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Towards ICT based Solution for Stuttering

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Abstract— *Stuttering is speech disorder that has affected a large group of people in the world population. ICT based solutions for stuttering treatments are not well known. Information about the existing ICT based solutions, their effectiveness, and the user satisfaction of the currently available solutions are not studied thoroughly. Therefore, present day researchers have fell into greater trouble in delivering the best possible solution to the masses. This paper provides the results of a cross sectional survey conducted towards identifying the differentiation of age groups, duration of existence of stuttering, use and experience of existing solutions, and the effectiveness of their performance. This paper will be an initial step towards engineering an ICT based solution to assist stuttering treatments.*

Keywords— **Stuttering, Survey, Treatments**

I. Introduction

Stuttering, a disruption in the fluency of verbal expressions characterized by involuntary, audible or silent, repetition or prolongations of sounds or syllables (Büchel C, 2014).History of stuttering dates back to the Biblical Mosses, "Slowness of speech and tongue", which stated back then as a significant disruption that cause to fluency of all people, irrespective of their ethnicities or cultures. Even to date the mystery of language production amuses speech experts, disorders like stuttering are even more poorly implied (Büchel C, 2014). Studies show that 1 % of the total population at a given time suffers from stuttering (Bloodstein, 2008). Stuttering is classified under 3 categories, which are repetition, prolongation, and blocks (Reardon, 2010). Their nature is explained in table 1.

Table 1. Types of stuttering

Type	Nature
Repetition	Repetition of multisyllabic words ("mommy- mommy-mommy let's go")
	Repetition of monosyllabic whole words ("I-I-I want to go")
Prolongations	Syllable prolongation ("lllllllike this")
Blocks	If the pause exists for more than 2 seconds ("I----ike this")

These categories are diversely spread among the stutter community. Many tend to have multiple types of stuttering and some may become dominant in one. Symptoms results in creating social awkwardness and mental pain gained by not able to speak the way they want.

A survey performed by "I Have a Voice" foundation (QUIÑONES, 2012), which got 52 responses shows that different age groups suffer at different stages in life. It presents the symptoms that aroused in the respondents under 3 categories: core, secondary, and psychological.

At present, research and development work has been carried out on the cause and effect of stuttering. Though information about the biological and social aspects of stuttering are available, focus on getting help of ICT for the domain of stuttering is lacking. This paper addresses the study results in different features utilized as a tool for ground preparation in developing a software solution to facilitate comfortable oral communication with the people suffering from speech disabilities.

Section II provides the methodology used for the cross-sectional survey. Section III discusses the results of the survey via an analytical explanation on the collected data. Section IV concludes the paper indicating the future avenues and the nature of the solution where the performed study can be utilized.

II. Methodology

This section presents the methodology used for the cross-sectional survey. The survey was done focusing on two groups: general public, who is suffering from stuttering and experts/professionals related to the domain.

A. General Public

A questionnaire was used, created using Google forms, with 14 questions, for respondents to provide reliable answers anonymously without directing to any privacy issue. The fundamental goal of arranging the questionnaire is to obtain overall understanding of the following areas.

- Self-identity (gender, age)
- Genetic and family background
- Commencement of the stutter (starting point)
- Stutter type
- Opinion on usage of existing solutions
- Desire for a ICT based solution

The questionnaire was distributed among the members of two Facebook groups, namely "Stuttering hangouts"

(Hangouts, 2017) and "Stuttering arena" (Arena, 2017). Each group comprises well over 3000 members. These groups are created for the sole purpose of motivating the stuttering people by each other and circulating important information among the group members. The survey was conducted for 29 days started from 13/11/2016 to 11/12/2016.

The first question of the questionnaire was used with the intention of sampling the group whether they presently suffer from stutter or not. Responses gathered through the respondents are shown in table 2.

Table 2. Responses to the present stutter condition

Do you stutter?	Percentage	No of respondents
Yes	100%	60
No	0%	0

Introducing a sampling technique for the responses gained through the questionnaire was intentionally avoided since all of the 60 respondents are suffering from stuttering with a percentage of 100.

B. Expert Interviews

Expert interviews were performed with 3 doctors: a physician, a paediatrician, and a speech therapist as the most appropriate sampling group of experts. The selecting criteria of the professionals are as follows.

1) Physician*:* Physician who specialized in diagnosis and medical treatment, examines the patients with different categories of illnesses. Physician also has a capability to diagnose and identify the patients who suffer from stuttering.

2) Paediatrician*:* Paediatrician who specialized in medical care for children has easy access to gather information from the parents/guardians about their child's significant variations of speech patterns (dysfluency and fluency).

