



IIT Jodhpur

# DHVANIK

Wearable Tympanometric Diagnostic  
Tool for Middle Ear Ailments



# Problem Identification

- Hearing impairment is a highly prevalent yet ignored issue in India.
- The National Sample Survey 2002 estimated that for every 100000 people, 291 suffered from hearing loss in urban areas while in rural areas the number is 310.
- According to WHO about 50% of hearing loss can be attributed to hereditary/genetic issues. About 10.3% are due to aging. 15.9% is attributed to ear wax, however this form of hearing loss is reversible.
- The leading cause of hearing loss is associated with the middle ear (about 9%) of which nearly 80% is either treatable or preventable, which turns out to a staggering 2.5million.

# Introduction

---

## Problem Addressed

- Tympanometry is a simple test used to monitor the functioning of the middle ear.
  - It can detect problems such as presence of fluid, middle-ear infection (otitis media), tear in the tympanic and problems associated with the eustachian tube.
  - Negligence of above problems is the leading cause of hearing loss.
- 



# Introduction

---

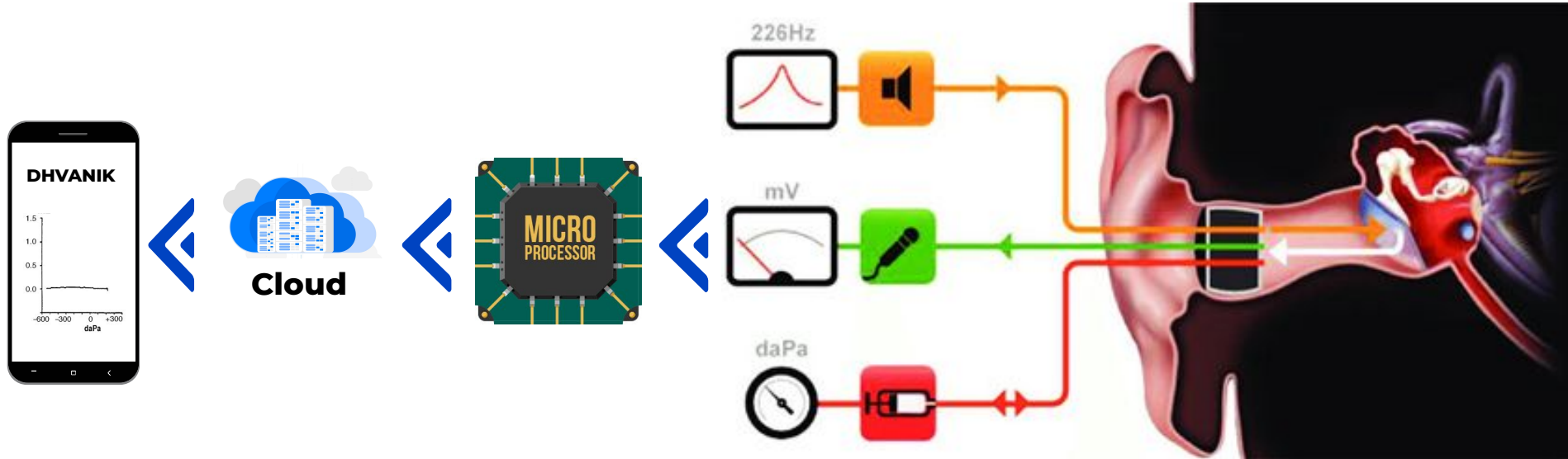
## Problem Solution

- DHVANIK aims to provide a low cost head-phone sized tympanometer.
  - It transfers the results directly to a smartphone, thus being an IoT enabled device.
  - The user requires no specialized knowledge to operate the device.
-

