

Silicon Labs' Social Entrepreneurship Challenge

Problem Statement by Silicon Labs

10th Inter IIT
Tech meet



Submitted By-
Team 17

Mental Health: An alarming issue

The 21st century introduced remarkable advancements in the field of Neurosciences which has helped researchers understand the complex Human Psyche in much detail.

10.7%
Population of Globe is
suffering from Mental
Health disorders

1 Billion+
Estimated count
Post-Pandemic

45%
Suicide victims
suffered from an active
Disorder

\$6 Trillion+
Projected cost to the
world economy by
2030



13.73%
Population
suffering from
Mental Health
disorders

\$1.03 Trillion
Economic Loss
incurred due to
poor mental health

13%
YoY increase in
CNS drug
consumption

0.8%
% of healthcare
budget spent
on Mental
Healthcare



Globalization, digitization, technological progress, Competition, etc. have significantly raised mental health concerns. When these concerns prevail for a longer time, and affect the mood, thinking, efficiency & behavior of a person, then they are identified as mental illnesses/disorders.

Mental Health: An alarming issue



Micro Level-

- The feeling of self-alienation, helplessness, depression, sadness, social ostracization.
- Affects the productivity of the person and efficiency of work.
- Increase in the Suicide rate
- Incidences of violence
- Gender discrimination, social exclusion, unhealthy lifestyle, physical ill-health and human rights violations

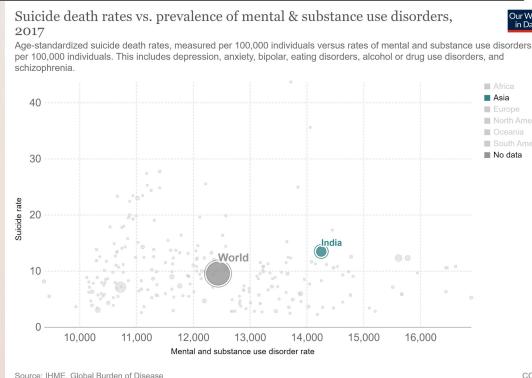
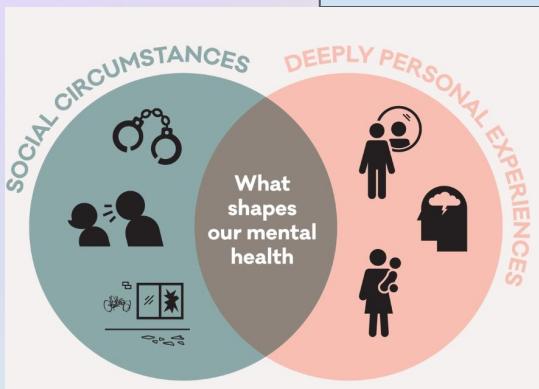


Fig: Suicide rates

Macro Level-

- WHO: GNP of every nation is affected.
- Lancet Commission: mental disorders will cost the global economy \$16 trillion by 2030.
- 12 billion working days are lost due to mental illness every year.

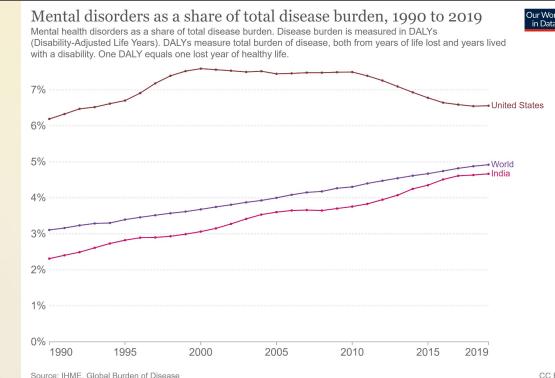


Fig: Trend in Mental Health Cases

Customer Profile



User Jobs

- Regular visits to Psychiatrists to check progress
- Use some app to schedule therapy sessions
- Rely on self-assessment tests
- Check daily compulsions through external agencies
- Doctors need to perform various tests



User Pains

- Time Consuming
- No real time monitoring
- Chances of severe health conditions
- No SOS sent to Family in case of emergency
- Unable to record medical conditions continuously for better prognosis.



Goals

- Reduce time in overall process.
- Continuous monitoring of data and all data stores & secured
- Early prediction of severe health condition
- Mitigation steps, SOS sent to Family in case of emergency

By Disorder - Anxiety Disorders -Bipolar disorder -Depression -ADHD -Schizophrenia

By User Persona - Individual Patient -Family -Psychiatrists

By Service Provided - Clinical -Administrative -Financial

Identification of Problem Statement

Common Mental Health disorders in India



5 Major Mental health disorders in India-

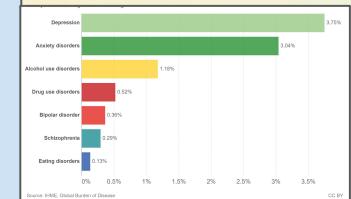
- Depression
- Anxiety Disorders
- Attention-deficit/hyperactivity disorder
- Bipolar Disorder
- Schizophrenia

Target: Anxiety Spectrum disorder is one of the disorder prevalent in India. 10M cases reported each year



Some characteristics of anxiety spectrum disorders are-

- Treatable by a medical professional
- Usually self-diagnosable & manageable
- Lab tests or imaging not required



Post Trauma Stress Disorder

Sleep Quality Degradation

Anxiety/Panic Attacks

Obsessive-compulsive disorder (OCD)

 Boston 25 News

Even as pandemic fades, concerns OCD behaviors will remain prevalent

Obsessive compulsive disorder is a diagnosis of being unable to ... created by COVID-19 really created a perfect storm for OCD in many ways.

2 weeks ago



Identification of Problem Statement

PROBLEM STATEMENT:

To develop an **end-to-end IoT-based** solution to help patients with **anxiety spectrum disorders**, **track** their mental health status, **manage** their cognitive behavior, and help them **mitigate** their issues by using a Smart wearable wristband and a mobile-based application.

01

Tracking all Parameters
necessary for identification

- Can be done using IoT devices
- Active tracking and sharing of Data

02

Display & Analyse the recorded
parameters in lucid way

- Integration of ML and AI in analysing data
- To give smart suggestions & in App

03

Help Mental disorder patient
mitigate their problems

- Provide Free of cost

Existing Market Players



Wysa

About

Helps users to self-manage their mental health using AI-based questionaries and remedies.

Flaws

- It is AI-based, with no real data tracking/monitoring.
- Usually, a Mental health victim may not answer in the true sense



InnerHour

About

Self-care therapy-based tools to overcome depression beat anxiety, tackle stress. Guides in meditation.

Flaws

- Does not monitor patient progress



MindFit

About

Connects professionals with patients. Provides for Medication facility

Flaws

- More into counseling services
- Accessibility issues.

Clearly, All these are SaaS based startups with no real time monitoring that can resolve patient issues. None has Integrated IoT solution in their approach.

Existing Market Players



OuraRing

About

24/7 heart rate monitoring, personalized health insights, sleep analysis.

