

An Application to Support Stuttering People by Implementing Linguistic Variable Based on Fuzzy Logic

Dr. Ashit Kumar Dutta *

Associate Professor, Shaqra University, Kingdom of Saudi Arabia

Email: drashitkumar@yahoo.com

Abstract

Fuzzy logic is the idea behind the artificial intelligence and automated machines are the brain child of it. Linguistic variable are the special type of variables used in the fuzzy logic to represent the characteristic of an object. The scope of the fuzzy concept is wide and implemented successfully in the field of science. Stuttering or stammering is the speech syndrome causes improper speech or broken accent and make people to afraid to speak in public areas. The aim of the paper is to design an application to support stuttering people to reduce their problem and improve their life style. The research utilises the concept of linguistic variable in fuzzy logic and develop the application.

Keywords: fuzzy logic; linguistic variable; stuttering; artificial intelligence.

1. Introduction

Fuzzy logic was introduced by Dr.Lotfi zadeh during 1960's. He analysed the Boolean logic and found not useful for natural language, which is not possible to express in '0' and '1'. He found the fuzzy logic is the best way to express the natural language because of its nature of computing based on the degrees of truth than the usual Boolean logic computing method. Fuzzy logic analyses vagueness in natural language and real time applications. Soft computing utilises the techniques of fuzzy to develop application model deals with complicated data. It deals with multiple – value logic and eradicate vagueness found in the data. It converts human supplied rules into mathematical expressions, simplifies the complicated job of system designers and make an accurate representation of the system behaviour in the real world. Fuzzy inference systems consist more number of conditional "if – then" rules. Designers can easily understand the inference rules and build an inference system to solve a vague problem.[6,7,8] Linguistic variables represent well defined information appropriate for the problem. It is used in fuzzy based systems to deal with the vagueness of the data. For example, "Very hot day" is a general sentence to express the feelings of activities related to hotness.

* Corresponding author.

“hot” can be the linguistic variable to build an inference found in the system and generate results like “ Drink water” , “Switch on A.C.”, “ Take rest”, “Use Umbrella”, and “Rain may come”. It can be combined with logical operators to produce results related to the logical operations [1,9,10,11].

The values of linguistic variables will be worlds or sentences which is a contradictory to the traditional programming environment. Linguistic variables are numerical values to define a system having vague data.

Stuttering is also called as stammering is a communication syndrome causes broken speech, prolongations, abnormal sounds and accent. It may occur to the child at infant stage. Research shows that genetic, child growth, and neurophysiology are the reasons for the stuttering. Statistics shows that 70 million people having the problem, which is 1% of the total population. Every child develops speech at different stage and if there is a syndrome then they get into stutter and prolong further in their life [16,17,18,19].

The research is to find a solution to reduce the difficulties face by the stuttering children. The work deploys the fuzzy logic to build an application to support the children to reduce their stress. The following section will discuss the literature review and results and discussion.

2. Review of Literature

L.A.Zadeh had done a review on the concept of linguistic variable and its rule in fuzzy logic. The work is a bench mark in the field of fuzzy and referred by many researchers in their work. The review work discussed the concept of fuzzy logic, linguistic variable and its truth variables. The author developed a compositional rule of inference and approximate reasoning in fuzzy logic [1,2].

L.A.Zadeh proposed a research based on linguistic variable for approximate reasoning. The work shown the application of the variable in finding the mean of approximate characterization of phenomena which considered as too complex or too ill-defined in conventional quantitative terms. The result of the research shows that the linguistic approach is the best way for the programming in artificial intelligence [3,4].

Jannis K.Androutsopulous had proposed a research using the concept of linguistic variable to German youth slang. The work described mechanisms of slang and its variation. It has tried to fill the gap between slang studies and variation socio linguistic methods. The work has focussed on the different aspects of slang of the youth in German [5].

Walter Banks has done a review on linguistic variables. The author discussed the common applications of linguistic variable including home environment, control, product pricing and process control. Moreover, it shows that the linguistic variable reduces the computation complexity of the application. The work argued that the variables are central in the fuzzy logic manipulations [6].

3. Methodology

The research focus on the reasons for stuttering and provide solution to overcome the problem. The work has

designed an interface for the people to interact with the application. The following factors are the root cause of stuttering and they are

- (I). More nervous
- (II). New Environment

The research work provides a solution to overcome the factors and leads to avoid stutter and people can speak fluently without any problem. Figure 1 shows the model of the system.

