INTELLIHEART
TECHNOLOGIES

Cardiac Arrythmia Detection

Using Machine Learning Techniques

Our Agenda for Today

LIST OF KEY CONCEPTS

- What is Cardiac Arrythmia?
- Electrical Activity in the Heart.
- Some Examples of ECG Signals
- Our Machine Learning Model
- Gene Editing on Humans
- Moral Considerations

Cardiovascular diseases are the number 1 cause of death globally, taking an estimated 17.9 million lives annualy.

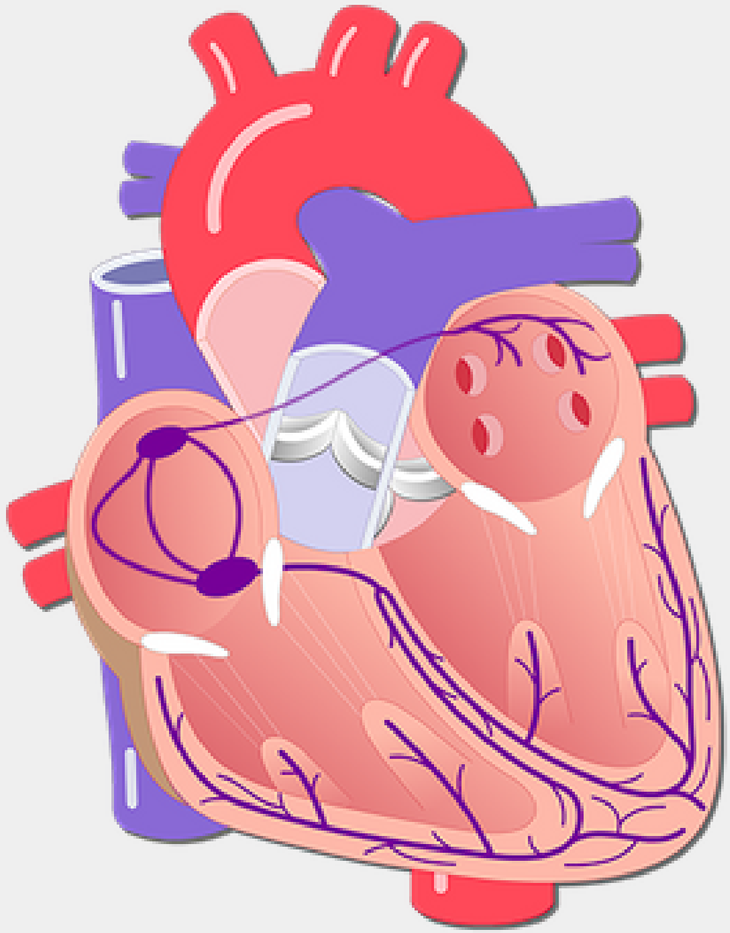
- World Health Organiztion

What is cardiac arrythmia?

IN A NUTSHELL - IRREGULAR HEARTBEATS

It is a group of conditions where the heartbeat is too slow, too fast or irregular.