Flaws

- Price \$300
- No mitigation



Dhyana

About

A meditation guide. Tracks heart rate variation and breathing irregularities. Biofeedback mechanism

Flaws

- Concerned to meditation only
- Price 7000 INR



Neuphony

About

Smartwatch of your brain. Helps in stress relief using Biofeedback

Flaws

- Cannot wear continuously
- Price 35000 INR

Clearly, Solutions are NOT targeting mental health. These have a less user base in India and have an affordability issue associated with them.

Our Solution



About SAATHI -

SAATHI is a comprehensive IoT based wearable product which provides real time analytics on various psychological parameters tailored specifically to the improvement of mental health of the users.

3 Major Components of the Solution-

- Smart Wearable
- SAATHI+ Mobile Application
- Saathi Patient Management System





Technical Implementation



Computing & Analytics

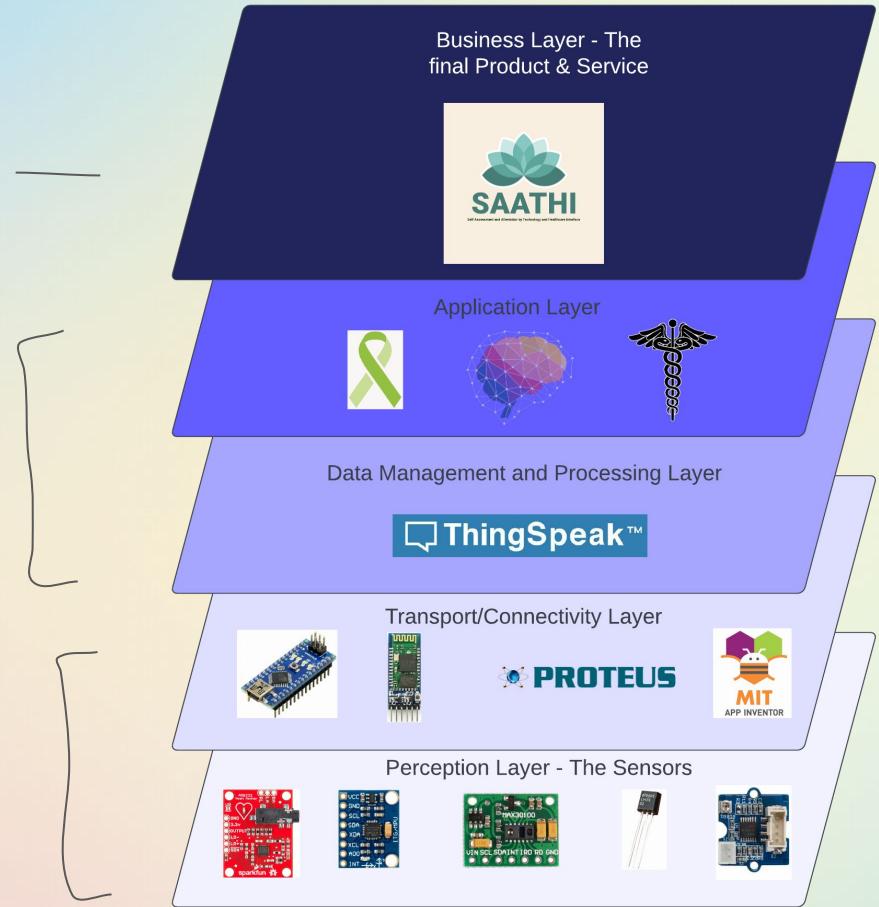
Hardware

User-end Application

Product Layer

Software Layer

Hardware Layer



Software Implementation - Features

OCD Event Detection

- Uses ML to automatically detect OCD related actions.
- Employs a three stage strategy for better scalability and efficiency.
- Requires accelerometer and gyroscope data only.
- Features high adaptability and can be customised to every user depending on his/her behavior.
- Provides real time feedback to the user.

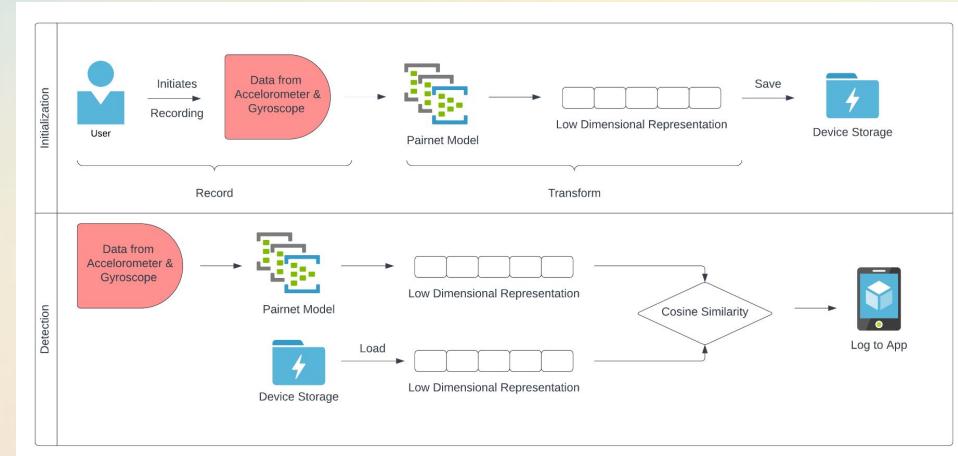


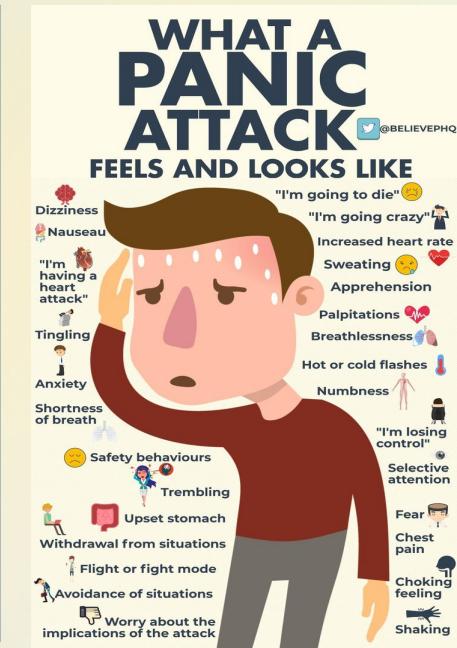
Fig: Entire flow diagram of OCD detection pipeline

Aim - To provide OCD patients with mitigation steps to help them curb the ill - effects of OCD

Software Implementation

Panic Attacks Prediction

- Our product uses multiple data feeds - Live data from ECG, temperature, EDA and PPG sensors for detection of panic attacks in our users.
- Uses a combination of statistical and machine learning algorithms to accurately transform the input data feeds to an aggregate score, which is indicative of the severeness of the panic attack.
- On successful detection, our application can provide with multiple methods to mitigate the panic attack.
- Future development of this feature will focus around predicting panic attacks on the basis of long term and medium-term physiological indicators and sleep quality by using state of the art time series forecasting techniques.

