# ECG to Detect Heart Arrhythmia

Pouya Rassouli, Michael Fong, Allen Earley,
Rishab Madabhushanam, Sujit Tunuguntla

# Heart Arrhythmia

- Heart Arrhythmia occurs when the heartbeat becomes irregular
- There are two main types of heart arrhythmias:

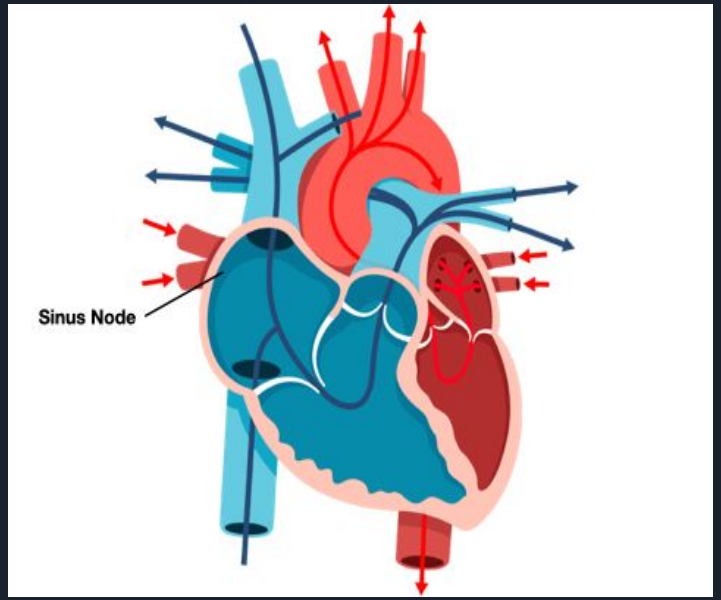
  1) Tachycardia: Resting heart rate is over 100 bpm

  2) Bradycardia: Resting heart beat is below 60 bpm

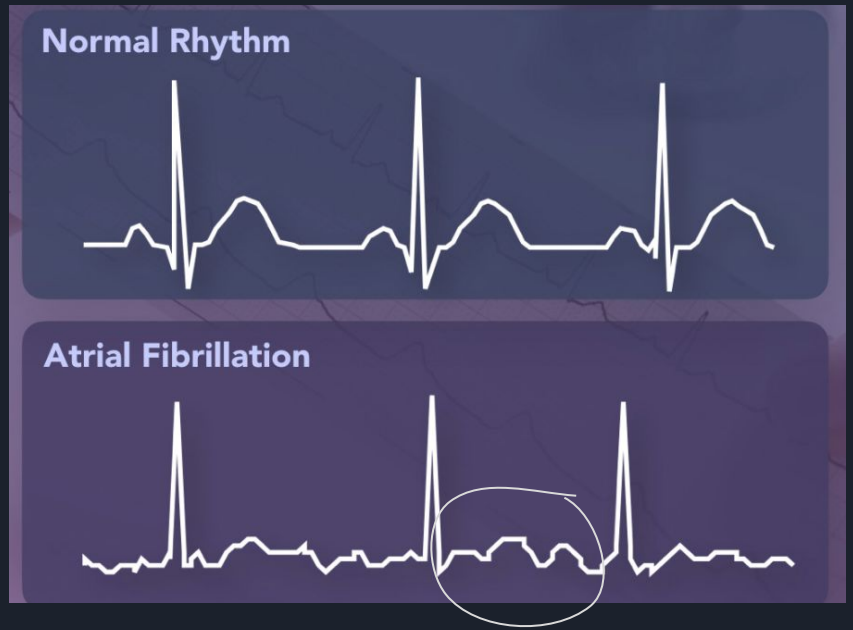
- Some arrhythmias have no symptoms, others include palpitations, lightheadedness, shortness of breath, and fainting.
- Usually occurs in older people, can be effectively treated but can also be fatal or cause a stroke or heart failure.
- Since arrhythmias occur with relation to electrical conduction coming from the heart, there are ways that they can be tested for and treated as well.
- One method that this can be done is by using an ECG (electrocardiogram)
- We developed an ECG circuit to help detect  atrial fibrillation(Afib), the most common form of heart arrhythmia

# Atrial Fibrillation

- Atrial fibrillation is an irregular heartbeat rhythm that is very rapid, over the normal range of bpm.
- It can increase the risk of stroke and lead to the formation of blood clots in the heart
- Can last for less than a week, but can also last for longer if it’s a form that's difficult to treat.
- Bioelectrical signals cause Afib to start in four pulmonary veins that carry blood from the lung to the Left Atrium
- If the atrioventricular node doesn’t stop these signals from entering the heart ventricles, the heart will continue to beat irregularly fast.
- Can use what we know about these bioelectrical signals to help us design a circuit for an ECG



# Afib ECG vs. Normal ECG




- The initial upward pulse of the signal is called the P wave. In a normal heart, there is P wave before the next upward spike (called the QRS complex)
- In the Afib ECG wave, you can see that there are more tiny fibrillation waves with varied amplitude, rather than one distinct P wave before the QRS complex occurs, these are called f-waves
- This is the primary difference between a normal heart ECG and a normal heart ECG.

