

## Engineering Project Detailed Research Plan

Please complete the information/questions begun/seen below in red ink. Save this document to your computer, and add a printed hardcopy to your application.

**Date:** Sunday November 5, 2017

**Student Name:** Sreehari Ram Mohan

**Project Title:** Convolutional Neural Network classification of Mel-Spectrograms to diagnose Heart Arrhythmias

**Engineering Goal:** PROBLEM BEING ADDRESSED: All engineering projects solve a problem or fill a need. This goal should be a simple statement that describes the product being designed, the customer it is for and the problem or need it satisfies. Example” “The goal is to design a solar powered lawn mower for inexpensive automated lawn care for homeowners”

**My Project Goal is:** To use Deep Learning to accurately diagnose life threatening heart abnormalities. This involves designing a tensor flow model which can determine whether a patient has life-threatening abnormalities at cardiologist level accuracy. The hardware goal is to create a device which can take accurate heart recordings at an affordable price, and then diagnose whether the patient has a heart condition on the spot, and get results within 1 minute

**Design Criteria:** Design criteria define the product’s required performance . Examples: “ It will have a minimum speed of 10 KPH”, The output will be within 15% of the mean of the experimental data”. “It must withstand 15 repetitions of a 10N impact” The International System of units (SI) required.

**My Project Design Criteria are the following:**

**Design Criteria for the Hardware Component:**

- It must withstand being dropped from a shoulder height (1.5 meters)
- It should be able to accurately record audio
- Battery life should last at least 8 hours with intense use of 1 diagnosis every 1-2 minutes.
- The patient data should be stored in a .csv file safely on the device for easy extraction and transfer.
- It must not wear out with repeated use.

**Constraints:** Constraints are factors that limit the engineer’s flexibility such as size, cost, and time limitations. Examples: “It must fit in a box no larger than 10x20x50 cm” “The maximum cost is \$50” “The software must run in real time on a Raspberry Pi”

**My Project Constraints are the following:**

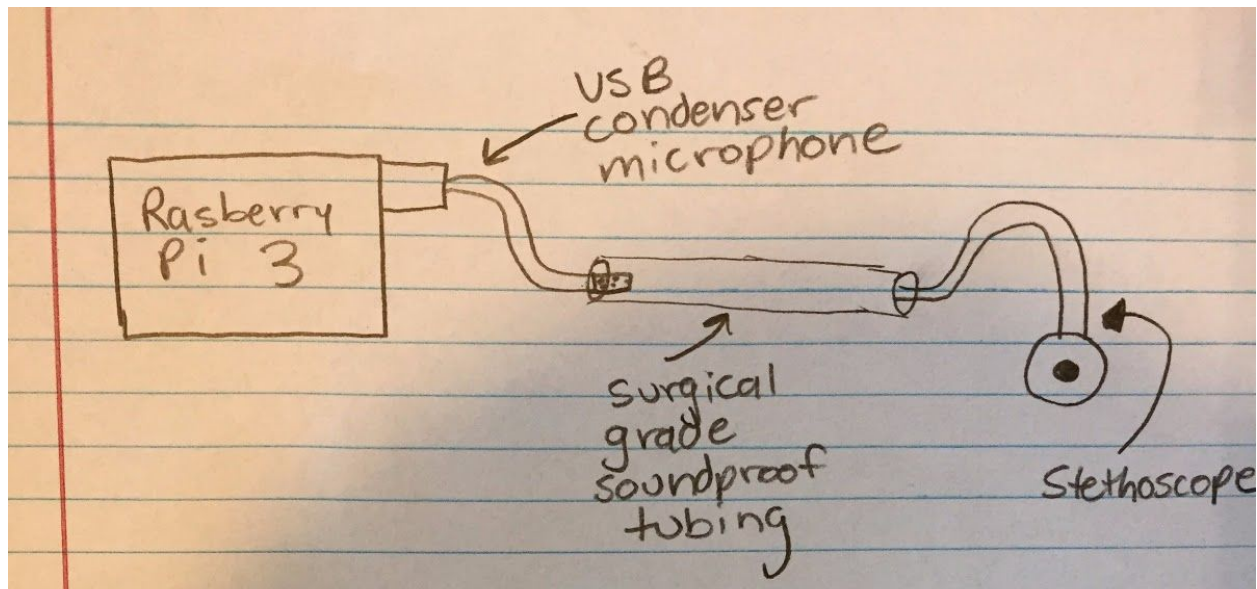
- Low cost: < \$80 for the hardware
- It must be able to fit in the hand of a healthcare worker

- It must weigh less than 1 kilogram
- The CPU intensive software must be able to run on a Raspberry Pi 3 (powered by battery).
- It must fit within a protective box of 15 \* 15 \* 20 cm.