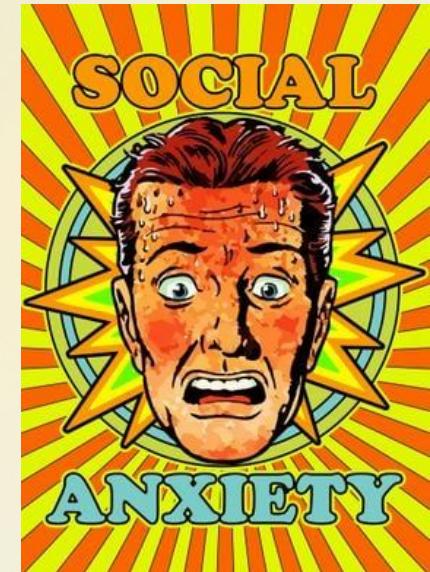


Aim - To provide strong mitigation steps to soften impact of panic attacks.

Software Implementation

Stress and Anxiety Detection

- Provides informative quantitative insights into the anxiety and stress levels of the user via real-time monitoring.
- Use ECG sensors for heart rate variability, accelerometers for movement and restlessness, EDA sensors for skin conductance (perspiration), PPG sensors for blood flow and temperature sensors for body temperature as input feeds
- Employs a ML-based algorithm to provide smart recommendations based on the input feeds in order to reduce the stress levels.



Aim - To monitor psychological stress in real-time and provide appropriate relaxation aid

Software Implementation

Sleep Analysis

- Similar to other products on the market, our device provides a comprehensive system for analysis of sleep cycles.
- Sleep is classified into three categories - Mild Sleep, Deep Sleep and Awake, depending on the predicted stage of sleep by the ML algorithms.
- Depends solely on the accelerometer data and utilises efficient and scalable pipeline for near-real time inference and insight generation.

Aim - To track sleep cycles over a aggregated period of time and provide useful insights

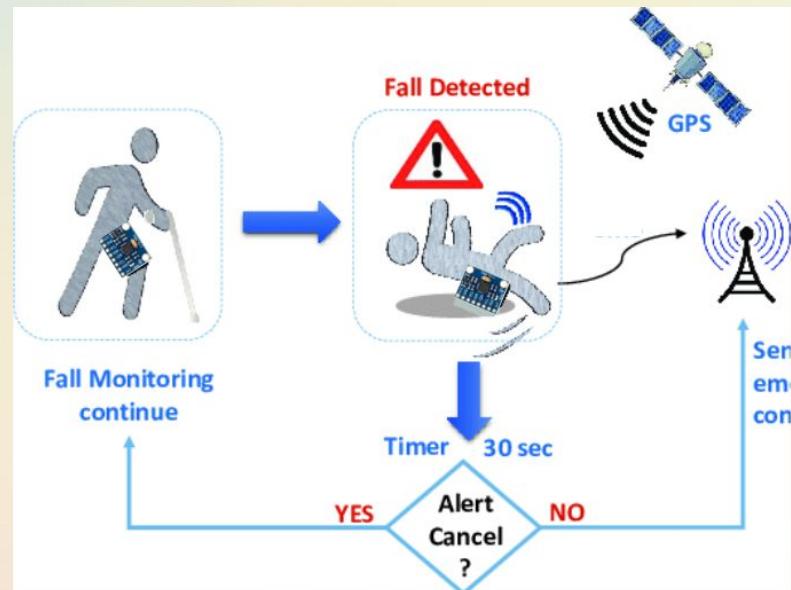


Software Implementation

Fall Detection

- Using AI accelerated algorithms, our product SAATHI provides an accurate fall detection feature which proves useful especially for vulnerable users such as elderly and disabled.
- Uses accelerometer and gyroscope data for accurate fall detection in real time.
- Ensures quick access to healthcare services by sending SOS signal to the emergency contacts of the users in case of a fall.

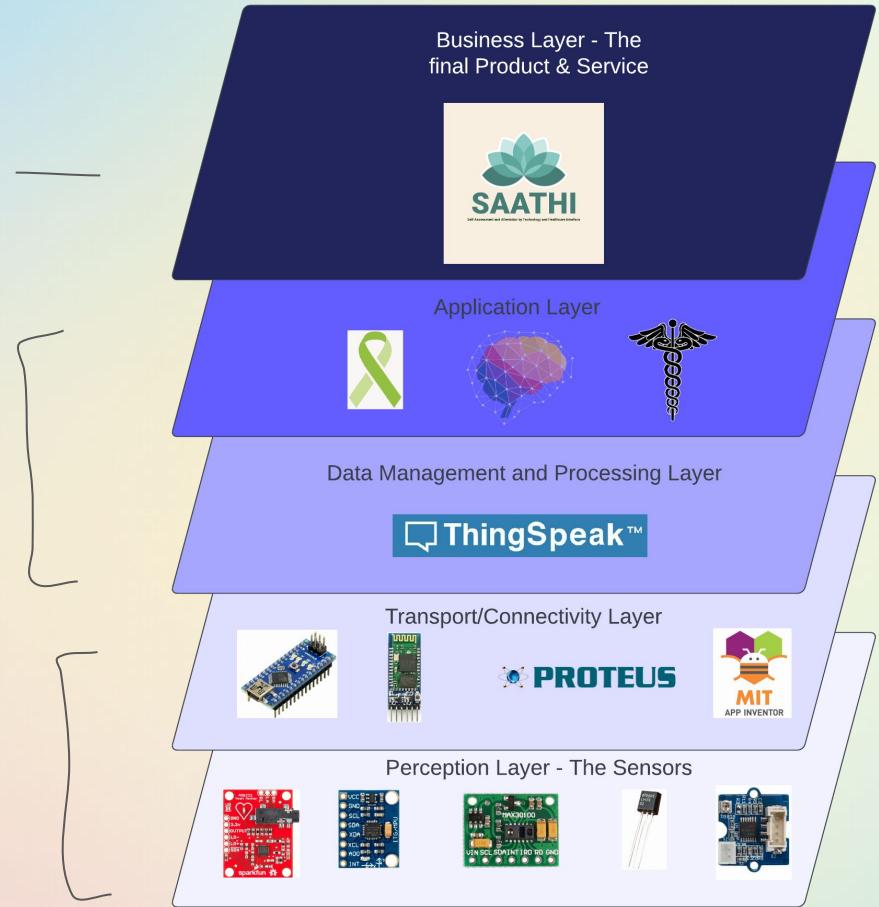
Aim - To detect falls in users and send immediate SOS to the emergency contacts.