3) Speech Therapist*:* Speech therapist who specialized in evaluation, diagnosis, treatment of communication and voice disorders maintains a close relationship with the people who stutter.

At the interview with the aforesaid professionals, they were presented with open-ended questions. All three doctors explained the cause and effects of stuttering quoted in medical text books, results of the recent researches, poor performance of the existing technological solutions, variety of experiences gathered through their long years of career in the medical field and critical need of having a developed ICT based solution.

Even though the doctors were having busy schedules in their routine day to day medical activities, the interviews held in several occasions were in a healthy manner with the pre-arranged appointments. 45 - 60 minutes were spent in each occasion to answer the pre-arranged questions and further clarifications. Note taking and recording were the primary source of information assimilation.

III. Results of the cross-sectional survey

The fundamental purpose of conducting the cross-sectional survey was to obtain an overall understanding of the nature of individuals who stutter, use and experience of existing solutions, and the effectiveness of their performance.

A. General Public

The results of the survey were very impressive and many aspects of the target audience such as gender, interrelationship of family members, age group, stutter type and glimpse of the existing solutions used by the respondents, and their experience of using these solutions were highlighted. 55% of male and 45% of female had responded among the total 60 respondents.

Many attempts were taken by past researchers to find the family background of stuttering. Researchers such as (Andrews, 1991; Howie, 1981; Felsenfeld, 2000; Ooki, 2005; Dworzynski, 2007) provide evidence that genetic factors play a role in causing stuttering. Stuttering mainly affects males, transmission from fathers to sons is commonly observed (Drayna, 2011). Several questions were added to the questionnaire to gather the information covering the area of family history.

Questionnaire examined the family background of the respondents. It helped to identify whether there is a member in the family who stuttered earlier. Results showed that majority of the respondents had at least 1 or more family member who has suffered from stuttering as indicated in table 3.

Table 3. Family member who stutter

H – Hesitation P – Prolongation R – Repetition I - Interjection

Family Member	Responses	Stutter type			
		H	R	P	I
Father	6	4	2	0	0
Cousins	6	4	1	1	0
Mother	5	5	0	0	0
Brother	5	4	1	0	0
Grandfather	4	4	0	0	0
Grandmother	3	0	3	0	0
Uncle	3	3	0	0	0

As mentioned by researchers, stuttering affects more population in the age group of 5 – 19 years (Sadashivappa, 2015). However, the clear known cause for these speech disabilities among the children is not highlighted (Caruso, 1999).

Age classification was done in the survey considering the age groups mentioned by the healthychildren.org website (healthychildren, 2017) The extracted age groups are as follows.

- 3 – 5 years (Pre - school)
- 5 - 12 years (Grade-schooler)
- 12 -18 years (Teen)
- 18 -21 years (Young adult)
- Above 21 years

According to the survey 83.3% of the 60 respondents were above 21 years and young teens making the next in the list. But when comparing the inception of the stutter, majority of the respondents started to stutter at their pre-school period making 58.3 % of the 60 participants. Table 4 shows the analysis of this result.

Table 4. Age group when respondents started to stutter

H – Hesitation P – Prolongation R – Repetition

I - Interjection

Age group	Percentage	Stutter type			
		H	R	P	I
Pre- school	58.3%	20	5	9	1
Grade-schooler	36.7%	7	10	4	1
Teen	5%	1	1	1	0
Young adults	0%	0	0	0	0
Above 21 years	0%	0	0	0	0

A question was included to identify the significant category of stutter type. Respondents were given multiple attempts to choose one or more stutter types they possess. 46 respondents out of 60 were under the hesitation category making the highest number in the list. while repetition and prolongation making the next in the same shown in the table 5.

Table 5. Stutter type of respondents

Stutter type	No of respondents	Percentage
Hesitation (Blocks)	46	78%
Repetition	35	59.3%
Prolongation	33	55.9%
Interjection	20	33.9%

Currently available devices and technological awareness on the solutions to cure stuttering were given a prominent place in the survey. 80% of the respondents were aware about the available solutions in the market to help overcome their stutter. Delayed auditory feedback devices were taken the major quota of the survey results.

Table 6. Software and apps used by respondents to overcome stuttering

DAF – Delayed auditory feedback

Software/apps used by the respondents	No of responses	Category
Speech easy (SpeechEasy, 2013)	1	DAF
SSEP online course (SSEP, n.d.)	1	DAF
Voice amp (voiceamp, n.d.)	1	DAF
DAFT	3	DAF
Fonate DAF (DAF, n.d.)	2	DAF iPhone app

Delayed auditory feedback (DAF) and Frequency auditory feedback(FAF) devices are the techniques used at present among the people with speech disabilities to reduce stuttering in different degrees. “Choral effect” is the phenomenon underling these devices (STUTTERINGJACK, n.d.). DAF plays person’s own voice back to them with a slight delay, tenth of a second later and FAF interchange the frequency of the feedback that the person hears. Thereby high pitch voices and low pitch voices will be changed into high and low frequencies respectively.