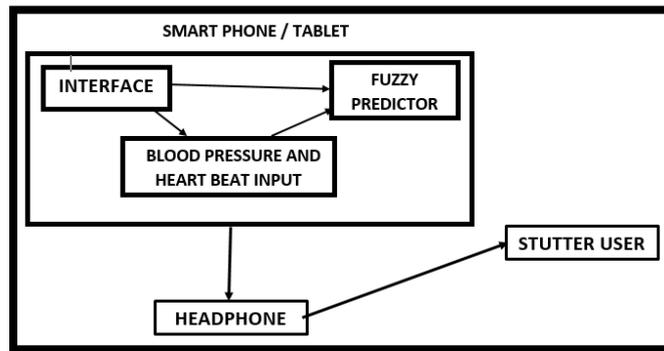


Figure 1: Model of the system

The model interface will monitor their blood pressure and heart beats values, as they are using a headphone with the application, it will be easy for the interface to monitor them. It is very much necessary for the user to use the headphone with the application, interface will send the data about the user situation to the fuzzy predictor. The fuzzy predictor uses linguistic variable and shown below:

Linguistic Blood_pressure TYPE int SB(min 120 max 140) DB(min 80 max 95)

```
{
    Member SB { 90, 140, 160, 180}

    Member DB{ 80, 100, 90, 75}
}
```

The linguistic variable “Blood_pressure” stores the value of systolic and diastolic blood pressure value and trigger the fuzzy predictor for the further step in the application. The fuzzy predictor stores the words in the user accent and intimate them during their nervous situation. The system can be triggered directly by the user in the worst situation / new environment. It helps user to visualize those words by using the properties of word. User can store their difficult words in the application and fuzzy predictor automatically adds the properties for the word to help user to visualize the particular word. For example, “car” is the word stored by the user and fuzzy

predictor stores the properties like “it has 4 tyres”, “Toyota, GMC are the famous companies”, and “Many luxurious cars are available”. The user can remember their difficult word and overcome the worst situation very easily.

4. Results and Discussion

The following code shows fuzzy predictor and different kind of linguistic variables used for the application and figure 2 and 3 shows the screen shot of the application. The figure 2 specifies the modules to be carried out by the user. User has to store the difficult words so that application can store and trigger it during the stuttering situation. 1000 words can be stored by the application. The next module is to store the voice of the users, the application will use the user’s voice to spell out the word so that they can grasp the word easily. The last module is the voice is male or female, it is important to know that males are largely affected by the stuttering problem than the female. Table 1 shows the snippet of module used in the research.

Table 1: Code for fuzzy predictor

```

Linguistic Blood_pressure TYPE int SB( min 120 max 140) DB(min 80 max 95)
    {
    Member SB { 90, 140, 160, 180}
    Member DB{ 80, 100, 90, 75}
    }
Linguistic Heart_beat TYPE int min 70 max 90
    {
    Member low{ 60,65,69}
    Member high{90,85,80}
    }
Linguistic start_ap type int start 1
    {
    Member self_start{1}
    Member manual_start{0}
    }
Linguistic store int min 0 max 1000
    {
    Member full{999}
    Member empty{0}
    }
Fuzzy predictor()
{
If blood_pressure is sb then appstart is on
If blood_pressure is db then appstart is on
If blood_pressure is min then appstart is off
If Heart_beat is max then appstart is on
If Heart_beat is high then appstart is on
If Heart_beat is low then appstart is on
If start_ap is start then self_start is on
If start_ap is start then manual_start is on
If store is max then full
If store is min then empty
}
void main()
{
predictor();
}
    
```

The figure 4.2 shows the measurement of blood pressure and heart beat. The application can be triggered automatically when the measurement exceeds in normal values. The user has to wear the headphone for the better results of the application.