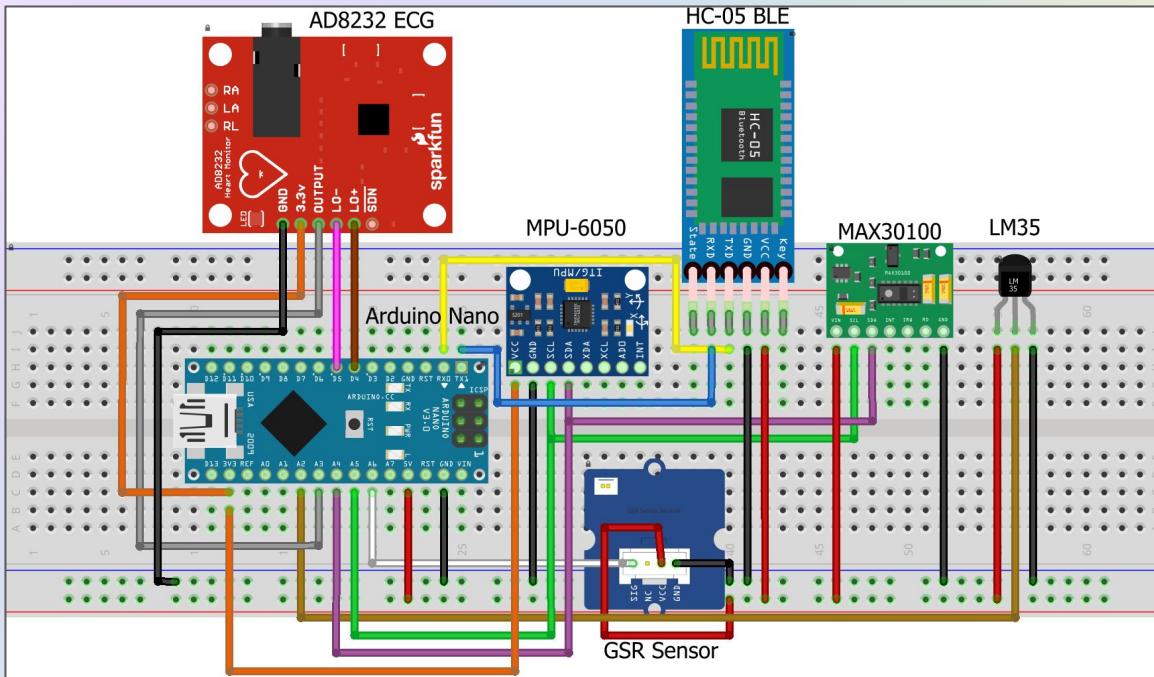
Product Layer

Software Layer

Hardware Layer

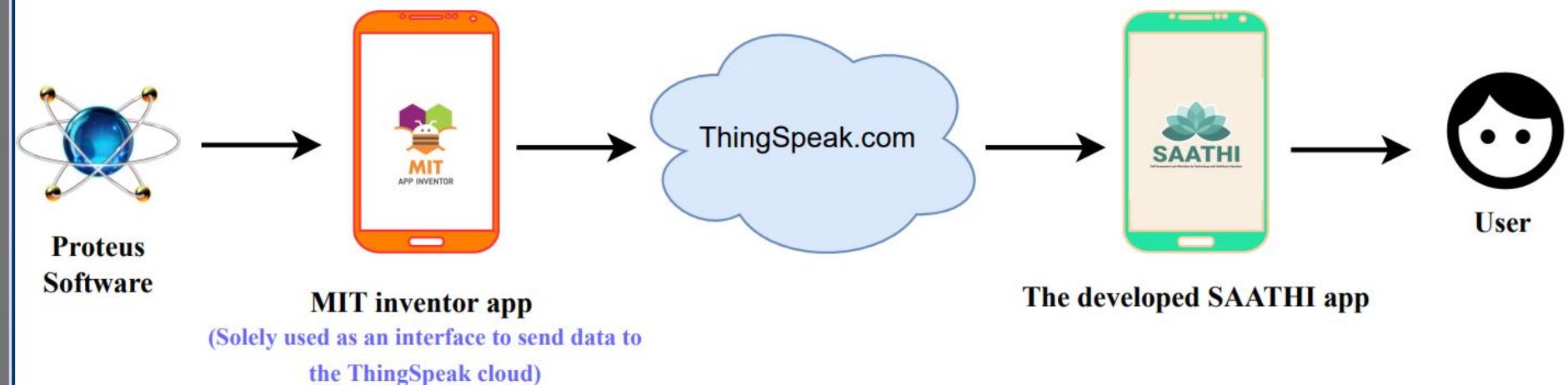


IoT Based Prototype Circuit

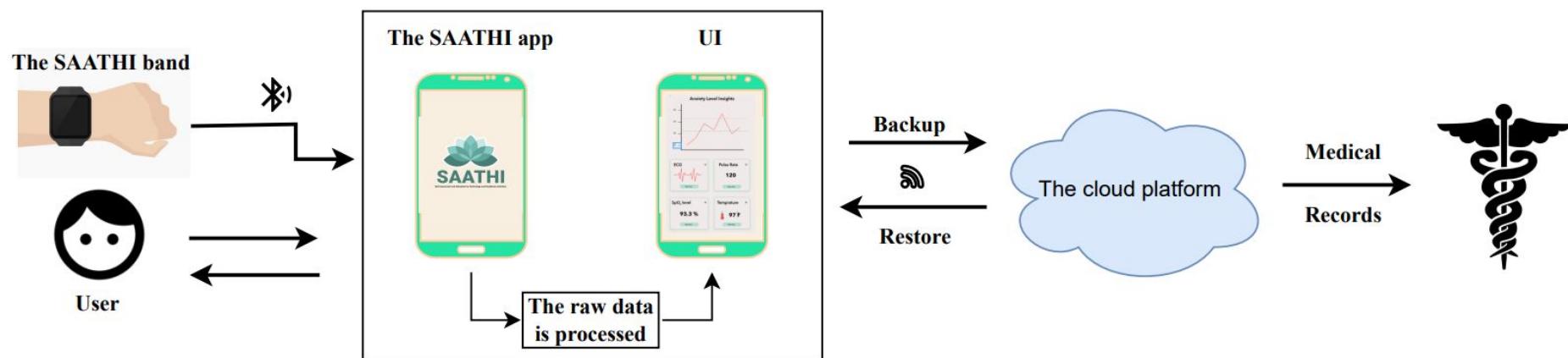


Component	Purpose
Arduino Nano	The Microcontroller board
HC-05	Bluetooth Module
MPU-6050	Motion Detection(Accelerometer & Gyro)
MAX30100	Pulse Rate & SpO ₂
LM35	Temperature Sensor
AD8232	ECG Sensor
GSR Sensor	Electrodermal Activity

