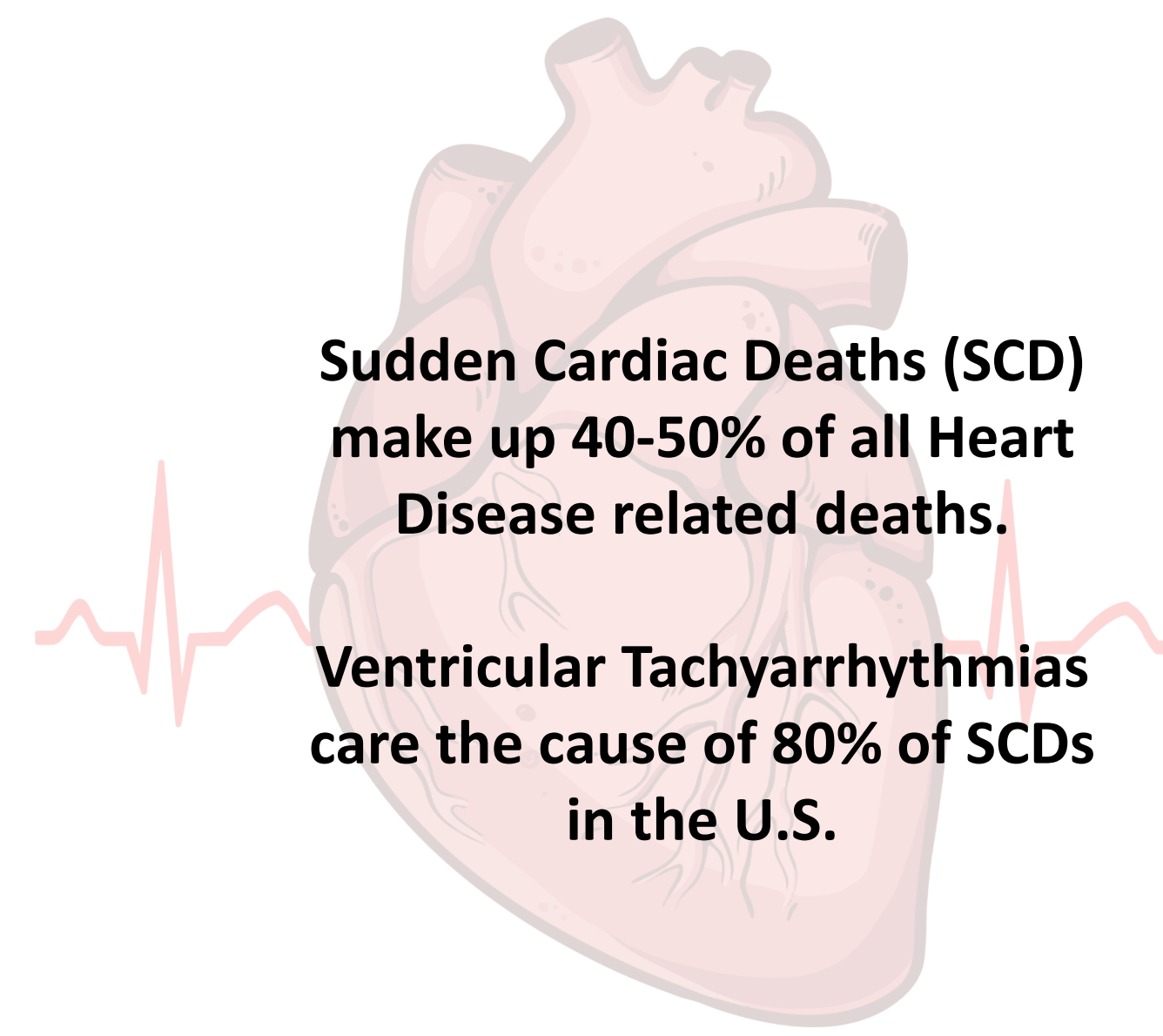
