Analysis of Human heart using machine learning and 3-D visualization
Cardiovascular Diseases (CVD)
- Killing 17.3 Million globally every year
- That’s 30% of total deaths.

Early detection and treatment could have saved them
- HOLTER monitor (ECG >=24 Hours) used to detect Arrhythmias, Heart rate variations

Manual analysis
- Next to impossible
- Inefficient in terms of time consumed

Theoretically, Heart beats 72 times per min. That’s over one lakh times a day
Solution

- Automated Monitoring tools
  - Beat to Beat analysis possible
  - Instant and accurate results
  - Detection of abnormalities

- IOT based solutions
  - Remote monitoring possible
  - Unhindered Mobility and activity
  - Compact and cheap
How Solution works

Patient

 Physician

Diagnostic Report
Approach

- Signal acquisition/Noise removal
- Clustering
- Pattern matching
- Smart detection
Signal Acquisition
Clustering/Pattern matching
Smart Detection

Heart rate Variability

Average heart rate

Abnormalities

Heart rate abnormalities

- ventricular ectopy: < 1%
- Normal: 99%

- trachy: 23%
- brady: 60%
- sinus: 8%
- normal: 10%
3D Model of Heart

Average Heart Rate

Heart rate variability

Monitoring Summary

Start Time: 16:02:34 on 22-Oct-16
End Time: 15:32:34 on 23-Oct-16
Monitored Period: 24 Hours
Time Analyzed: 23 hours 38 minutes
Artifact Time: 1 hour 45 minutes
Off Time: 30 minutes

<table>
<thead>
<tr>
<th>Type</th>
<th>Count</th>
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</thead>
<tbody>
<tr>
<td>Normal Beat</td>
<td>19</td>
</tr>
<tr>
<td>Ventricular Ectopic Beats</td>
<td>10</td>
</tr>
<tr>
<td>Supraventricular Ectopic Beats</td>
<td>12</td>
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First Graph

<table>
<thead>
<tr>
<th>Type</th>
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<tbody>
<tr>
<td>V Couplet</td>
<td>3</td>
</tr>
<tr>
<td>V Trigemmy</td>
<td>2</td>
</tr>
<tr>
<td>V Run</td>
<td>3</td>
</tr>
<tr>
<td>SV Couplet</td>
<td>1</td>
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<tr>
<td>SV Trigemmy</td>
<td>1</td>
</tr>
<tr>
<td>SV Run</td>
<td>1</td>
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</table>

Second Graph

Type                  | Ventricular | Supraventricular |
----------------------|-------------|------------------|
Couplet               | 0           | 1                |
Trigemmy              | 0           | 0                |
Tricouplet            | 0           | 0                |
Trigemmy              | 0           | 0                |
Run                   | 0           | 1                |

Third Graph

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<tr>
<td>Normal Sinus Rhythm</td>
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<td>Tachycardia (&gt;100 bpm)</td>
<td>0</td>
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<tr>
<td>Bradycardia (&lt;60 bpm)</td>
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<tr>
<td>Asystole (Pause &gt;2 sec)</td>
<td>0</td>
</tr>
<tr>
<td>Sinus arrhythmia</td>
<td>2</td>
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</tbody>
</table>
3 D visualisation
Test Results
- ECG – Tested with 300 patients (72 hours/patient). Accuracy > 98%.
- PCG – Physionet tested our algorithm against 3200 recordings – 88% accurate

Publication – “Monitoring Cardiac Stress from Heart Sounds” at 43rd International Annual Computing in Cardiology conference 2016, Vancouver, Canada