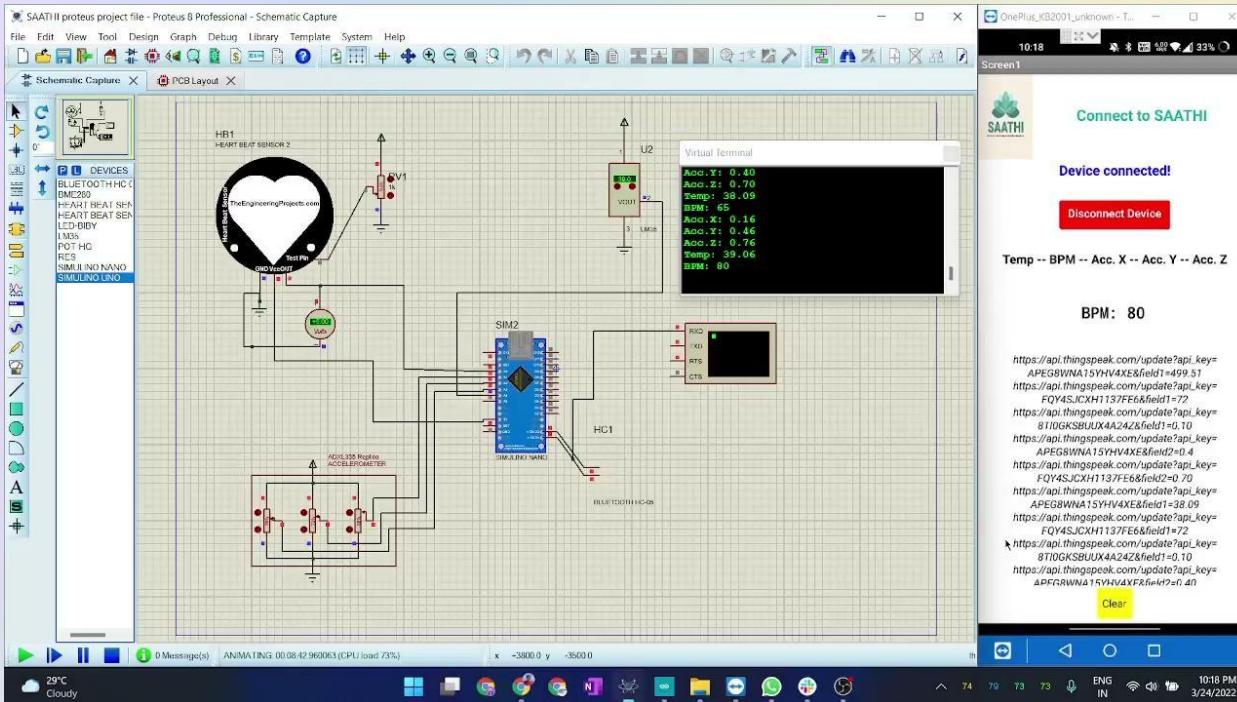
Simulation Data Flow



Proposed IoT System Data Flow



Video Demonstration

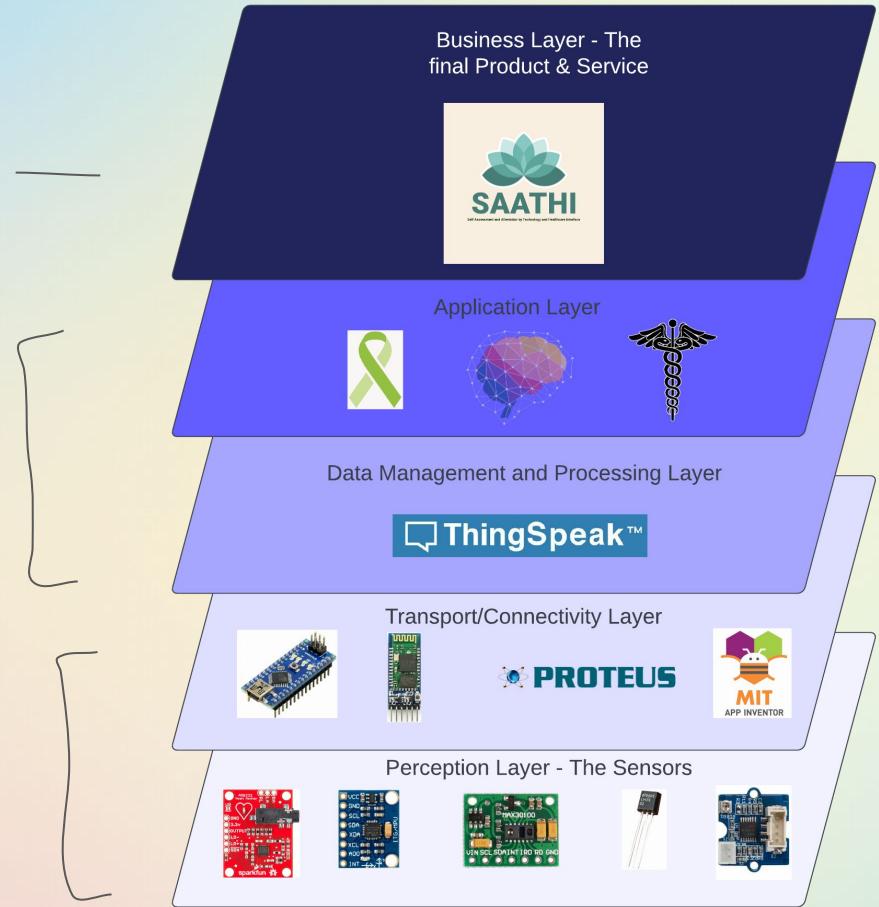


[Click here to view video](#)

Product Layer

Software Layer

Hardware Layer



User End Application: Feature List

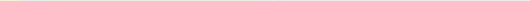
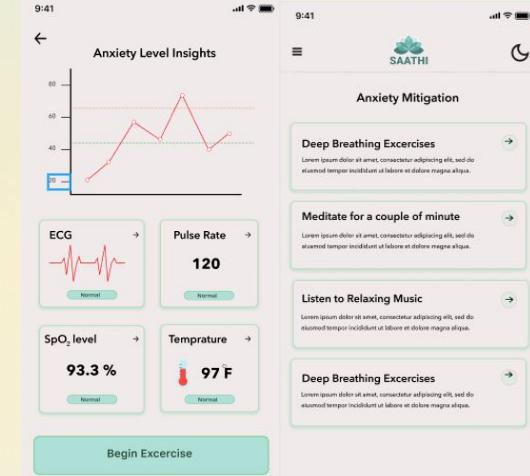
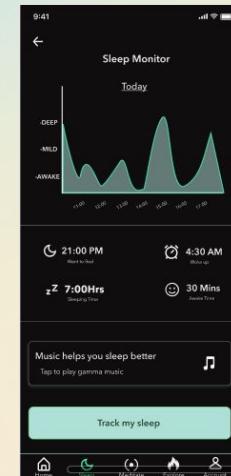
Tracking Features - Stress & Anxiety Levels, OCD Compulsion tracker, Panic Attack Prediction, Sleep quality, ECG, HRV, Blood Oxygen Level, Pulse rate, Body Temperature, Skin Conductance, Fall Detection.

Mitigation Features - Daily Therapy Sessions, Immediate Mitigation Measures, Relaxing Games & Music, Meditation guide.

