Early
Detection
&
Screening

Case Study

gslab

Harnessing voice samples to diagnose health issues using data science

A healthcare technology disruptor develops a disease screening & monitoring platform based on speech analysis

Executive Summary

We developed a next-gen data science driven solution for a healthcare technology startup which diagnoses medical conditions using a person's voice as a biomarker. This platform enables users to record short voice samples and turns these into analytical data. This data is used to train data science models which develop a deeper understanding of diseases and underlying health conditions. Developing this end-to-end platform enabled the client to bring forth a new perspective towards methods of screening and early detection.
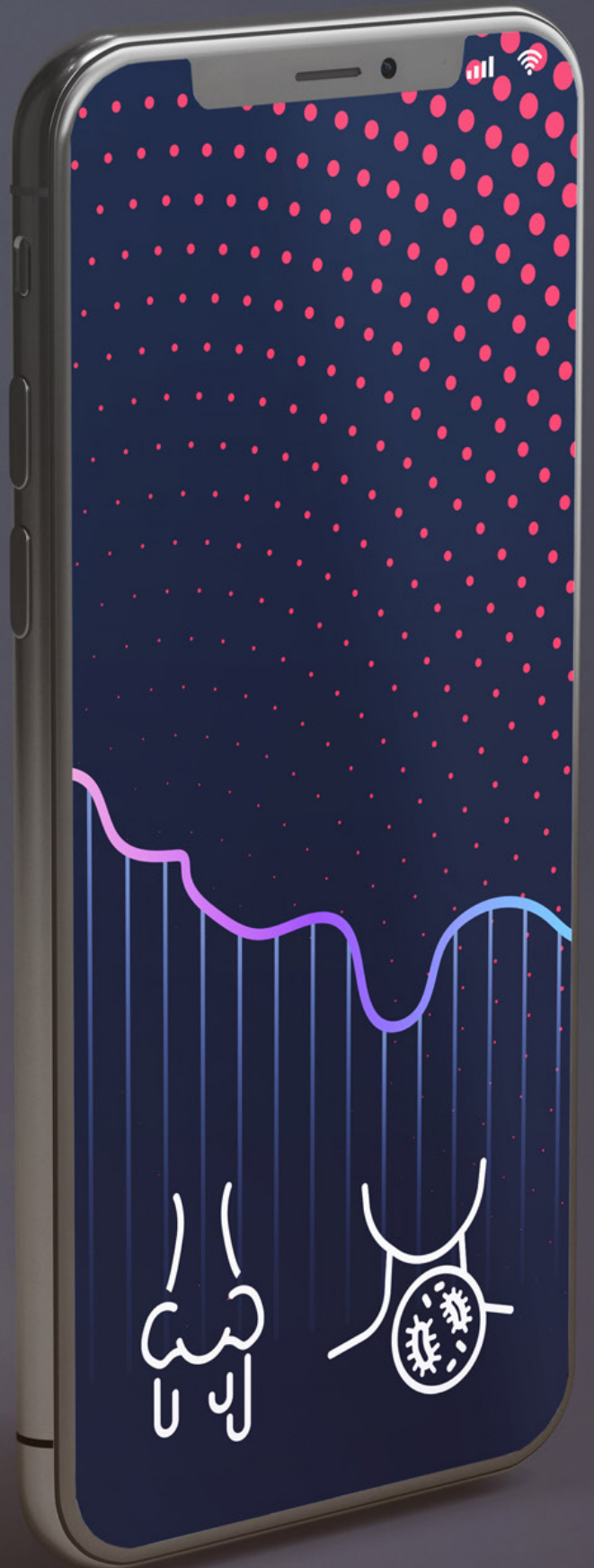
Overview

Traditionally, healthcare has mostly been an industry where physical presence is necessary for identification and treatment of medical conditions. Today, newer technologies are now enabling us to use innovative diagnostic approaches wherein our biological markers pinpoint to various ailments we might be suffering from. Our client is one such leader across the healthcare technology industry pioneering the use of data science in deciphering human health. They started developing a platform which would diagnose the mental & physical health of patients based on their voice samples.

Challenge

This problem necessitated the creation of a platform that would score a participant on clinical (depression, Alzheimer's etc.) or wellness (nasality, stress, sleepiness etc.) parameters based on few seconds of voice sampling. Development of mobile apps was also necessary for clinical studies with hospitals and pharma partners to discover new vocal biomarkers.

The app would also enable organizations to monitor wellness of their employees or end-customers. Partner apps could also be powered to use our diagnostic model through APIs and SDKs. Data capturing apps and mobile platforms would accelerate the discovery of data science models for newer health conditions. Creation of this ecosystem would enable doctors to use many new biological markers to accurately identify the medical condition.

