DAB 304 – Healthcare Analytics: Project Proposal

Dyslexia: Stuttering severity Identification post speech fluency therapy

Introduction:

Speech is the most basic and effective forms of expression and communication. According to data from westutter.org, only *1% adults and 5% children* cannot achieve what a normal human being does without any effort i.e., speaking fluently. Stuttering is a disorder directly related to speech where the *fluency flow is interrupted by repetition of words, involuntary pauses and being stuck for a while before attempting to speak*. Dyslexia and stuttering, although the two disorders are unique, the underlying neural disorder process connects the two. Through the lens of dyslexia, we can have a perspective of reality and challenges concerned with stuttering. This how stuttering may look like –

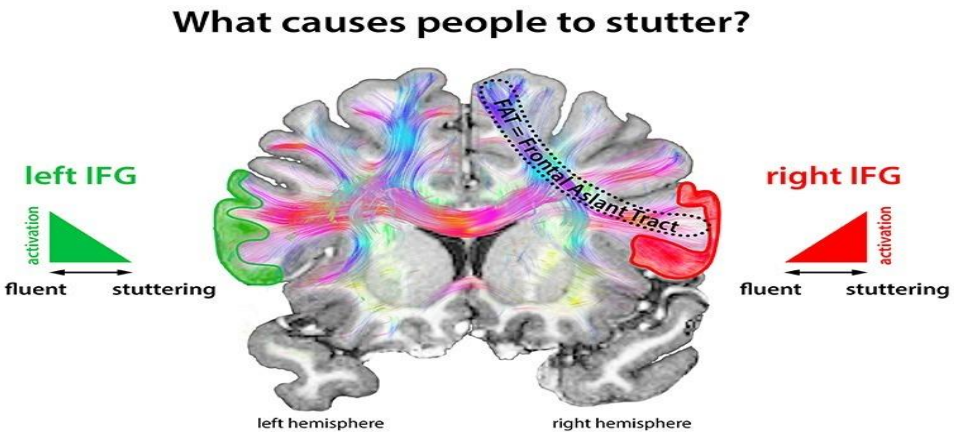
My name is **"Sai A-A-A-A bhiram, I have Sta-sta-sta-tuttering disorder" –** sign of repetitions.

"_____pro-pro-ject is based on dyslexia" – sign of being stuck for a while before attempting to speak

What neural process causes stuttering?

Nicole Neef, neuroscientist at MPI CBS – Max Planck Institute for Human Cognitive & Brain Sciences in Leipzig and University of Medical Centre Gottingen have gained crucial insights in regard of stuttering. According to their insights,

- The *hyperactivity in the regions of right hemisphere of brain is the central cause for stuttering.*
- Parts of *right inferior frontal gyrus (IFG)* are active when we stop actions such as hand or speech movements. If this region is overactive, it hinders other brain areas that are responsible for speech.



- In the above figure, the *right inferior frontal gyrus (IFG)* restricts the flow of speech while the *left IFG* supports it but in people who stutter, the both areas are conversely activated. Right IFG gets overactive and leads to tightened connections with *frontal aslant tract (FAT)*, which further is sign of strengthened movement inhibition causing interruptions in flow of speech and might inhibit activity in left IFG. The *left IFG processes the planning of speech movements* while *left motor cortex controls speech movements*. "If these two processes are sporadically inhibited, stuttering results in the affected person."

Motivation:

We as a group strived to work on unique real life health scenario that any of our group member is directly facing. Since one of our group members is an active stutterer, we chose to explore this area. One must be able to speak efficiently and read efficiently to be successful in most careers and to live life completely. It can be daunting to grasp steps leading to success but fall time and time again. Stutter might always feel like "I'm living in a world that is not meant for me because of who I am." Stutterers always suffer with problems like thoughts like depression, anxiety, stage fear, stress, loneliness, acting like introvert and others.

Since only 1% of adults and 5% of children are affected with this disorder and is a rare case, there is not much research done on this field of healthcare further leading to data restrictions. Considering all the challenges, we found it very motivating and interesting to work and explore this area of healthcare.

Fluency therapy can inspire dreams and when a dream has truly been embraced, it fulfils the heart of man or a kid. Sometimes it takes something or someone to help light a spark and that spark in this case might be a fluency therapy by a pathologist. Fluency therapies include speech exercises, meditation and yoga and other techniques which reduce stuttering by lowering disfluency affecting factors like stress, depression, fear and others.

Stuttering identification is an interesting interdisciplinary research problem involving pathology and psychology making it hard and complicated to detect. By working on projects like this we will learn with (mainly Pathologists) and from a person stuttering which can be a bridge for bringing in ideas, therapies and techniques to reduce stuttering and create awareness. Considering all the above, this topic has motivated us.

Evaluation and success criteria:

With the minimal data available from the online sources and data developed by our group, we will analyse the same by performing following steps:

- Data gathering through **group research** and online sources and **verifying** the gathered data.
- Data Cleaning and transformation using **MS Excel** and **SQL**.
- Performing Exploratory Data Analysis (EDA) on the developed data using **Python**.
- Analysing the **patterns** and **corelating factors** like Patient ID, Gender, Age, Profession, Stutter Type, Stutter Frequency, Number of Repetitions, Severity After Therapy using **Python**.
- Performing **regression tests** and **building a model** using packages like **sklearn** and train the same to predict the severity before and after speech fluency therapy.
- Performing visual analysis using **Tableau**.

By performing and working on all the above processes and by measuring the result to be above 70% for severity reduction after therapy from the model, we will consider the project to be successful.

As stuttering is a disorder without any cure, if we are able to correlate the factors using analytical process and prove that speech fluency therapy with respect to individuals personal and mental conditions improve the stuttering condition, then it is a straight communication success.

References:

1. https://vkc.vumc.org/childhoodstuttering/forscientists_datasets.html - Partial data collection.
2. Understanding Stuttering through Dyslexia: Finding Hope and Inspiring Dreams – International Stuttering Awareness Day (isad.live) – study on importance of speech therapy.
3. Machine Learning for Stuttering Identification: Review, Challenges & Future Directions (archives-ouvertes.fr) - Further study on types of stuttering, severity and factors.
4. Scientists Image the Brains of Stutterers to Find Cause | Technology Networks – learning the cause of stuttering.
5. (https://stammer.in) – TISA, Categorical features collection.
6. Release 1 (ucl.ac.uk) – Partial numerical features collection.

Contributions:

Sai Abhiram GP (779155):

- Research and study on stuttering disorder
- Data Collection, developing data and Verifying data.
- Correlation between factors, regression test, building a decision tree model using scikit learn.

Aniketh Reddy (793954):

- Study on brain and neuro-disorders directly related to stuttering
- Developing new numerical feature related to frequency of stuttering
- Exploratory Data Analysis and statistics
- Visualisations with respect to factors.

Kummetha Madhusudan Reddy (785790):

- Study on techniques used to measure stuttering like SSI-3, SSI-4
- Creating new categorical feature based on severity i.e., Low, Moderate, High
- Data Transformation using Microsoft SQL server.
- Supporting in regression tests and model building using python.

Pragna Reddy Arra (792673):

- Data exploration and gathering using resources like UCLASS and SEP-28K
- Study on the cause of stuttering.
- Developing new categorical and numerical features like Profession, Number of Repetitions.
- Data cleaning using MS Excel.
- Supporting in EDA and regression test.
- Tableau visual analysis.

"You don't have a choice as to whether you stutter but you do have a choice as to how you stutter"

Joseph G. Sheehan

(Ph.D. Psychology, Renowned Writer)