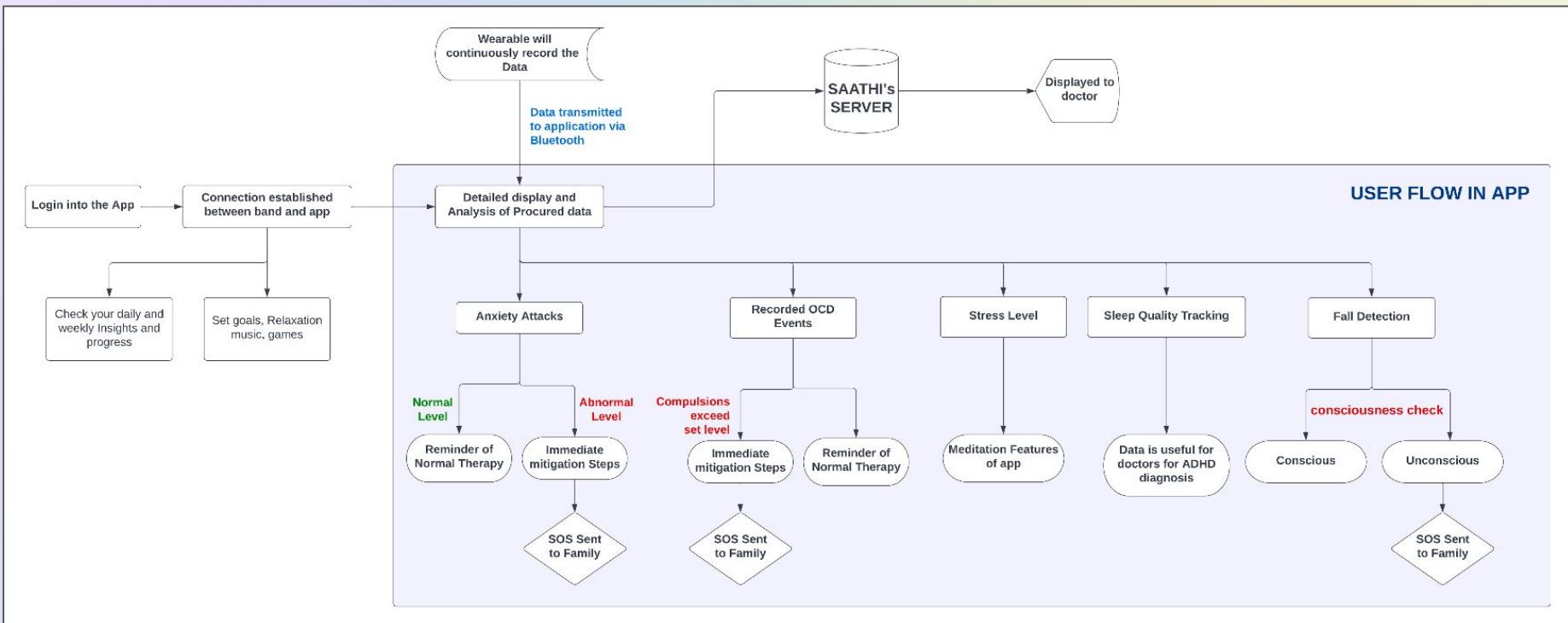
Emergency Features - SOS to Family members, Alert to a nearby ambulance

Premium Features - Advanced Analytics, Consultation Services

Alerts/Feedback - Alerts of Abnormal Behavior, Alert on Exceeding the Threshold



User End Application: User Flow



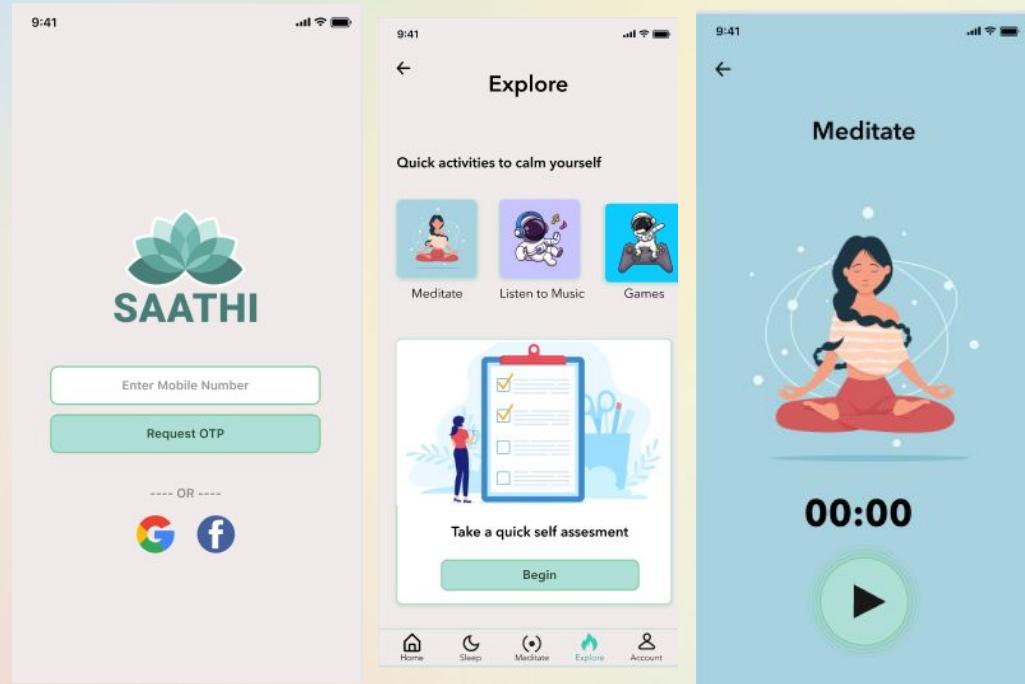
User End Application: UI Proposal



[Click here to view video](#)

User End Application: Success Metrics/KPIs

- **% Response rate:** Ratio of no. of successful clicks on the alerts sent to the total no. of alerts sent to the patients.
- **% Successful prediction:** Ratio of successful compulsion prediction to the total compulsions predicted.
- **% Engagement rate:** No. of mitigations done after each compulsion.
- **% Query Resolution:** No. of total queries solved to the total no. of queries received
- **% Transactions:** No. of In-App transactions per 100 users



VALUE PROPOSITION

CONSUMER PROFILE

GAIN CREATOR

- Smart band and app to monitor & predict severe health conditions
- Cloud storage & data analytics
- Prediction based on data recorded by band
- Inbuilt mitigation steps according to severity of disorder

PAIN RELIVER

- Instant process and automatic monitoring of essential parameters
- Prediction of severe health conditions
- Doctor end application with readily available data

PRODUCT & SERVICE

- 24/7 health monitoring using Smart band
- User end app for tracking and mitigation
- Prediction of severe health conditions
- Doctor end application with readily available data

CONSUMER JOBS

- Regular visits to Psychiatrists to check progress
- Use some app to schedule therapy sessions
- Rely on doctor's checkup report
- Check daily compulsions through external agencies
- Doctors need to perform various tests

PAINS

- Time Consuming
- No real time monitoring
- Chances of severe health conditions
- No SOS sent to Family in case of emergency

GAINS

- Reduce time in overall process.
- Continuous monitoring of data and all data stores & secured
- Early prediction of severe health condition
- Mitigation steps, SOS sent to Family in case of emergency



Business Model Canvas

Market Report

Finance Model

Business RoadMap
/Go-to-Market Plan

Market Report: Behavioral/Mental Healthcare Market Analysis



Drivers of Growth

- Increasing Awareness of Mental Health
- Post pandemic demand of Mental health care infrastructure
- Increase in Startups, innovation, their funding & Investments
- Hospitals adopting Health care systems
- Deteriorating Work conditions & increase in average stress levels
- Governmental Initiatives

Evidences of Growth

- The growing interest of Investors in this domain
- Increase in the number of mobile apps targeting Mental health
- Rising numbers of NGOs dealing with this issue
- Increase in Government spending

Why Indian Startups are yet to BOOM

- Scalability Issue: Present startups are trying to connect professionals with patients. However limited psychiatrists put up a ceiling in scalability.
- Trust, sense of security, and breach of privacy are a few factors that contribute to people not being completely accepting of mental health startups.



