed in capillary tissues. As a result, the volume of capillary tissues is increased but this volume is decreased after each heartbeat. This change in volume of capillary tissues, effects on the LED light of heart rate pulse sensor, which transmits light after each heartbeat. This change in light is very small but this can be measured by connecting any controller with this pulse sensor.

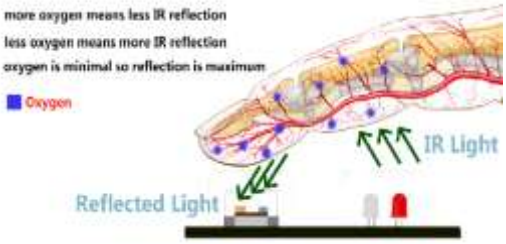
Means, the LED light which have every pulse sensor helps for measuring pulse rate . The working of this sensor could be checked by placing human finger in front of this pulse sensor. When finger is placed in front of this pulse sensor then the reflection of LED light is changed based on the volume of blood change inside capillary vessels. Means during heartbeat the volume of blood in capillary vessels will be high and then will be low after each heartbeat. So, by changing this volume the LED light is changed. This change in of LED light measures the heartbeat rate of finger. The theory behind optical heart-rate sensors is very simple. If you've ever shined a flashlight through your fingers and observed your heartbeat pulsing, the concept of optical heart-rate pulse sensors can be easily grasped.



A pulse sensor, like any other optical heart-rate sensor, works by shining a green light (~ 550nm) on the finger and measuring the amount of reflected light with a photosensor. This optical pulse detection technique is known as a Photoplethysmogram.



The oxygenated hemoglobin in arterial blood has the property of absorbing green light. The redder the blood (the higher the hemoglobin), the greater the absorption of green light. With each heartbeat, blood is pumped through the finger, causing a change in the amount of reflected light, which in turn produces a waveform at the photosensor's output. As you keep shining light and taking photosensor readings, you quickly begin to obtain a heart-beat pulse reading. This signal from the photosensor is typically small and noisy; therefore, it is passed through an R/C filter network and then amplified with an Op-Amp to create a signal that is significantly larger, cleaner, and easier to detect.



The pulse sensor shines light through the skin and measures the reflection with the photodetector. This method of pulse detection through light is called Photoplethysmogram. The working of the sensor can be divided into two parts, one is heart rate measurement and another is blood oxygen level measurement.

6.Pulse Sensor Pinout

The sensor comes with a 24″ flat ribbon cable with three male header connectors. The pinout is shown in the figure below.

7.Heart Beat Sensor Library for Proteus

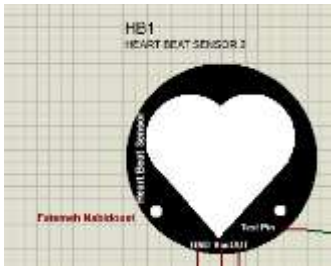
The heart rate sensor is a very important sensor to monitor the heart rate when we use an electronic medical device to measure the heart rate instead of counting through the finger by placing the pulse on it to count the number of beats. This is the sensor where the red and black wires are for VCC+1 and the purple is for data. The heartbeat sensor library is very important for an electronics engineer to simulate or test their design, so click on the link below to download the library.

https://github.com/electronic-astro/HEART-Beat-Library/

8.Start Work

Now open your Proteus software or restart it if it's already opened. In the components section, search for Heart Beat and you will find two results as shown in the below figure:

Now place it in your Proteus workspace and it will look exactly like the old one, as shown in below figure: As you can see, we have four pins on it.

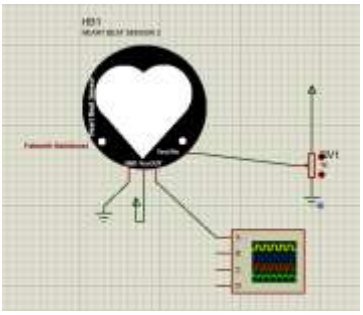


in this version, we can change How fast or slow the heart is beating by changing the voltage at TestPin.

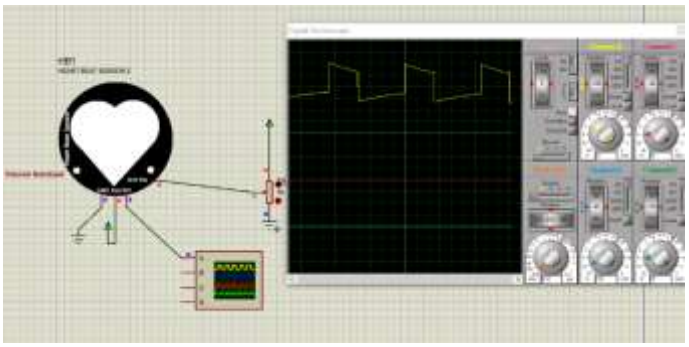
TestPin voltage must vary between 0 to 5.

So, when you apply like 1V then Heart Beat will be Fast and when will you apply 4V then it will be very slow.

OUT Pin will give us the Heart Beats, so when there's a beat OUT will be HIGH otherwise LOW. Now design a simple circuit as shown in the below figure:



So, now let me run this simulation and show you the results on our Proteus Oscilloscope:



I hope you will enjoy it. Will meet you guys in the next tutorial. Till then take care and have fun