But when comparing the satisfaction on the existing solutions, the results pointed towards uncertainty. Majority responding “Proper solution has not addressed yet”. Respondents believed that 100% usable and efficient solution is not in their reach.

Table 7. Respondents reaction to present day solutions

Respondent comments	Percentage
Satisfactory	13.3%
Need to be improved	33.3%
Proper solution has not addressed yet	53.3%

DAF devices tend to have a common set of limitations in its physical form as well in practical usage. Speech easy, a DAF device, showed drawbacks such as uncomfortably, while using daily, battery issues, background noise, fragility and difficulties in volume adjustments. (STUTTERINGJACK, n.d.; Dalton, n.d.)

Questionnaire was used to get suggestions for having a newly built software solution to prevent stuttering. Majority positively responded to have a solution with the following features mentioned in table 8.

Table 8. Features requested by respondents

Feature	Number of respondents
Easy to use	14
Affordable/free	6
Friendly, adaptable, portable and accuracy	4

During the survey, the following question indicated below was asked to gather the genuine opinion on how many respondents anticipated an ICT based solution.

- **Question**: *Will an intelligent Solution that monitors your speaking patterns and supports you to pronounce words and phrases be helpful?*

Table 9. Willingness to the proposed solution

4 - Very important

1 - Not important

H – Hesitation P – Prolongation R – Repetition

I - Interjection

Scale	Responses	Stutter type			
		H	R	P	I
4	19	10	4	3	2
3	19	8	6	5	0
2	13	6	6	1	0
1	9	4	0	5	0

The above responses in table 9 indicate that the stutter community is eagerly waiting to have an ICT based solution for their burning issue.

B. Expert Interviews

All experts provided similar opinions/ideas towards the questions asked. Majority strongly believe that speech therapy is the most reliable solution at present, available to cure stuttering. Speech therapist commonly use the manual method of listening to the patient's speech pattern, frequency of words uttered and clarity of the voice, to identify the dysfluency.

C. Analysis

Online questionnaire depicts 80% of the total respondents were aware about the existing solutions. Though 48 respondents have used apps/software, 8 members believe that there is a satisfactory solution in the market. 32 responded negatively that the existing solutions are not geared enough to use as a better treatment for their dysfluency. Considering the responses in table 9, respondents are willing to have a developed ICT based solution with the features mentioned in table 8.

The genuine opinions of the target audience itself undoubtedly confirm that the purpose of gathering the required information through the survey conducted to design and develop a well framed, acceptable solution to the stutter community is achieved successfully.

Responses provided by the experts whom interview were took place helped to gain an insight on their day to day medical activities and their notion about the therapeutic facilities they provide to the patients. Following is a summary of the responses to the interview carried out.

- Speech therapy is the ideal way to cure stuttering. Many have overcome stuttering from it.
- Manual method to assess the patient is used to asses from the inception by all speech therapists.
- People in different age groups tend to stutter. But majority of the patients start to stutter at their preschool days when they begin to speak long sentences.
- Close relatives in the family suffer from stuttering in some form among the majority of the patients.

When comparing the similar natured responses gained by the questionnaire survey and the interview performed, It is clear that the aid of an ICT based solution could be used to address the issues.

IV. Conclusion and Future Work

When considering both information gathered through the online questionnaire and the expert interview, it is clear that the masses of all age groups are eagerly anticipating to get a cure for this troublesome symptom. Many of the respondents preferred to have a user friendly advanced technological device, which is affordable, portable and unnoticeable.

Experts such as speech therapists and physicians also suggest that ICT based solutions are not available at present to make their task fast and effective. Stuttering is a condition mainly affected at the small age (Bloodstein, 2008). Though it is important to provide a solution as a treatment for the small age group, the risk factor of handling cannot be avoided by providing a technical solution in the form of a device.

While considering all the available sources and responses to the questionnaires and interviews performed, this

paper suggests that an ICT based solution to support speech therapists is important to cater the present day needs of this problem.

Accuracy, affordability and user friendly can be treated as the salient features for the proposed ICT based solution as per the responses of the participants in the survey questionnaire in table 8

We anticipate in extending this survey further to engineer the aforementioned ICT based solution in catering the critical needs of the stutter community.

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