ET tech

Investments in mental health startups: US vs India



India's mental health problem in numbers

A 2017 study by medical journal The Lancet found that:

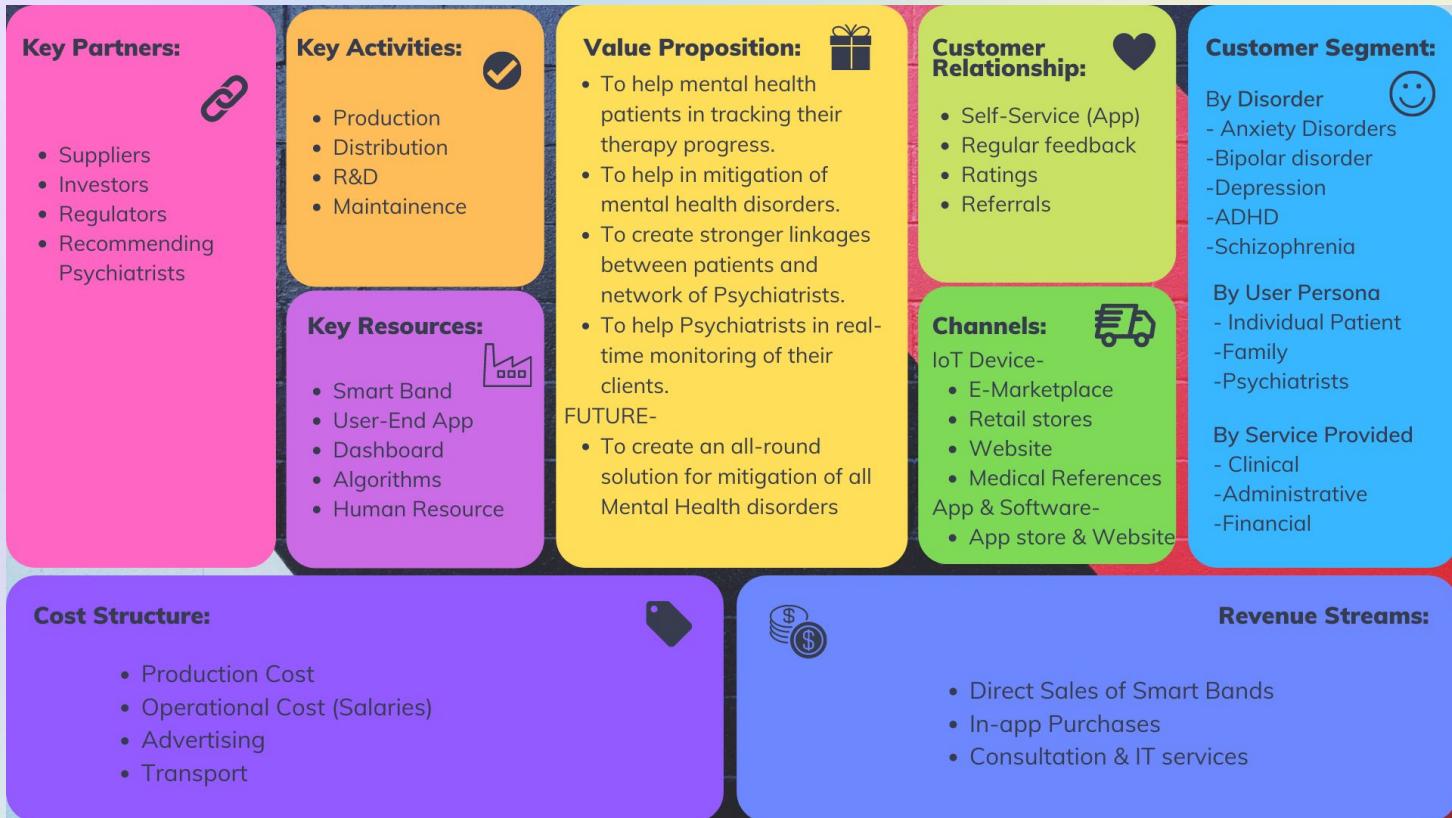


197.3 million Indians - 14.3% of the population - suffered from some form of mental illness in 2017



Of these, **45.7 million** had problems with depression and 44.9 million had anxiety issues

Business Model Canvas



Finance Model

ASSUMPTIONS

- We have Initial Capital for Production
- No abnormalities in the Inflation rate
- All the channels are working at their full efficiency

Here we are estimating number of customers we can get annually.

Source : Stastica

MARKET CAP GUESSTIMATES		
Parameter	Assumed percentage	Value
Population of India	-	1,30,00,00,000
No. of people suffering from Anxiety Spectrum Disorder	2%	2,60,00,000
No. of people that can afford tele-health services	5%	13,00,000
Market capitalization of our brand/product (Potential customers)	5%	65,000

PRODUCTION COST

Sensor Required for The device	retail costing
Arduino nano	₹499
EDA - Skin Conductance (SeeedStudio Grove GSR sensor)	₹820
LM35 Temperature sensor	₹53
ECG Sensor Module (AD8232)	₹650
MPU6050 Gyro-Accelerometer	₹1,000
Pulse Oximeter Heart Rate Sensor Module (MAX30100)	₹160
Total	₹3,182
Bulk production cost of the components	70% of Retail cost
Additional cost to production	Percentage in bulk prod cost
Packaging	2%
Governmental Taxation	18%
Actual production cost Per Unit	2,673 INR
Production Cost	2,673*65,000 =INR 17,37,45,000

Cost Structure

OPERATIONAL COST			
Operators	no.	Expenditure per person	Total Expenditure
Average Salary of employees	100	₹5,00,000	₹5,00,00,000
Rent	-	-	₹20,00,000
TOTAL fixed cost			₹5,20,00,000
Transportation cost	-	-	₹50,00,000
Advertising	-	-	₹50,00,000
Business essentials (legal service,etc.)	-	-	₹10,00,000
TOTAL variable cost			₹1,10,00,000

Revenue Stream

REVENUE			
Revenue Stream	Price per product	estimated yearly sales	Revenue Generated
Operating Revenue (through direct sales)	₹4,000	65,000	26,00,00,000
In-App purchases (premium service)	₹500	30,000	15,00,000
Software solutions to Doctor/Hospitals	Free	0	0
TOTAL REVENUE Generated			26,15,00,000

P&L and growth analysis

Yearly Inflation in production= 5%	Source: Statista				
Customer Growth rate= 8%					
Fixed cost growth= 1%					
	Financial Year 1	Financial Year 2	Financial Year 3	Financial Year 4	Financial Year 5
Projected revenue	26,15,00,000	28,24,20,000	30,50,13,600	32,94,14,688	35,57,67,863
Projected Production costs	17,37,45,000	18,24,32,250	19,15,53,863	20,11,31,556	21,11,88,133
Fixed Costs	6,30,00,000	6,36,30,000	6,42,66,300	6,49,08,963	6,55,58,053
Profits	2,47,55,000	3,63,57,750	4,91,93,437	6,33,74,169	7,90,21,677