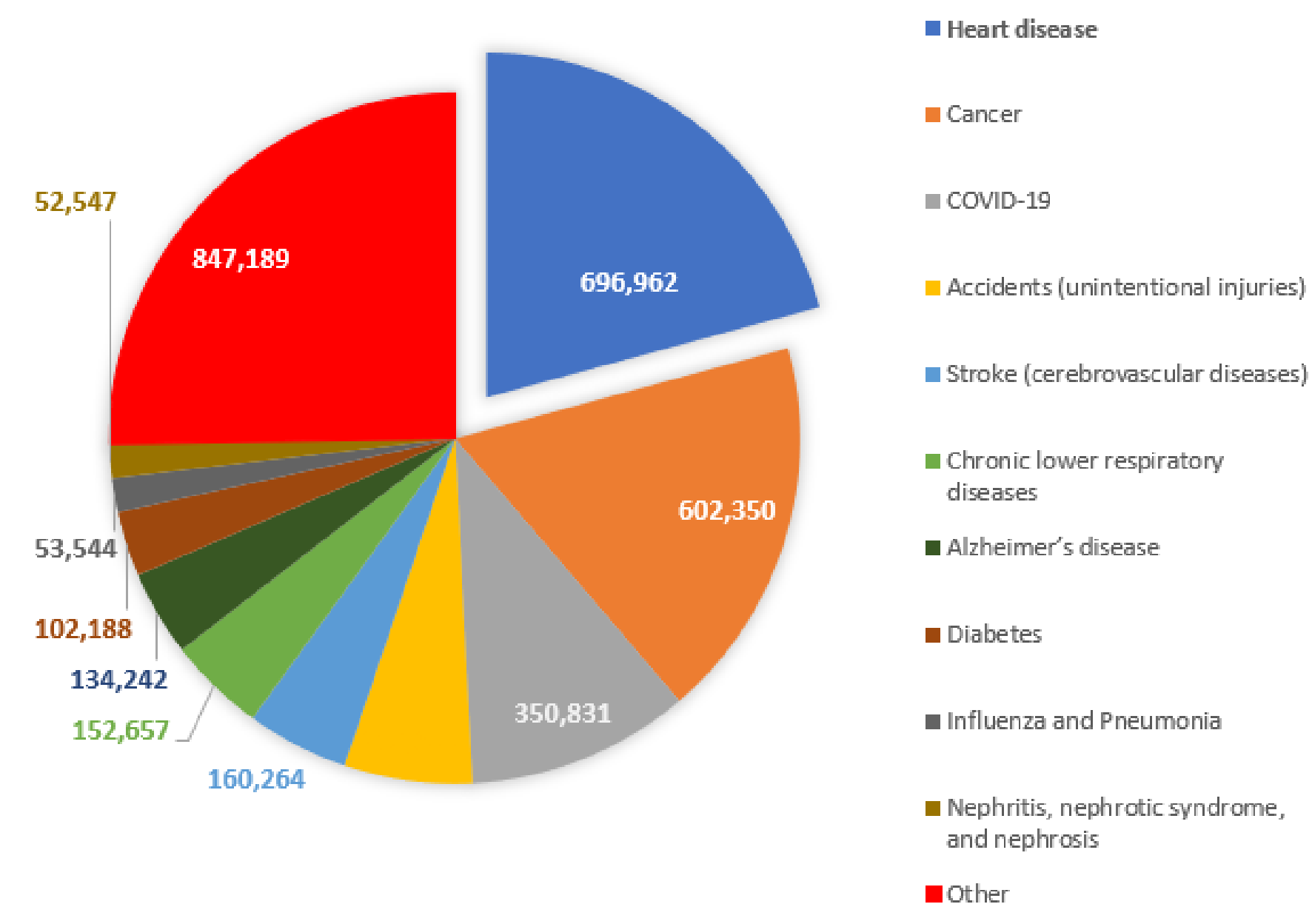