Electical Activity in the Heart

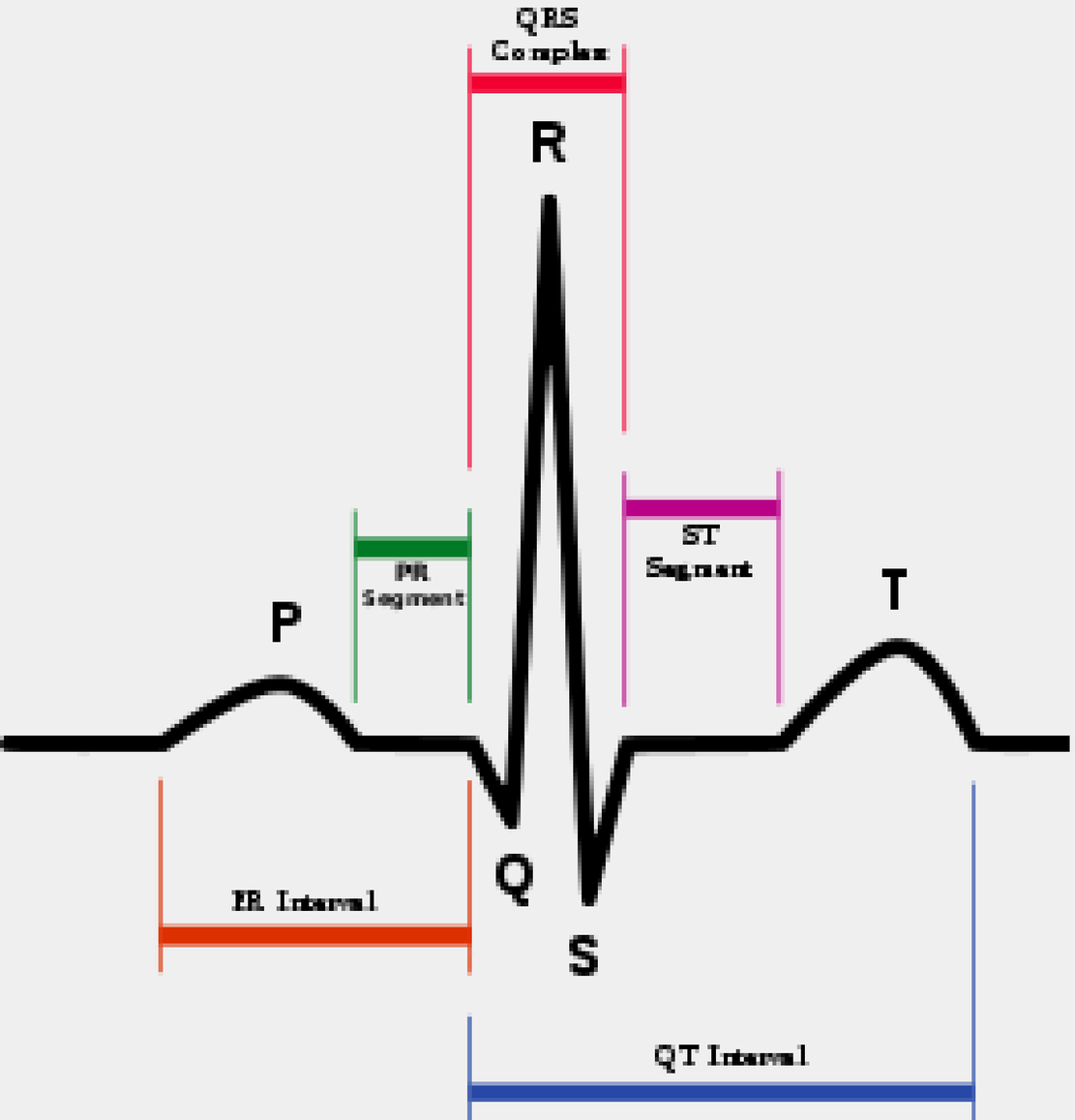


Heartbeats are triggered when electrical signals travel down the SA Node, AV Node and the Bundle of His

The ECG

detects and amplifies, the tiny electrical signals that the heart produces as when the heart muscles contract.
Extremely useful but a lot of expertise is required for effective diagnosis.