Data capture and data processing channels would also needed to adhere to strict privacy & data protection laws of various jurisdictions. The real challenge lay in stitching together all the components so seamlessly that everything worked together in the form of a single predictive tool based on data science.
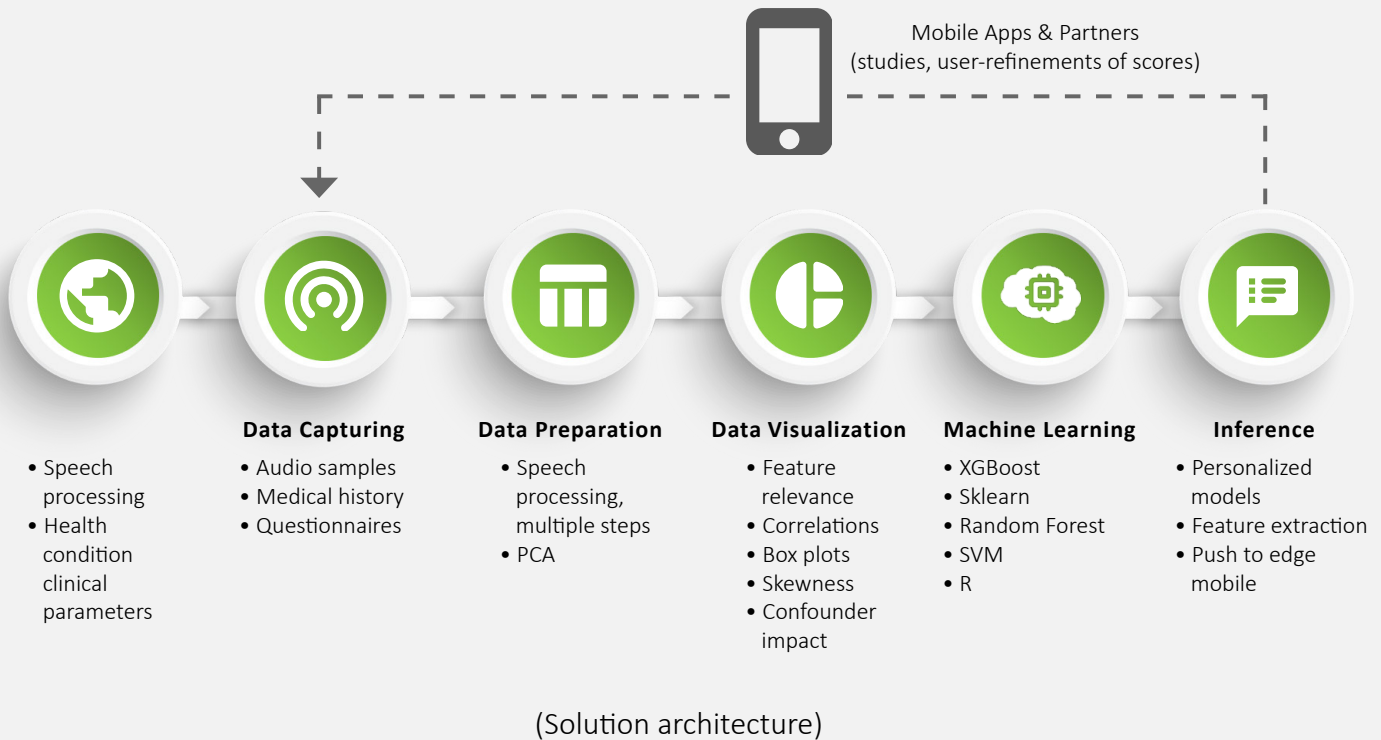
Solution

The project started off by understanding the nuances of speech processing and setting up of parameters for the clinical study. A lot of data was needed for analysis and an app was created which would capture data in various formats like voice samples and questionnaires. An understanding of mechanics of human speech and deep knowledge of digital signal processing was required to convert the voice samples into usable data.

ML models were then created for conditions such as depression, sleepiness and sinus congestion. To accelerate this discovery process of the data science team, we also created a scalable platform which powered data collection tools and partner apps adhering to region-specific regulatory constraints. This included design & implementation of the data engineering pipeline to provide a sandbox. We also created tools for collaborative experimentation for a distributed, interdisciplinary data science team consisting of citizen data scientists, signal processing experts and data scientists.

Additionally, we designed an approach to push the entire signal processing and model inference to the edge mobile device which enables scoring in offline mode and reduces server-side costs. This involved solving several MLOps challenges along the way

Mobile Apps & Partners
(studies, user-refinements of scores)

- Speech
  processing
- Health
  condition
  clinical
  parameters

Data Capturing
- Audio samples
- Medical history
- Questionnaires

Data Preparation
- Speech
  processing,
  multiple steps
- PCA

Data Visualization
- Feature
  relevance
- Correlations
- Box plots
- Skewness
- Confounder
  impact

Machine Learning
- XGBoost
- Sklearn
- Random Forest
- SVM
- R

Inference
- Personalized
  models
- Feature extraction
- Push to edge
  mobile

(Solution architecture)

Reduced discovery time

'Discovery time' for creation of data science models which could screen newer ailments was reduced from a few months to a few weeks through automation.

Impact

Our solution created a scalable platform which enables early-detection and screening of medical conditions through an innovative approach. This platform can be plugged in to partner apps which creates the potential of leveraging a bigger ecosystem powered by data collection tools adhering to region-specific regulatory constraints. The 'discovery time' for data science models to understand new health conditions got reduced from a few months to merely a few weeks by automating data collection & processing at multiple layers. It is poised to be an efficient diagnostic tool in the arsenal of medical professionals.

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