## CAUSES OF DEATH IN THE UNITED STATES [1, 2]



- Arrhythmia is a disorder of the heart's electrical system which results in irregular heart beats and even death.
- Arrhythmia is the most common cause of Cardiovascular related deaths in the U.S.
- Heart disease costs the United States about \$363 billion each year from 2016 to 2017.
- The National Heart, Blood, and Lung Association spent \$193 Million on Arrhythmia Research.
- Early Arrhythmia detection can prevent death and ensure the arrhythmia can be controlled. (Pacemaker, medicine, lifestyle change, etc.)



Normal ECG signal



ECG signal with Arrhythmia

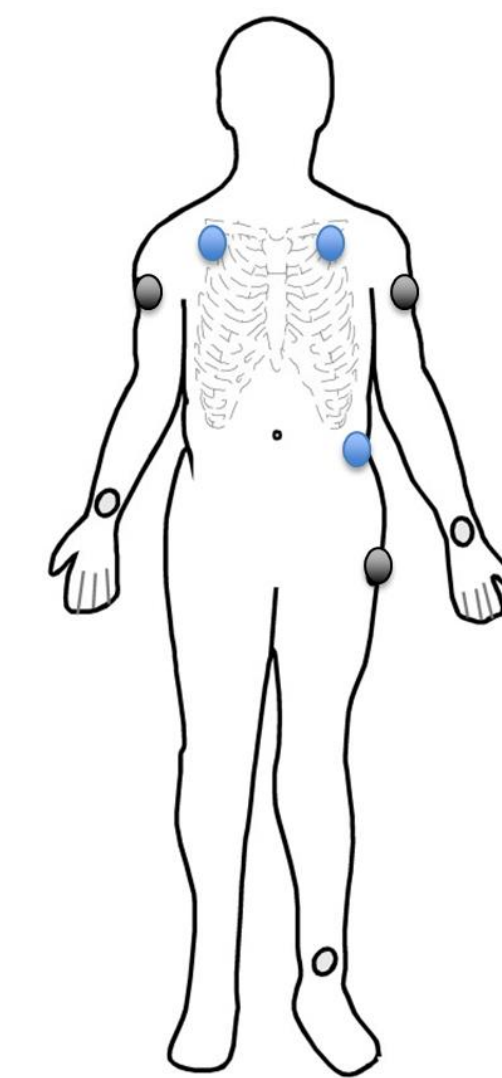
[1] Centers for Disease Control and Prevention, National Center for Health Statistics. Underlying Cause of Death 1999-2020 on CDC WONDER Online Database, released in 2021. Accessed at <http://wonder.cdc.gov/ucd-icd10.html>  
 [2] Murphy SL, Kochanek KD, Xu JQ, Arias E. Mortality in the United States, 2020. NCHS Data Brief, no 427. Hyattsville, MD: National Center for Health Statistics. 2021. DOI: <https://doi.org/10.15620/cdc.112079>external icon. Heart by Clipart.info is licensed under CC BY 4.0

## Current Technologies

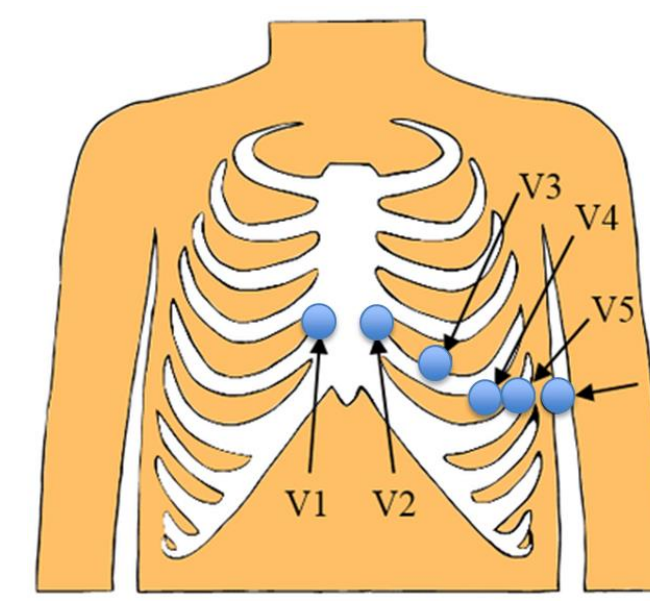
- Holter and Event Monitor
- Implantable Loop Recorder
- Electrocardiogram (EKG)