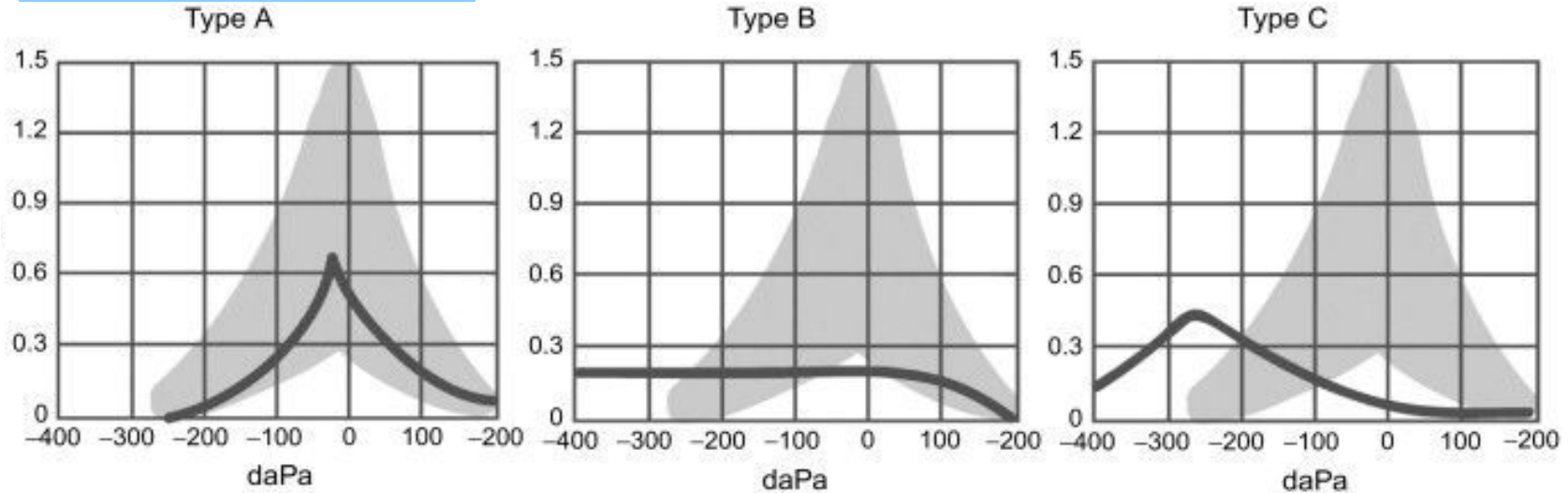
# Prototype Brief Details

- Preliminary Diagnosis tool
- Low Cost
- Headphone sized, wearable
- IoT Enabled
- User Friendly
- Portable
- Includes very basic components like Node MCU, bmp180 barometer, microphone and earphone.

# Technical Model



# Tympanogram

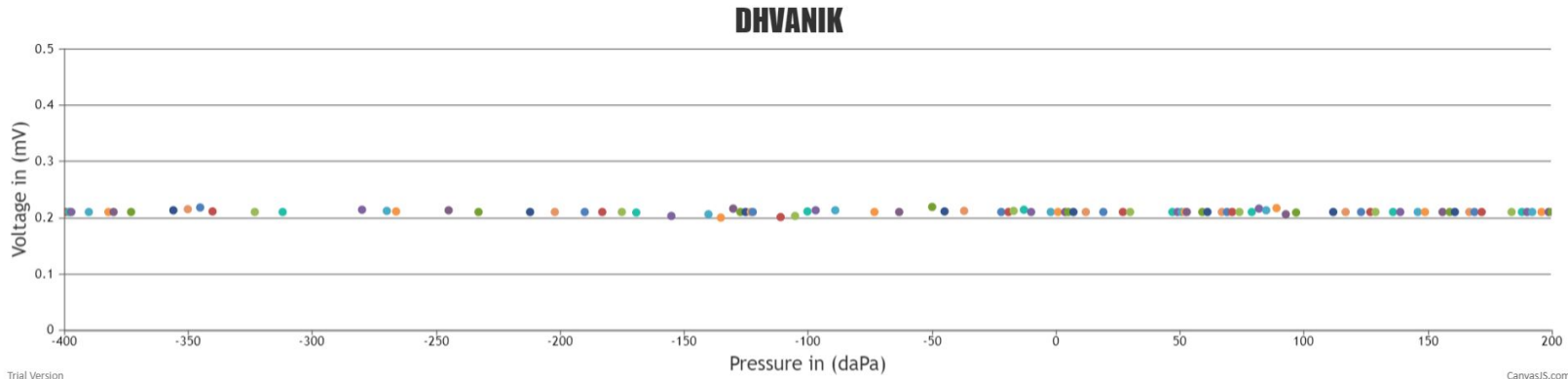


The type A tympanogram indicates that the ear system is functioning normally, and is free from anomalous fluids.