ECG Signals



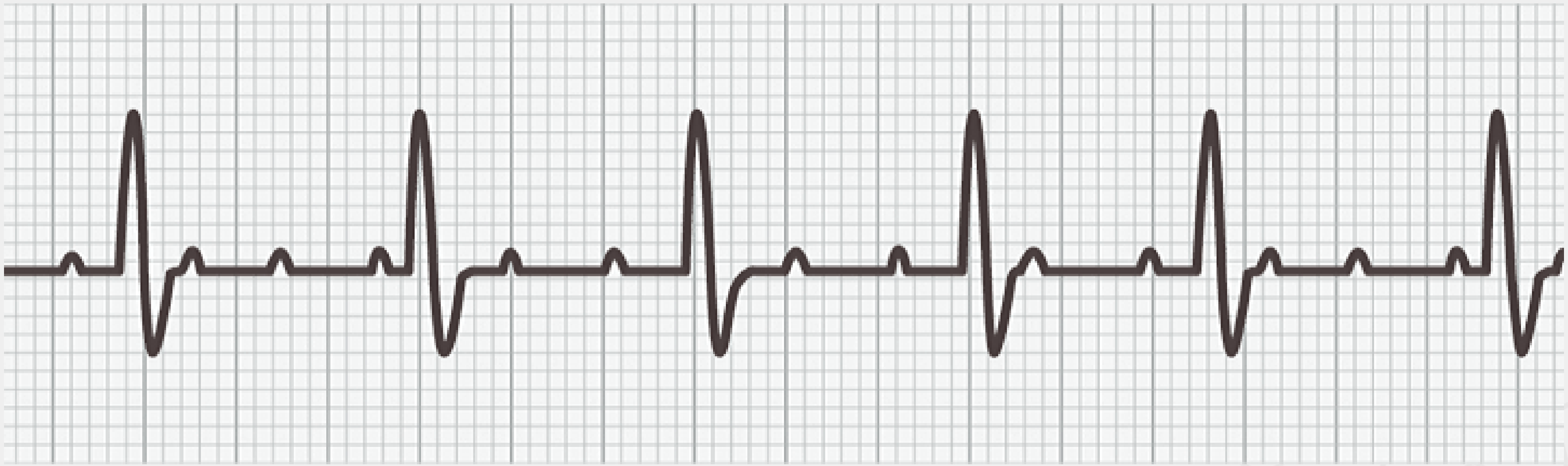
P Wave - Atrial depolarization (activation)
QRS Complex - Ventricular depolarization
ST Segment - Repolarization (deactivation)

By studying the patterns that occur between these waves, we can correctly diagnose heart conditions.

