Self-Stabilizing Spoon Using Fuzzy Controller

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Abstract: The main objective of this research is to develop a "smart" spoon using existing technology. Similar design, using programmable open source boards as controllers and vibration Sensors and servers act as input and output devices, respectively. The goal is to achieve a similar device having tremor stability performance similar to current technology. However, within a smaller budget, the cost of the consumer is lower. The basic idea is to use active cancellation (such as noise canceling headphones) to stabilize larger scales motions.

I. INTRODUCTION

Picking up a utensil to feed one's self is a luxury that people take for granted. For others with neurological conditions causing tremors, this basic activity can be a source of frustration and embarrassment. 'Smart Spoon' tries to eliminate that problem. Parkinson's often have trouble with tasks like writing, brushing teeth, or shaving. Eating can become a particularly difficult task since it becomes hard for Parkinson's sufferers to steadily pick up a spoon full of food. Parkinson's disease (PD) is a long-term degenerative disorder of the central nervous system that mainly affects the motor system. The

symptoms generally come on slowly over time. Early in the disease, the most obvious are shaking, rigidity, slowness of movement, and difficulty with walking. Thinking and behavioral problems may also occur. Dementia becomes common in the advanced stages of the disease. Depression and anxiety are also common occurring in more than a third of people with PD. Other symptoms include sensory, sleep, and emotional problems. The main motor symptoms are collectively called "parkinsonism", or a "parkinsonian syndrome".

It's a stabilization utensil gadget that offsets 85 % of unwanted tremors for users affected by diseases like Parkinson's. It contains sensors that detect hand motion and a small onboard computer that distinguishes unwanted tremor from the intended movement of the hand.

The project aims to build on the existing technology to produce a "Smart" spoon of a similar design, using an open source programmable board as the controller, and vibration sensors and servos as input and output devices respectively. The aim is to achieve a similar device with a similar tremor stabilization performance as the current technology, but within a smaller budget and therefore, at a smaller consumer cost. The literature review will cover different methods of design and come to a conclusion on which would be the best to base the project on.

A) Review of Literature

Parkinson's disease (PD) is a degenerative disease of the central nervous system in the long term. The system mainly affects the motor system. The symptoms are usually slow. As time goes by. In the early stages of the disease, the most obvious is tremor, rigidity and slowness. Exercise, walking is difficult. Problems of thinking and behavior are also possible. It happened Alzheimer's disease has become common. The late stage of the disease, Depression and anxiety are also common in more than a third of patients with PD. Other symptoms include sensation, sleepiness and emotional problems. The main motor symptoms are collectively known as "Parkinson's disease" or "Parkinson's syndrome". The objective of the project is to produce "smart" spoons based on existing technology. Similar design, using open source programmable plates as controllers and vibration. The sensors and servers act as input and output devices, respectively. The goal is to achieve an objective. A similar device with tremor stability performance similar to current technology, However, within a smaller budget, the cost of consumption is lower. The review will cover different approaches, design and draw conclusions, preferably based on the project.

B) System Overview

FUZZY CONTROLLER

Diffuse control system is a fuzzy logic based control system: mathematical system. System for analyzing analog input values based on assumed logical variables. Continuous values between 0 and 1 compared to classic or digital logic. Fuzzy logic operation with discrete values of 1 or 0 (true or false, respectively). Controller Block Implements Diffusion Inference System (FIS) in Simulink.

FUZZY SETS

Input variables in fuzzy control systems are usually mapped by multiple groups. A membership function similar to this is called a "fuzzy set." In conversion process. A clear input value to a diffuse value is called "fuzzification". The control system can also have several types of switches or "on-off" inputs. Of course, your analog input and said switch input will always have a true value equal to Either 1 or 0, but the program can treat them as a simplified fuzzy function become a value or another value.