The Type B tympanogram provides information about the presence and amount of fluid in the middle ear, tumor in middle ear, and perforation of the tympanic membrane or patent pressure equalization tube.

The Type C tympanogram is similar to type A tympanogram, but it is shifted towards the negative side of the graph would show signs of allergic reaction, sinus, or some stage of infection inside ear.

# Observed Tympanogram



Trial Version

CanvaSIS.com



# Business Model



# DHVANIK -Wearable Tympanometric Diagnostic Tool for Middle Ear Ailments

<p>1 PROBLEM</p> <ul style="list-style-type: none"> <li>- Conventional tympanometers are expensive.</li> <li>- Require trained personnel for operation and analysis.</li> <li>- Lack of availability of tympanometric devices in rural and remote areas.</li> </ul>	<p>3 SOLUTION</p> <ul style="list-style-type: none"> <li>- Affordable primary diagnosis.</li> <li>- Portable and user friendly device, similar to a headphone.</li> <li>- Report can be sent to doctor over internet.</li> </ul>	<p>2 UNIQUE VALUE PROP</p> <p>A portable and user friendly IoT enabled device at affordable cost and without any side effects, which can be operated using a smart-phone.</p> <p>DHVANIK for such customers is analogous to a diabetic patient having a blood glucose monitor.</p>	<p>7 UNFAIR ADVANTAGE</p> <p>Compact device based on simple and low processing requirement devices.</p>	<p>1 CUSTOMER SEGMENTS</p> <ul style="list-style-type: none"> <li>- General doctors in clinics.</li> <li>- Small hospitals and primary health centers in rural areas.</li> <li>- Patients having ear-ailments.</li> </ul>
<p>5 COST STRUCTURE</p> <ul style="list-style-type: none"> <li>- Hardware Cost</li> <li>- Distribution Cost</li> </ul>	<p>5 REVENUE STREAMS</p> <ul style="list-style-type: none"> <li>- Hardware purchase.</li> </ul>	<p>6 KEY METRICS</p> <ul style="list-style-type: none"> <li>- Purchases through e-commerce websites.</li> <li>- Commercial sales.</li> </ul>	<p>4 CHANNELS</p> <ul style="list-style-type: none"> <li>- General as well as medical specific online E-commerce websites.</li> <li>- Offline Medical stores.</li> <li>- Various Government and Non Government Organizations.</li> <li>- User and Doctor references.</li> </ul>	

# Market Analysis

- According to the All India Institute of Speech and Hearing, almost 60% cases of middle ear infection and tympanic membrane tears are diagnosed only when the patients reach the ENT specialists.
- Most of the patients neglect the hearing problem at an early stage, and get it reported when the condition has already been worsened, and is not perfectly curable.
- According to the IMA, about 70% of general physicians in India are limited to an auriscope when it comes to checking patients with ear problems.
- The above figures would be significantly less, if a cheap, portable, user friendly device is made available at almost every primary health centres.
- DHVANIK is an apt device, which is targeted to greatly reduce this problem.

# Addressable Market

- General doctors in clinics, small hospitals, primary health centers in rural areas and workers working in noisy environment are our potential customers.
- DHVANIK is a preliminary diagnosis tool and not a replacement for the highly specialized equipment available with ENT specialists.
- This feature is intended to target patients who have a case of recurring middle-ear infections. The purchase of DHVANIK for such customers is analogous to a diabetic patient having a blood glucose monitor.



# Product Differentiation

- The conventional tympanometers are expensive and require trained personnel for operation and analysis.
- DHVANIK is based on simplicity and includes some very basic components comprising a microcontroller, barometer, earphone and microphone allowing it to be low cost.
- Unlike available conventional tympanometers DHVANIK is able to communicate data to multiple devices using IoT.