ECG Signal Examples

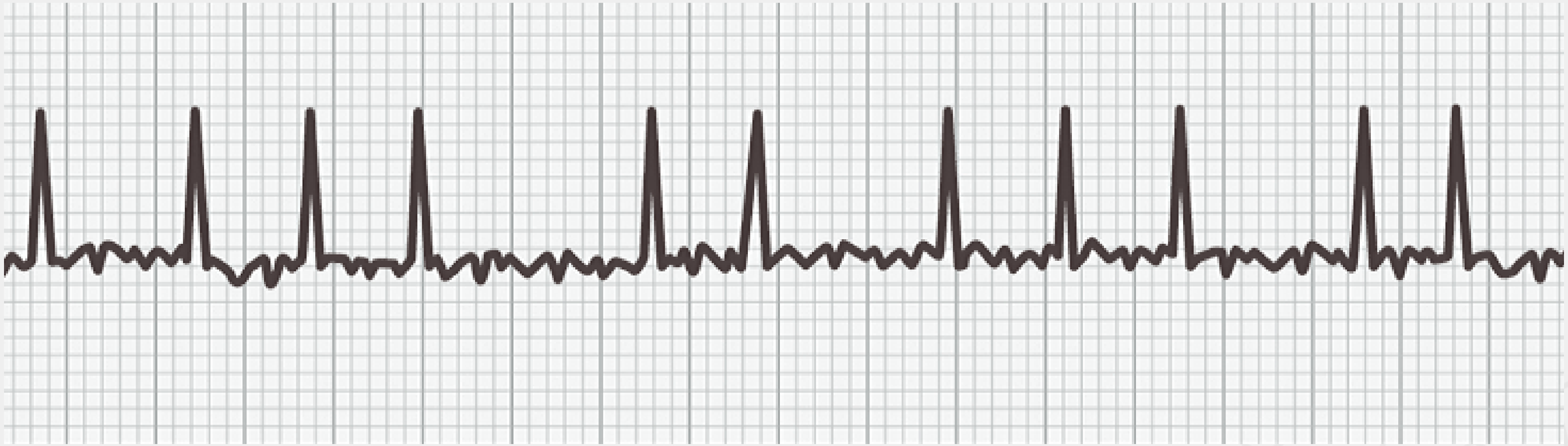
Normal Hearbeat

ECG Signal Examples



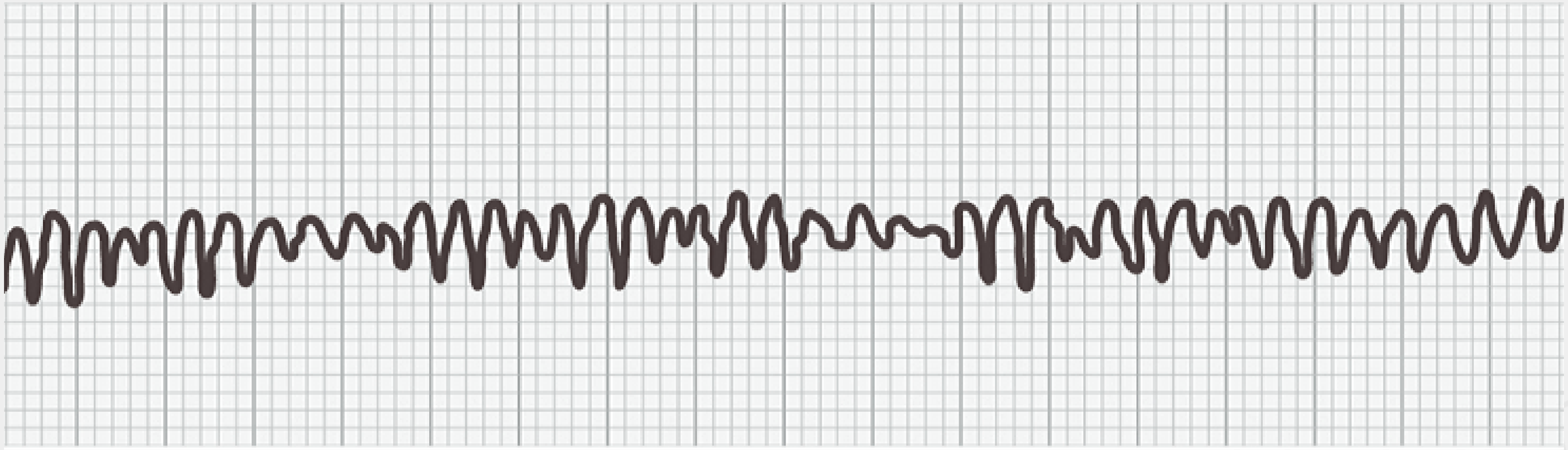
Second Degree Partial Block

ECG Signal Examples



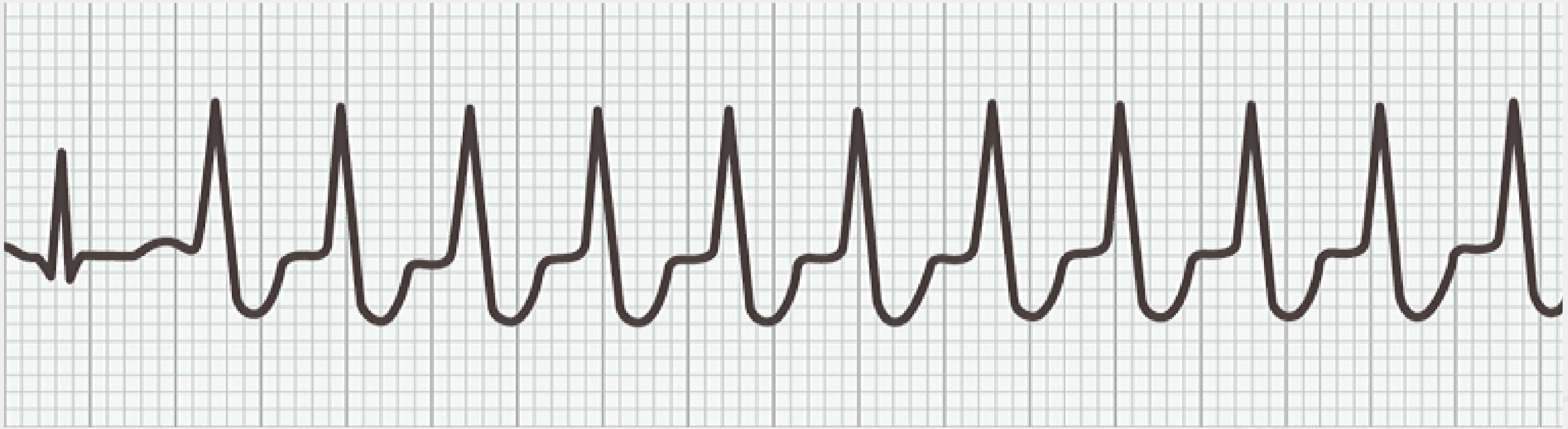
Atrial Fibrillation

ECG Signal Examples



Ventricular Fibrillation

ECG Signal Examples

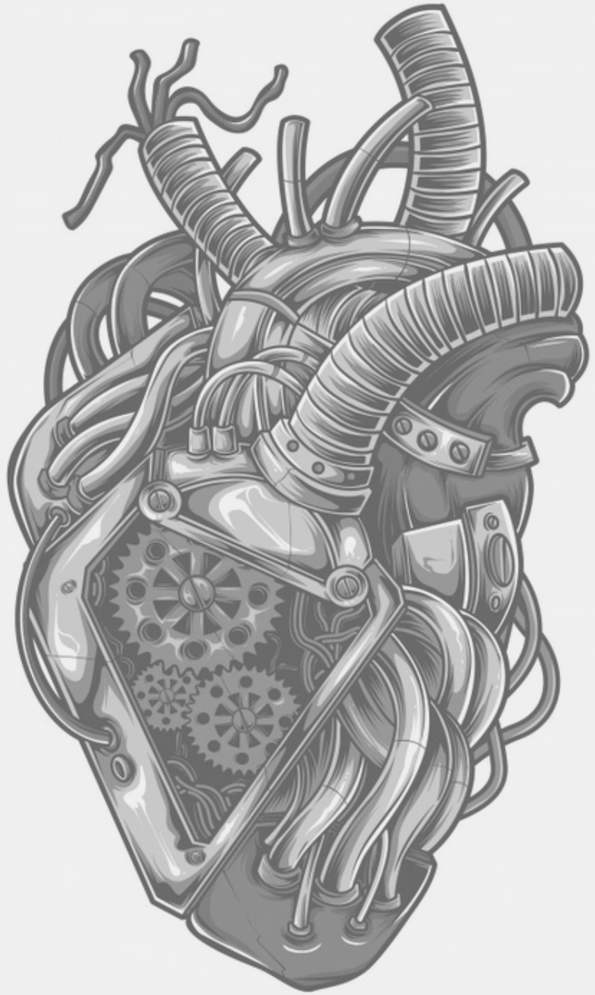


Ventricular Fibrillation

Our Machine Learning Model

TIME SERIES CLASSIFIER

Data obtained from an ECG is time series data. The objective of our model is to pick up on the subtleties of each type of wave and correctly detect and classify, the type of cardiac arrythmia



The Datasets used

TO TRAIN AND EVALUATE

MIT-BIH Arrythmia Dataset

Number of Samples: 109446
Sampling Frequency: 125 Hz
Number of Categories: 5
Classes: 0: Normal Heartbeat
1: Supraventricular Premature Beat
2: Premature Venticular Contraction
3: Fusion of Ventricular and Normal Beat
4: Unclassifiable (Other)