### Current ECG Technology Drawbacks:

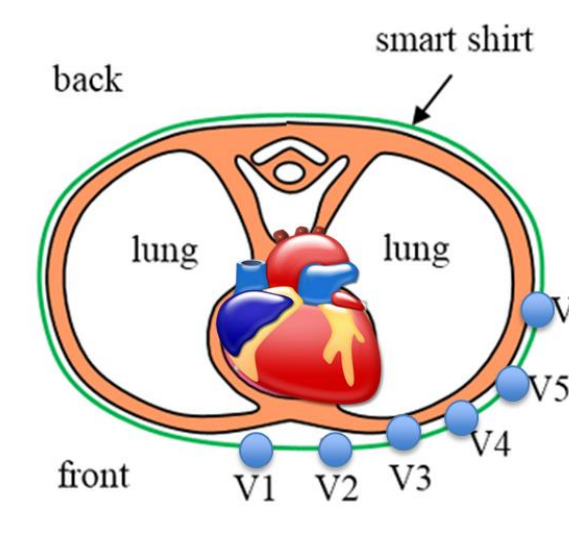
- Size
- Requires Medical Expertise to evaluate ECG
- Signals
- Cost
- Does not detect intermittent arrhythmias



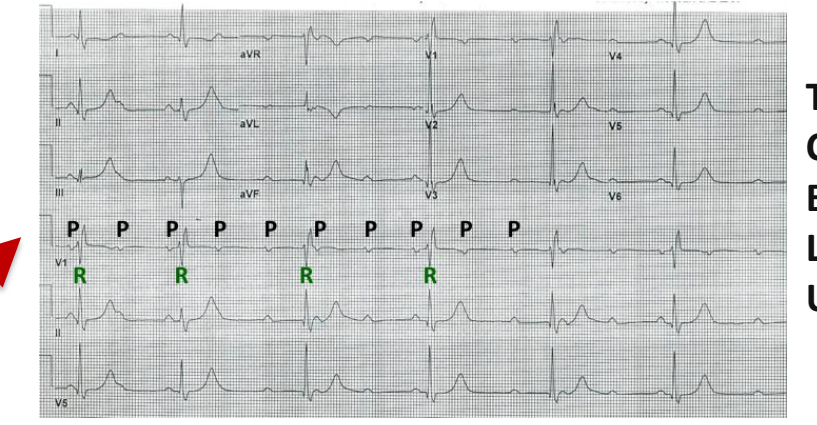
Limb Electrode Placement



Precordial Electrode Placement



Machine Interface



Third Degree AV Node Conduction Block. Source: Dr. Elma LeDoux (Tulane University)



Normal ECG – Left: the leads from the arms and legs, Right: the leads from the chest wall. Source: CCB Frankfurt

## Our Solution

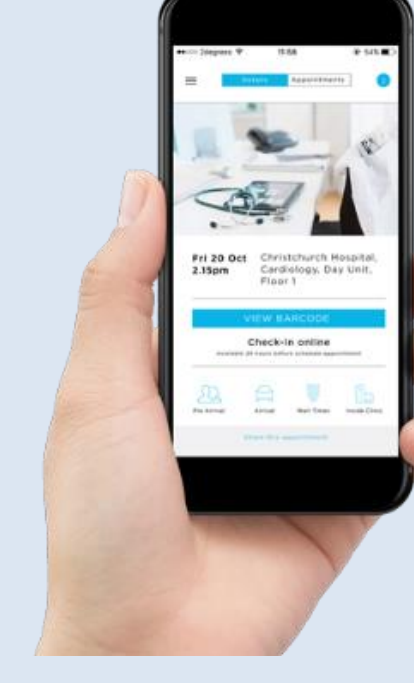
- We propose a novel IoT-based arrhythmia detection method utilizes smartphones, signal processing, and machine learning techniques.



