**Vision and Scope Document**

**for**

Classification of Stuttered Speech Behaviors of Filipinos Who Stutter Using Machine Learning Algorithms

**Version 1.0 approved**

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**Revision History**

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| --- | --- | --- | --- |
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# Research **Requirements**

## **Background**

People who stutter(PWS), if they choose to seek help, consult the help of a certified Speech Language Pathologist(SLP) to diagnose and alleviate stuttering. PWS undergo speech therapy with the aid of the SLP in effort to alleviate stuttering, however the SLP needs to perform a diagnosis in order to determine the best way to perform the therapy.

The SLP performs the diagnosis by conducting an interview in a form of a casual conversation. The patient’s basic information and history is asked to be discussed orally by the SLP; the SLP then observes unusual behaviors manifested by the patient as the patient discusses. Afterwards, the patient is asked to read a certain passage, as well as read another passage and explain orally what the passage was about. The SLP manually keeps counts of the number of times the patient stutters while doing these tasks, as well as the certain type or behavior of each instance.

However, the process of manually counting the instances of stuttered speech can be time consuming. There is also the risk of poor agreements when different judges make counts on the same material, as according to D. Kully and E. Boerg’s findings in their research. This research is being conducted mainly as an effort to reduce subjectivity of the classification of stuttered instances. The proposed classifier models are aimed to be a benchmark to some extent in order for diagnoses to be objective.

## Research **Opportunity**

Different studies have been conducted by other researchers involving the use of machine learning classifiers on stuttered speech. These researches have used feature extraction methods on stuttered speech such as obtaining Mel Frequency Cepstral Coefficients, Linear Predictive Coefficients, etc. This will be used as a dataset to train their classifiers. Different classifier algorithms has been used as well.

This research aims to use a different combination of feature extraction and classifier algorithms to achieve the task stated before. Aside from that, the research will focus on Filipino people who stutter as a source of their dataset, meaning the classifier models that will be produced will work best when dealing with Filipinos.

## Research **Objectives and Success Criteria**

The researchers of the study aim to identify and measure the effectiveness of different machine learning classification algorithms such as Multilayer Perceptron and Support Vector Machine in classifying stuttered speech behaviors, specifically whether or not stuttered speech is a repetition or a prolongation. The same dataset (that contains the Linear Predictive Coefficients of each stuttered speech instance) will be used to train and test the different classifiers. At the end of the research, it is expected that the researchers will be able to determine which classifier/s is/are the most effective as well as how and why this is so.

## **Customer or Market Needs**

As stated before, there is a risk of poor agreements when different judges make counts. This research is conducted mainly to solve that issue of subjectivity in diagnosis, specifically by using machine learning. Also, the researches involving machine learning on stuttered speech concerns speakers from other parts of the world. The researchers aim to accomplish the similar task but involving speakers from the Philippines. Different machine learning classifiers are also aimed to be utilized, such as Multilayer Perceptron and Support Vector Machines. More classifier algorithms will be used as well which will be documented in future revisions.

## Research **Risks**

The main risk that the research poses is the risk that the produced classifier models’ accuracy will be sub par after training and testing. Although this study’s main objective is to determine the most effective classifier algorithm, low accuracy results among all the classifiers will invalidate their purpose to classify stuttered speech behaviors in the first place.

Another problem that the project might encounter (if in case the results of the research were implemented as an automated machine), is the possibility that one might use this machine to self-diagnose their stutter. This can pose a problem to the accuracy of the diagnosis since people who stutter generally stutter less frequently when alone. In this case, a face-to-face diagnosis with an SLP can be deemed as more effective.

# **Vision of the Solution**

## **Vision Statement**

The main purpose of this research is to create a benchmark for the classification of repetitions and prolongations of people who stutter during diagnosis. As stated before in this document, different judges can make different counts of stuttered instances(on the same material). Thus, the researchers have proposed to use machine learning to accomplish this task, making the classification more objective.

## **Major Features**

At the end of this research, the results of the experiments will be comprehensively documented, especially the accuracy of the different classifier models. This research will also focus on using stuttered speech from Filipino PWS as the dataset, which other researches have not.

## **Assumptions and Dependencies**

The researchers have used the tool, Yet Another Audio Feature Extractor(YAAFE) to extract the audio features (Linear Predictive Coefficients) needed by the classifiers. YAAFE is an audio features extraction toolbox developed at Telecom Paristech. It has several dependencies namely, Eigen, Smarc, libsndfile, mpg123, and HDF5.

For training and testing the classifier models, the researchers intend to use Weka. Weka is a collection of machine learning algorithms for data mining. It contains tools for data pre-processing, classification, regression, clustering, association rules, and visualization.

The researchers have also requested the help of Ms. Roselle Wednesday Gardon to be the project adviser.

# **Scope and Limitations**

## **Scope of Initial Release**

At the end of the research, the results that are expected are comprehensive reviews regarding the effectiveness of each machine learning classifier used. From these reviews, a conclusion regarding which classifier is the most effective will be drawn. Aside from the results, the paper will contain an in depth discussion on the methodology used by the researchers in performing the experiments.

As for the classifiers, different algorithms are intended to be used such as Multilayer Perceptron and Support Vector Machine. More algorithms will be used and will be documented in the future. The dataset that will be used to train and test the classifiers will come from stuttered speech of Filipino PWS.

## **Scope of Subsequent Releases**

As stated before in the document, more algorithms are planned to be used in the experiments. The algorithms that will be used in the future should have a significant reputation as classifiers that can effectively be used to temporal data.

## **Limitations and Exclusions**

The research will only focus on the classification of segmented stuttered speech instances. Explicitly, the research does not aim to detect stuttered speech from speech audio. The expected input of the classifier models are audio features from segments of stuttered speech sounds, namely repetitions and prolongations. Furthermore, the project does not also aim to implement the results of the research into a working product, but rather aims to prove the theory that machine learning can be used to classify stuttered speech behaviors; the project also aims to determine the best classifier for this task.

# Research **Context**

## **Stakeholder Profiles**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Stakeholder** | **Major Value** | **Attitudes** | **Major Interests** | **Constraints** |
| People who stutter | more objective diagnosis | may or may not have faith on a computer that classifies stuttered speech | more objective diagnosis might mean more effective therapy | - |
| Speech Language Pathologists | new way to diagnose patients who stutter | may or may not be favorable using a computer that classifies stuttered speech | ease of diagnosis; standardized criteria for diagnosing | - |
| Medical and other reseach institutes | research advancement | interested in research findings | new findings related to the field; new knowledge | - |

## **Project Priorities**

|  |  |  |  |
| --- | --- | --- | --- |
| **Dimension** | **Driver (state objective)** | **Constraint (state limits)** | **Degree of Freedom (state allowable range)** |
| Schedule |  |  | at least one classifier algorithm trained by the end of the term |
| Features | 2 or more classifier algorithms used in the study |  |  |
| Quality |  |  |  |
| Staff |  | team consists of 3 members |  |
| Cost |  |  |  |

## **Operating Environment**

The people who would benefit from this research are main Filipinos. Suppose that a product will be created using this research, speech pathologists can use this product inside their clinics to help them classify stuttered speech behaviors more objectively. The speech pathologist can retrieve the diagnosis after the machine processes the needed information.