# General Circuit Design

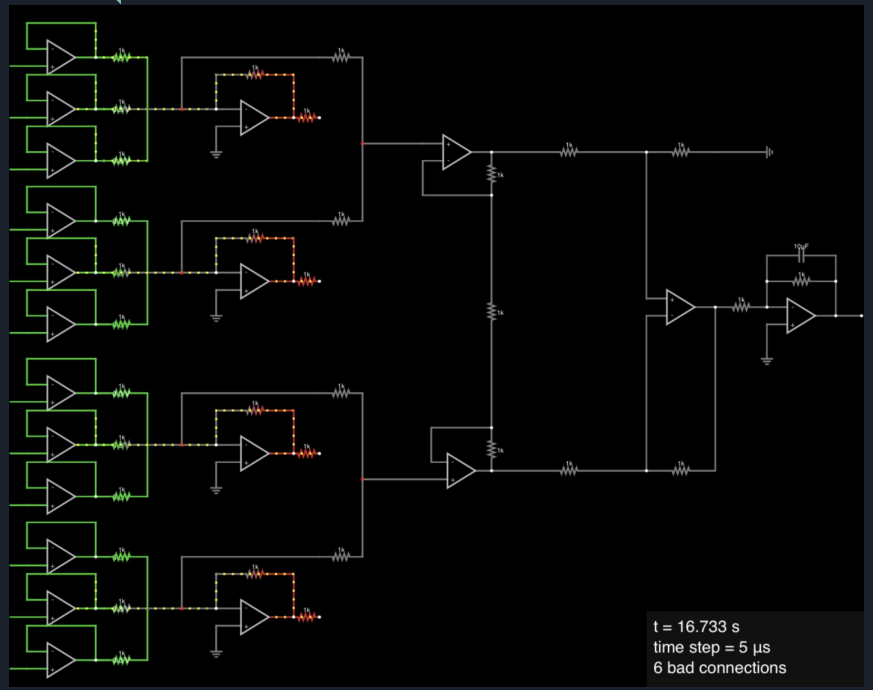
-Using an ECG design to notify user of atrial fibrillation detection

-6 frontal lead ECG with voltage measurements from RA, LA, LL, and RL

-Cascade of second order low-pass and high-pass filters to form a bandpass filter  for desired range of frequencies

-Bandpass filter output passes through comparator to signal the LED to light up if needed

# Driven right leg Circuit and Instrumentation Amplifier

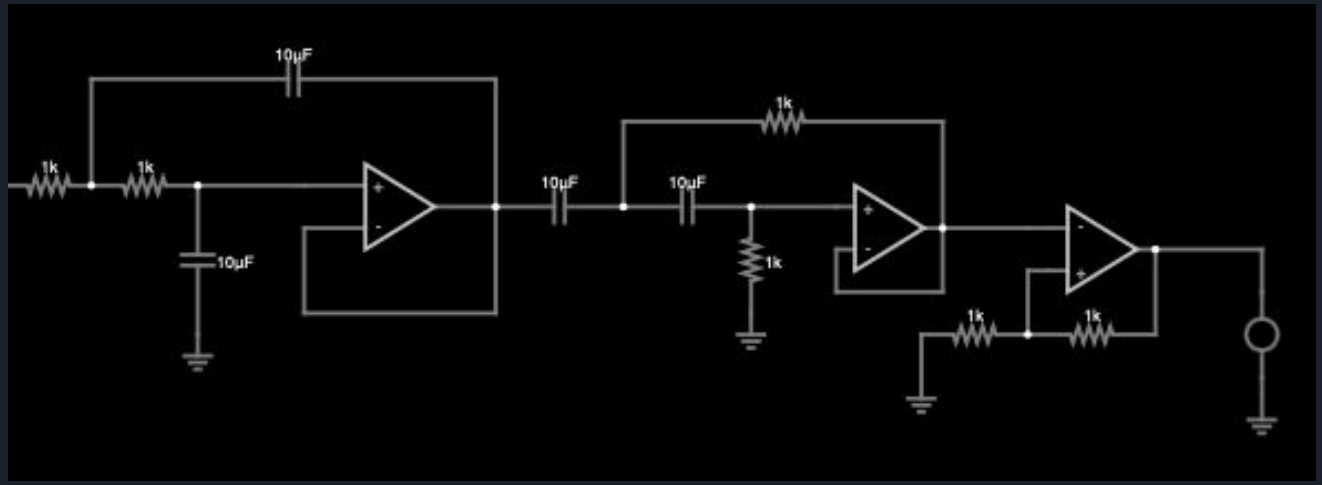



-Leads connect to the right arm, left arm, and left leg to collect voltage

-Connection to left leg to reduce common-mode interference

-Instrumentation amplifier provides high gain for low signals

# Bandpass Filter + Comparator & LED




- Usage of a band-pass filter to condition our signal for our desired frequencies.
- Voltage output of the filter will pass to the hysteretic  comparator and using specified resistor values for the comparator we will be able to set when the LED will turn on.

# Advantages & Limitations

Advantages

- Usage of silver-chloride electrodes onto patient's skin will allow the signal strength of the electrodes to increase by reducing skin resistance.
- Usage of the band-pass filter allows us to target the ideal frequency range for detecting atrial fibrillation.

Limitations

- Heart rate range of atrial fibrillation may overlap with other form of tachycardia.
- Usage of active filters may cause issues of inaccuracy if correct components or component values are not chosen.
- Only detects one from of heart arrhythmia.

# References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