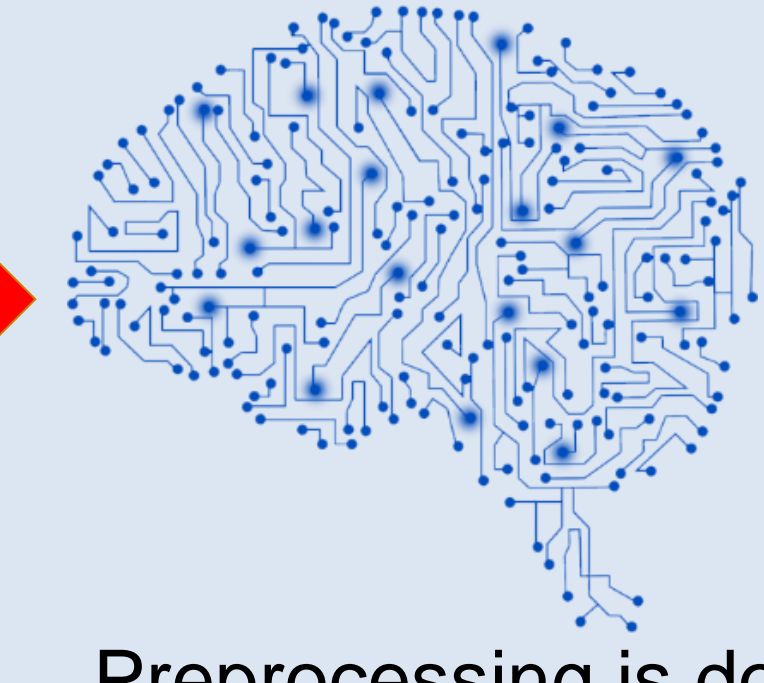
Our solution does not require cardiologist for diagnosis.



Patient ECG data are gathered using Node MCU IoT system.



The ECG data are sent to smartphone via cloud.

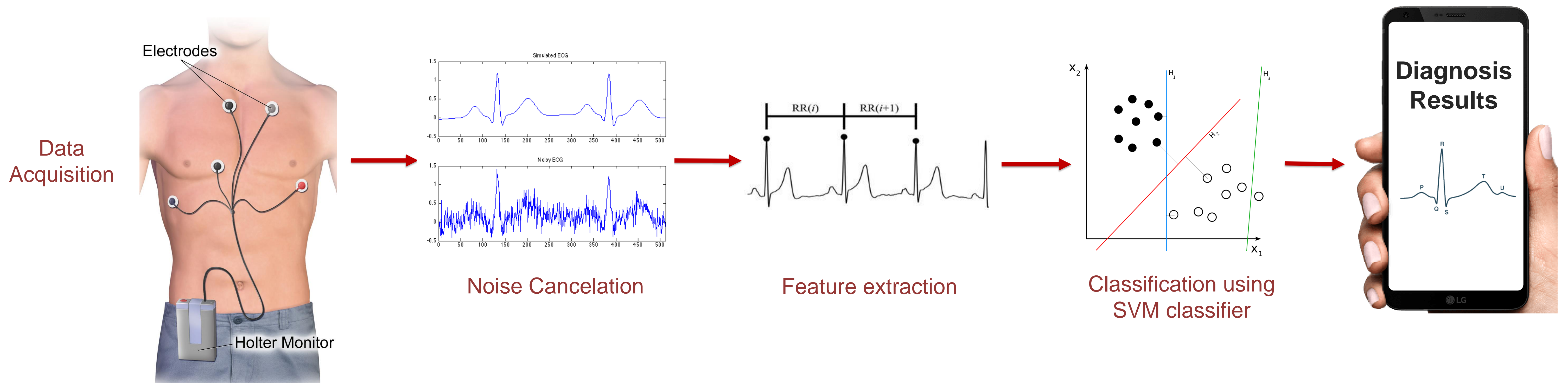
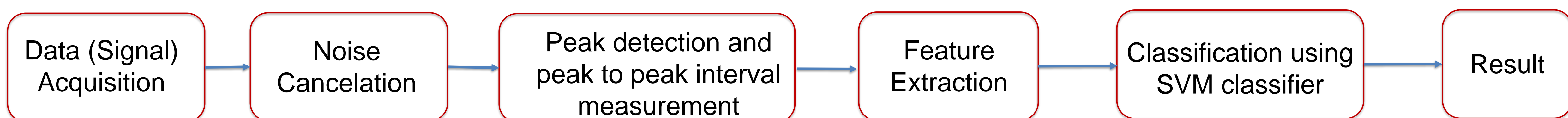


Preprocessing is done on the acquired ECG signals.