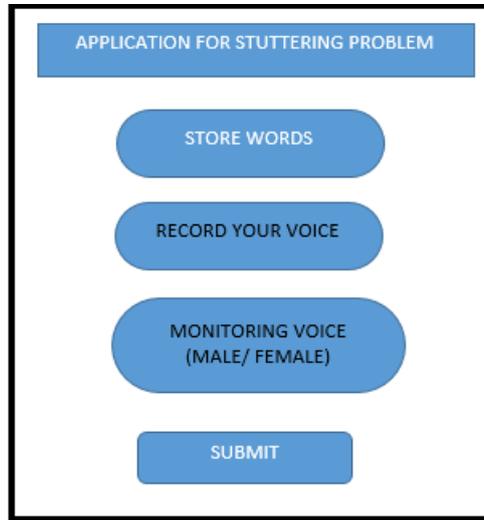


Figure 2: Application Interface – 1

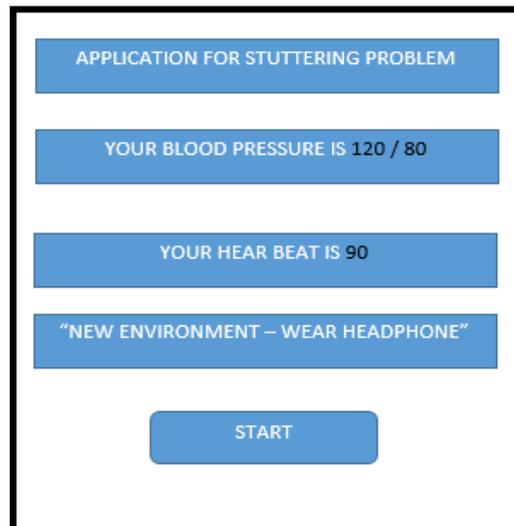


Figure 3: Application Interface – 2

5. Conclusion

Linguistic variables are the input / output variables of the system in a natural language. It can be defined as a set of linguistic terms. A fuzzy system is a non- linear mapping of input data set to the scalar output data. The research utilised the facilities of linguistic variable for the construction of the application to support the stutter people. Stuttering is the common problem found in the children and if it is not properly treated then spoil whole life of the children. The result of the research shows that the users uses the application felt well than the earlier situation. The application can be installed in smart phones and tablets to serve the stutter people. The further

research can help the people to eradicate the stutterness and lead a normal life.

References

- [1]. L.A. Zadeh, Fuzzy-set-theoretic interpretation of linguistic hedges, *Journal of Cybernetics* 2 (1972) 4–34.
- [2]. L.A. Zadeh, The concept of linguistic variable and its application to approximate reasoning (I), *Information Sciences* 8 (1975) 199–249.
- [3]. L.A. Zadeh, The concept of linguistic variable and its application to approximate reasoning(II), *Information Sciences* 8 (1975) 310–357.
- [4]. L.A. Zadeh, The concept of linguistic variable and its application to approximate reasoning(III), *Information Sciences* 9 (1975) 43–80.
- [5]. Jannis K.Androutsopoulos(Heidelberg), Extending the concept of the (socio) linguistic variable to slang ,*Language variation workshop*, April 1997.
- [6]. Walter Banks,Linguistic variables: Clear thinking with fuzzy logic, *Byter craft limited*
- [7]. J.Mendel, Fuzzy logic systems for engineering – a tutorial, *proceedings of the IEEE*, 83(3):345 – 377, March 1995.
- [8]. V.N. Huynh, T.B.Ho, Y. Nakamori, A parametric representation of linguistic hedges in zadeh’s fuzzy logic, *International journal of approximate reasoning* 30(2002), 203 – 223.
- [9]. H. Rasiowa, R. Sikorski, *The Mathematics of Metamathematics*, second ed., Polish Scientific Publishers, Warszawa, 1968.
- [10]. C.H. Nguyen, V.N. Huynh, A theory of refinement structure of hedge algebras and its application to linguistic-valued fuzzy logic, in: D. Niwinski, M. Zawadowski (Eds.), *Logic Algebra and Computer Science*, vol. 46, Banach Center Publications, 1999, pp. 63–91.
- [11]. J.F. Baldwin, A new approach to approximate reasoning using a fuzzy logic, *Fuzzy Sets and Systems* 2 (1979) 309–325.
- [12]. R.E. Bellman, L.A. Zadeh, Local and fuzzy logics, in: G.J. Klir, B. Yuan (Eds.), *Fuzzy Sets,Fuzzy Logic, and Fuzzy Systems: Selected papers by L.A. Zadeh*, World Scientific, Singapore,1996, pp. 283–335.
- [13]. D. Dubois, H. Prade, Fuzzy sets in approximate reasoning, Part 1: Inference with possibility distributions, *Fuzzy Sets and Systems* 40 (1991) 143–202.
- [14]. G.J. Klir, T. Folger, *Fuzzy Sets, Uncertainty and Information*, Prentice-Hall, EnglewoodCliffs, NJ, 1988.
- [15]. G. Lakoff, Hedges: a study in meaning criteria and the logic of fuzzy concepts, *Journal of Philosophical Logic* 2 (1973) 458–508
- [16]. <http://www.stutteringhelp.org/faq>
- [17]. <http://health.thefuntimesguide.com/2014/05/stop-stuttering.php>
- [18]. <http://www.wikihow.com/Stop-Stuttering>
- [19]. <http://www.stutteringhelp.org/stuttering-myths-beliefs-and-straight-talk-teens>
- [20]. *Do You Stutter: A Guide for Teens (book; code 0021) - Solid and supportive information for teenagers who stutter.*