PTB Diagnostic ECG Database

Number of Samples: 14552
Sampling Frequency: 125 Hz
Number of Categories: 2
Classes: 0: Normal Heartbeat
1: Abnormal Heartbeat

MIT-BIH

97.5% Accuracy

97.4% F1 Score on Test Set

PTB - Diagnostic

Correctly classified 99.7 % of data labelled Normal

However, classified a majority of the ones labelled abnormal as normal... More data needed

Potential Applications

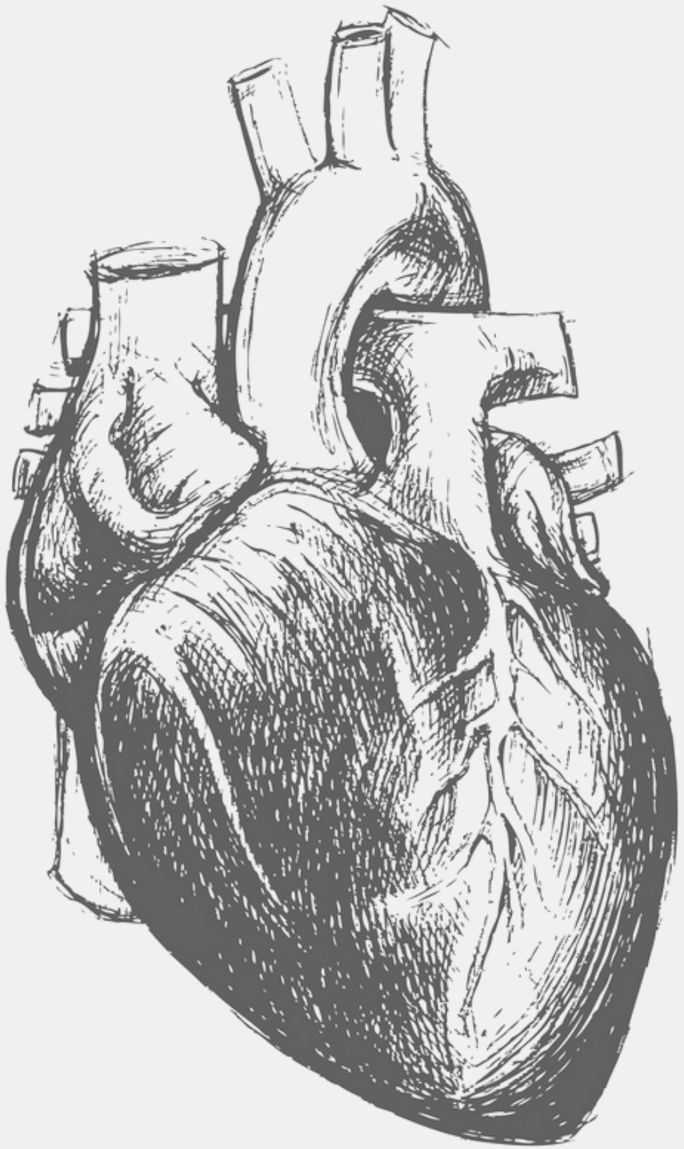
- **HIGH-TECH ECG MACHINES**
- **MEDICAL DIAGNOSIS SOFTWARE**
- **CONSUMER HEALTH AND FITNESS DEVICES**

Work to be done

Collect Additional Labelled Data.

Train models on multiple classes, currently just 4.

Add training data from a variety of sources.



References

1. Wikimedia Commons: Cardiac Arrythmia - https://commons.wikimedia.org/wiki/File:2024_Cardiac_Arrhythmias.jpg

2. Heart.org - What is Arrythmia? https://www.heart.org/-/media/data-import/downloadables/7/c/7/pe-abh-what-is-arrhythmia-ucm_300290.pdf

QUESTIONS?