The system uses Machine learning techniques for Arrhythmia diagnostics.

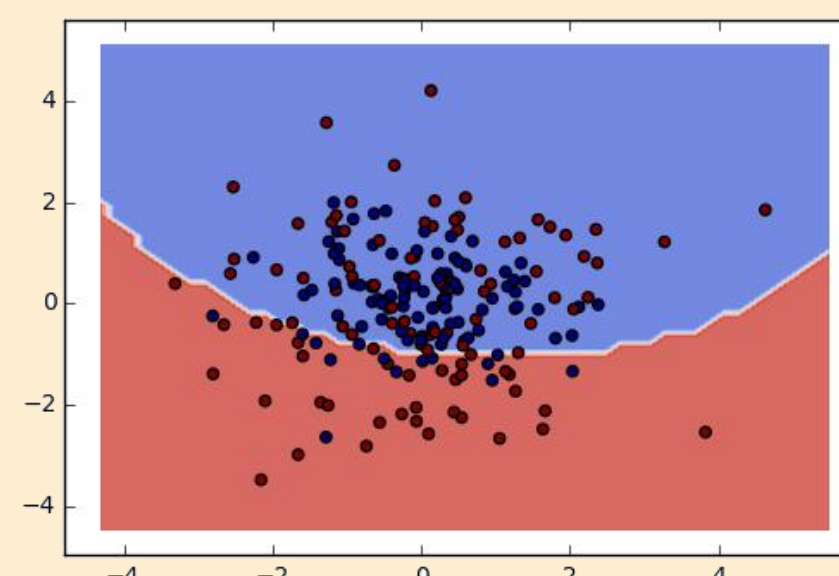
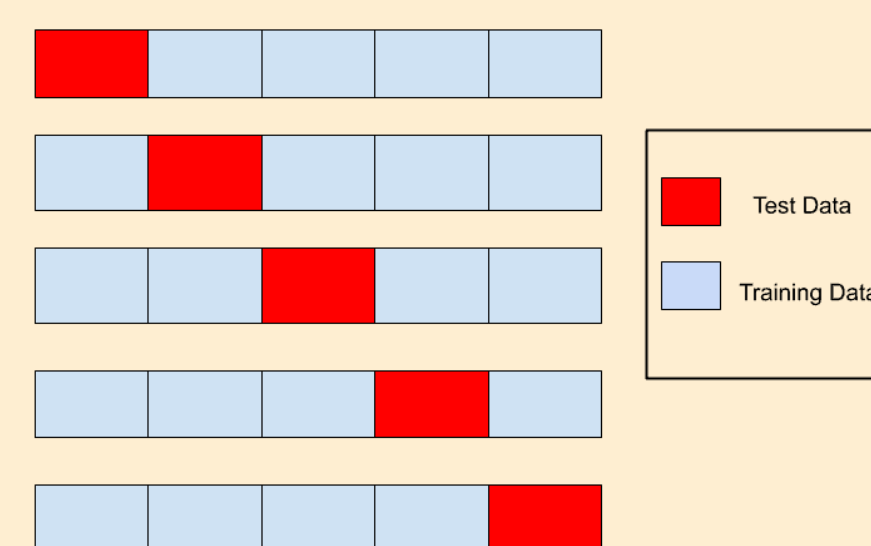
## Methodology



## Results

Using k-Fold cross validation and SVM as a classifier following results were achieved for Arrhythmia detection:

- Accuracy: 96.1%
- Specificity: 94.8%
- Sensitivity: 97.13%



## Contact

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