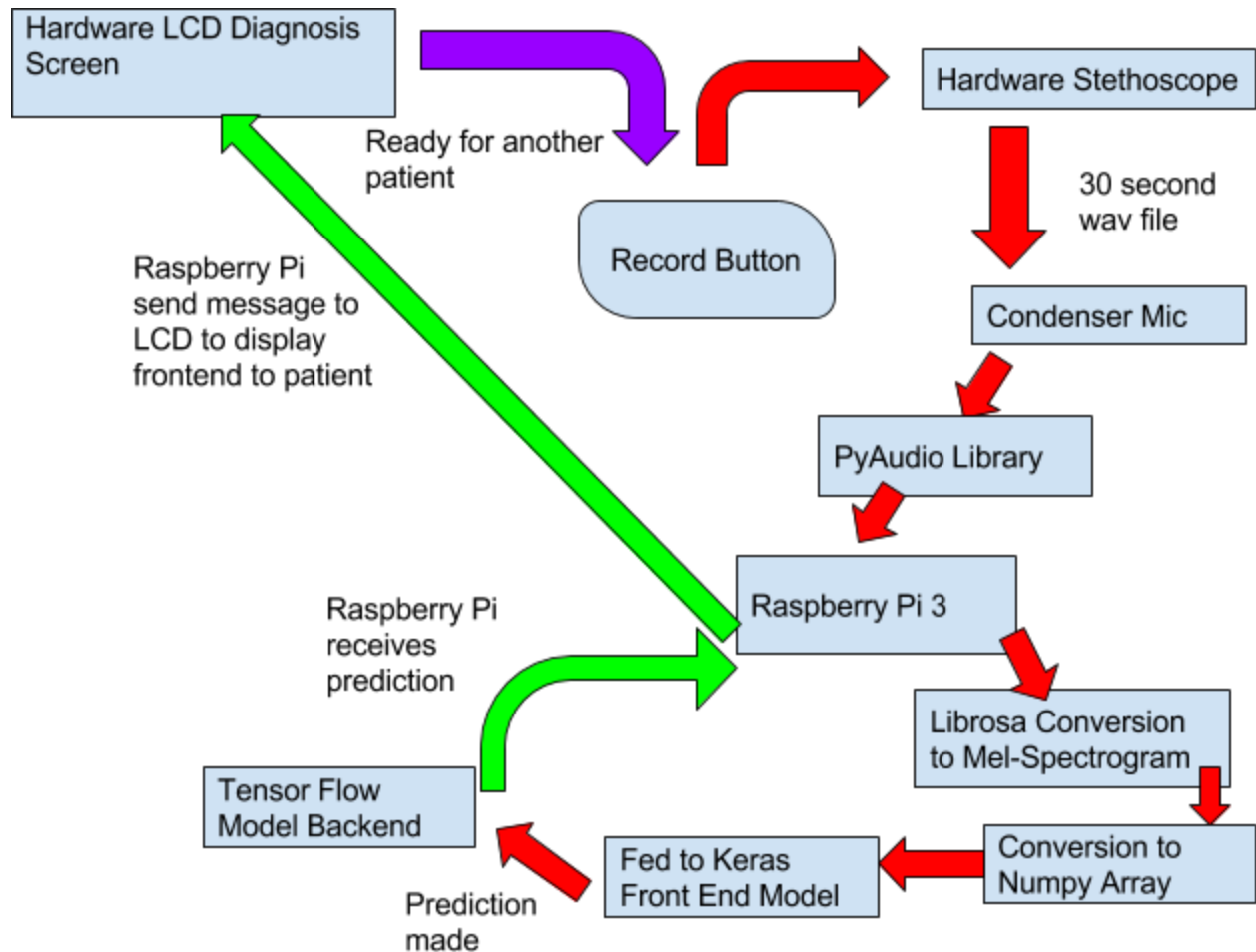
**Provide your chosen design.** For hardware, provide a sketch. For software, provide a flowchart. Indicate the components you will develop, and the libraries you are using.

**My Project Design is shown below: insert photos, diagrams, or illustrations below.**

**Hardware Design:**



## Software Design Layers:



**Test and evaluate your prototypes against the design criteria listed above to show how well the product meets the need/goal.** Provide a test plan describing how you will test the design criteria and constraints you listed above., How will you analyze the data? If the product requires human testing please fill out and append <https://science-fair.org/wp/wp-content/uploads/2015/10/Research-Plan-Human-Participants.docx>

**I test and analyze my prototypes using the following methods:**

- **Using my testing data (after the train test split 80%, 20%).**
  - **Use validation accuracy, confusion matrix, precision.**

**Human Participation:**

- I will use my electronic heart beat recorder to diagnose my own heart sounds and the heart sounds of my friends and family, to make sure the heart monitor predict NORMAL.
- This will consist of having each participant take the head of the stethoscope and place it on their chest after pressing the “record” button. The diagnosis will be displayed on a separate screen.
- I will make sure to sanitize the head of the stethoscope after each use with alcohol wipes and allow ample time for drying before moving on to the next participant.

**Bibliography:** List at least five (5) major references (e.g. science journal articles, books, internet sites & dates of review) from your literature review. If you plan to use vertebrate animals, one of these references must be an animal care reference.

1. <https://arxiv.org/pdf/1707.01836.pdf>
2. <https://stanfordmlgroup.github.io/projects/ecg/>
3. <https://news.stanford.edu/2017/07/06/algorithm-diagnoses-heart-arrhythmias-cardiologist-level-accuracy/>
  - a. Already contacted these people, asking if I could use their database.
4. <http://danielnouri.org/notes/2014/01/10/using-deep-learning-to-listen-for-whales/>
  - a. This person used deep learning to detect whale sounds, but his method is similar to what I plan to do for Heart Sounds.
5. <https://blog.cardiogr.am/applying-artificial-intelligence-in-medicine-our-early-results-78bfe7605d32>
6. [http://www.ijcai-boom.org/uploads/5/1/6/8/51680821/deep\\_learning\\_for\\_diagnosing\\_heart\\_problems\\_from\\_ecg\\_signals.pdf](http://www.ijcai-boom.org/uploads/5/1/6/8/51680821/deep_learning_for_diagnosing_heart_problems_from_ecg_signals.pdf)
7. <https://317070.github.io/heart/>
8. <http://www.sciencemag.org/news/2017/04/self-taught-artificial-intelligence-beats-doctors-predicting-heart-attacks>