FY 1

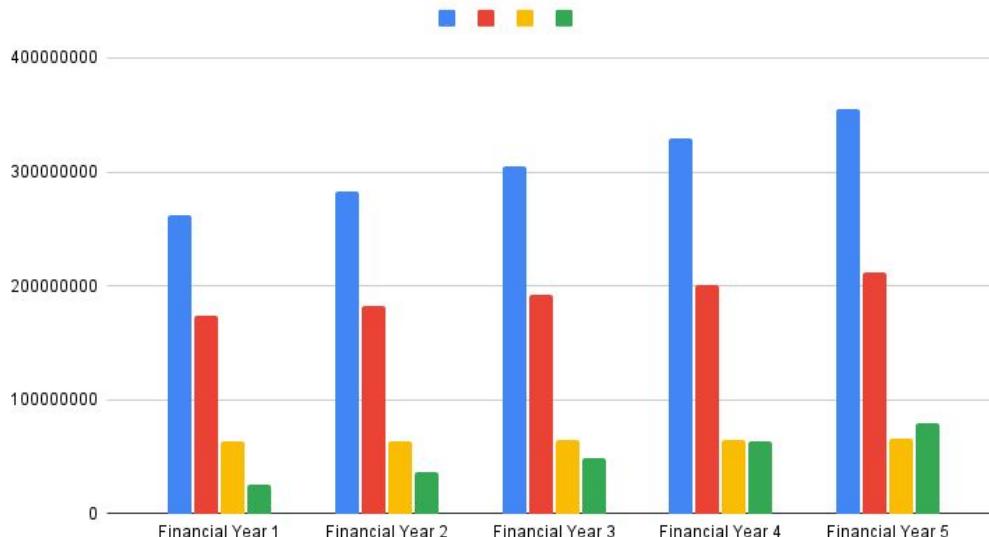
Price to earning ratio
 $= 23,67,45,000/2,47,55,000 = 9.56 \text{ INR}$

FY 5

Price to earning ratio
 $= 27,67,46,186/7,90,21,677 = 3.5 \text{ INR}$

P&L and growth analysis

Projected revenue, Production costs, Fixed Costs, Profits



In Financial Year 1, the **P/E ratio** is ₹9.56 i.e. for generating one rupee of profit, we have to invest ₹9.56.

This **P/E ratio** is reduced to ₹3.5 by the end of Financial Year 5. Hence the business has potential and is scalable for the long run.

Launch Strategy

Attract and Engage

Customers Directly:

- Create and release content available on Saathi App for free on social media
- Organize workshops and seminars at a large scale to create awareness at offices and educational institutes.
- Allow users to use the app for free even without the band for exploration
- Run targeted ads on social media platforms

Through Doctors:

- Reach out to doctors with our product in city centers.
- Give them free samples which can be tried by their patients
- Make them a part of the never-ending product development process

Servicing

- Design a manual for basic repairs and share it with distribution partners
- Establish a pick-up-drop repair service for customers with the help of delivery partners

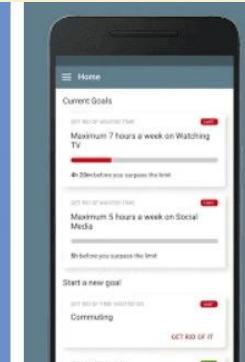
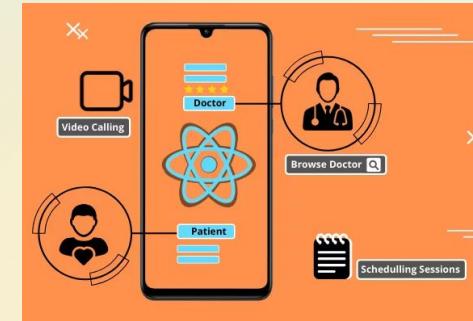
Sales and Distribution

- Sales through own website
- Partner with consumer retail chains for physical distribution in Tier-1 cities
- Introduce the product pan-India using e-commerce portals.

Business Growth

Technical Side

- Developing voice assistant for easy accessibility to vulnerable individuals.
- Tie-up with Online medical consultation platforms such as Practo, Portea to enable fast follow-up with experts.
- Monitor mobile and social media usage and suggest intelligent limitations on excessive use of any particular app
- To build Solutions which act as an extension to wearables and provide similar services.
- Devise edge computing algorithms to offload the lighter computational tasks to the wearable.
- Launch AI-assisted mental health helplines
- Improve feedback collection methods



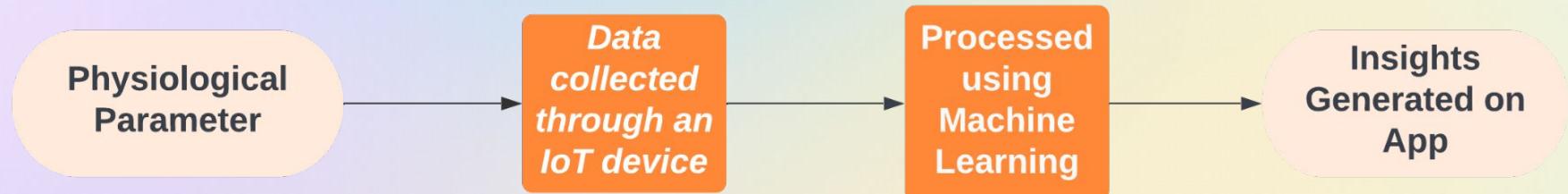
Business Growth

Strategy Side

- Targeting Tier-2 cities with NGOs, therapists and practitioners.
 - Explore collaborations with smart-watch brands to enter lifestyle industry.
 - Pursue deeper partnerships with doctors and treat them as customers for our product
 - Evaluate pharmaceutical chains and larger shops as potential distribution partners.
 - Increasing customer retention with fair trade-in prices for a new version in exchange for old one.
 - Introducing better warranty extension plans along with insurance at better rates.
 - To build a community of people suffering from mental health diseases in the application



Future Verticals



- Products which can be built over this fundamental framework:-
- Support people living with lifestyle disorders such as diabetes
- Performance, Form and Technique Tracking for Athletes
- Performance and Training Effectiveness for Animals (racing horses)
- Health Monitoring of Domesticated Animals

Future Initiatives

- Implement active engagement with qualified mental health coaches and therapists.
- End-to-end management of therapy and allied services over the course of the treatment of any disorder.
- Develop a voice assistant which can provide easy accessibility to vulnerable individuals. Improve synergy and cross-functionality with other IoT services and products such as smart homes to enable automatic control of mood lighting and music.
- Suggest health and nutrition plans on the basis of mental health condition.
- Monitor mobile and social media usage and suggest intelligent limitations on excessive use of any particular mobile app.
- Introduce the monitoring of more mental health diseases specifically phobias. Devise edge computing algorithms to offload the lighter computational tasks to the wearable.

Customer Stories

Rekha

Confused if meditation actually calms her down or not

Hema

Suffers from OCD, cannot get rid of her compulsions

Jaya

Suffers from panic attacks and loses control over her mind and body

Sushma

Forgets her coping mechanisms during anxiety attacks

Doctor

Patients cannot re-collect times of attacks

Aditya

Needs to see improvements in his sleep quality after following remedies



Thank You

Problem Statement by Silicon Labs

10th Inter IIT
Tech meet



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