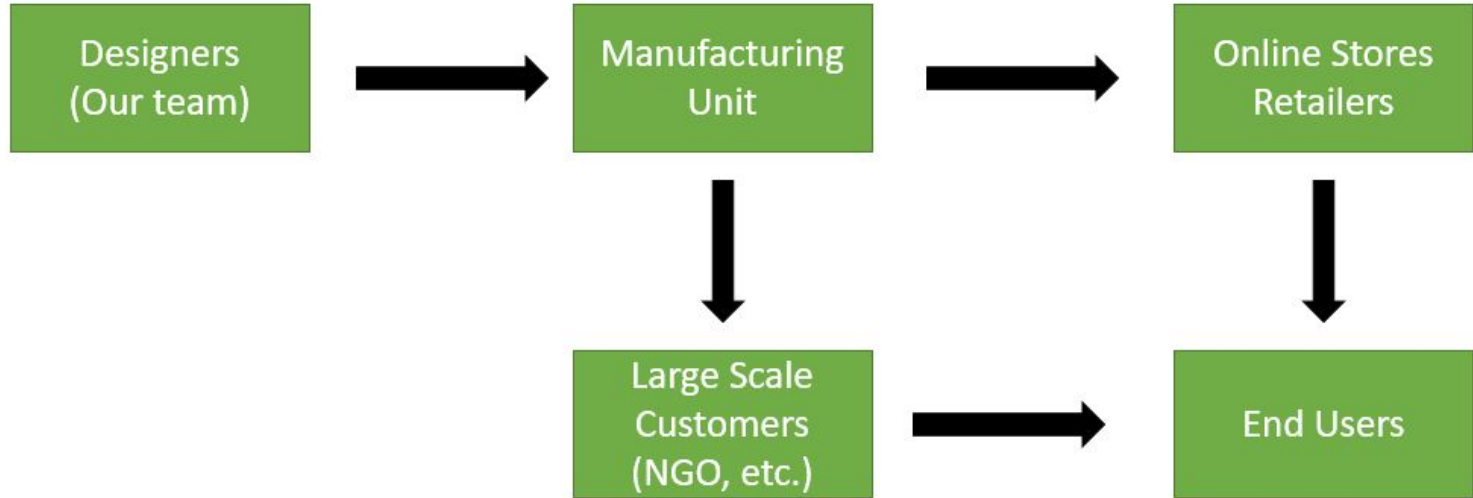
# SCALABILITY

- According to Medical Council of India, there are around 12,00,000 health centres in India.
- 22 million workers are exposed to potentially damaging noise at work each year according to Center for Disease Control (CDC).
- According to a report by Times Of India, in India 1 child out of every 250 suffers from some sort of hearing ailment, and it is advised by experts to monitor its condition once in every 3 weeks to prevent adverse effects.

# Addressable Market

- Individual customers can be targeted through retail sale in medical stores since the product is low cost
- Sales can be through online stores, both general and medical specific such as Amazon and 1mg respectively.
- Registering DHVANIK on a crowdfunding platform such as Kickstarter can serve to increase awareness and provide publicity
- Create a channel of awareness through government and non government organizations.

# Distribution Channels





# Estimated Cost

- Earmuff : ₹300/-
  - Wi-Fi enabled microcontroller: ₹500/-
  - Pressure Sensor : ₹200/-
  - Earphone + Microphone : ₹150/-
  - DC Air pump : ₹300/-
  - Fabrication cost: ₹400/-
  - Total production cost: ₹1850/-
- 
- Available device in the market costs around 1-3 lacs.

# Monetization Plan

- Primary source of revenue through sale of devices.
- Initial offer will be at discount prices to attract customers and establish product.
- Secondary source of revenue through a percentage fee from doctors and health centers.
- Sales through franchises and royalty from them adds to profitability.
- It can very well be subsidized by the government similar to hearing aids.

# Social Impact of DHVANIK

- Successful implementation of DHVANIK can largely cure hearing problems among people of rural area, children, etc. in its early stage.
- Reduced cases of severe hearing impairments caused due to middle ear ailments.
- Contribution in overall medical growth of the nation.



# Future Goals

- Integrating Machine Learning model to compare dataset of the graph of a particular patient over time, and generate a particular warning if the graph varies more than a specified limit.
- Create a global dataset to compare the tympanograms of patients, and sell the statistical model.
- Relevant companies producing cures of hearing ailments (for eg. Eardrops) can advertise their products through recommendation based on the tympanogram generated.



**IIT Jodhpur**

॥ त्वं विद्यया विद्यमानसि ॥

**Thanks!**