FUZZIFICATION

Fuzzification is the process of changing a real scalar value into a fuzzy value. This is achieved with the different types of fuzzifiers (membership functions). Fuzzy Linguistic Variables are used to represent qualities spanning a particular spectrum. The MATLAB

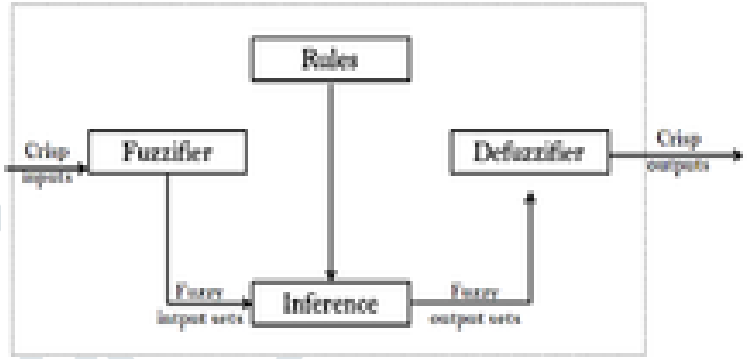
toolbox includes 11 built-in membership function types. These 11 functions are, in turn, built from several basic functions:

- piecewise linear functions
- the Gaussian distribution function
- the sigmoid curve
- quadratic and cubic polynomial curves

The simplest membership functions are formed using straight lines. The simplest is the **triangular membership** function, and it has the function name **trimf**. The **trapezoidal membership** function, **trapmf** has a flat top and really is just a truncated triangle curve. These straight line membership functions have the advantage of simplicity.

DEFUZZIFICATION

Defuzzification is the process of producing quantifiable results in clear logic, given the fuzzy set and the corresponding membership. This is the process of assigning a fuzzy set to a clear set. Fuzzy control systems are usually required. They will have a series of rules that convert a series of variables into diffuse results, i.e. the results are described by the membership of the fuzzy set. For example, rules designed to determine how much pressure to apply can result in "reducing pressure (15%), maintaining pressure (34%), and increasing pressure (72%)." Defuzzification is the interpretation of the membership of a fuzzy set in a particular decision or actual value.

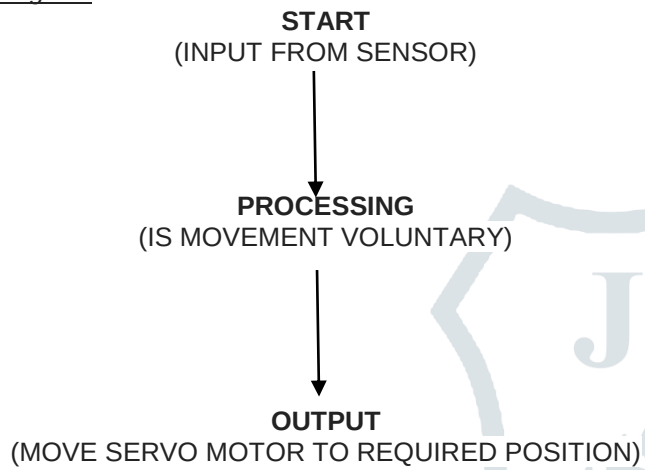


C) Stages of Implementation

Algorithm

1. Start
2. Take values from sensor ADXL335 on ANALOG PIN A0 of Arduino UNO.
3. The analog values are of X_roll which range from 265 to 401 and are converted to angle using g_fisInput [0] = (g_fisInput [0]-268)*(180/135)
4. The values are passed to fuzzy controller which performs fuzzification using various membership functions for angles ranging from 0 to 180 degree.
5. The membership functions used are triangular (trim_f) functions.
6. Then IF Then rules are applied to the fuzzified values. If the sensor gives 0 degree no corrective action is performed.
7. If a small tilt is observed then corrective action is performed by tilting the servo angle to compensate it.
8. The output fuzzy value of servo motor is then defuzzified using bisector method.
9. The value is passed through arduino to servo motor using PWM pin

Block Diagram



D) FUZZY RULE LIST

1. If roll is small deviation then servo is none
2. If roll is less right then servo is less left
3. If roll is more right then servo is more left
4. If roll is high right then servo is high left
5. If roll is mega right then servo is mega left
6. If roll is too mega right then servo is too mega left
7. If roll is rightest the servo is leftist.
8. If roll is too extreme right then servo is too extreme left
9. If roll is higher right the servo is higher left
10. If roll is less left then servo is less right
11. If roll is more left then servo is more right
12. If roll is high left then servo is high right
13. If roll is mega left then servo is mega right
14. If roll is too mega left then servo is too mega right
15. If roll is leftist the servo is rightest
16. If roll is too extreme left then servo is too extreme right
17. If roll is higher left the servo is higher right

These are the fuzzy rules which we used. Here 'roll' refers to the input roll angle from the sensor and 'servo' refers to the output signal given to the servo to make it move accordingly.

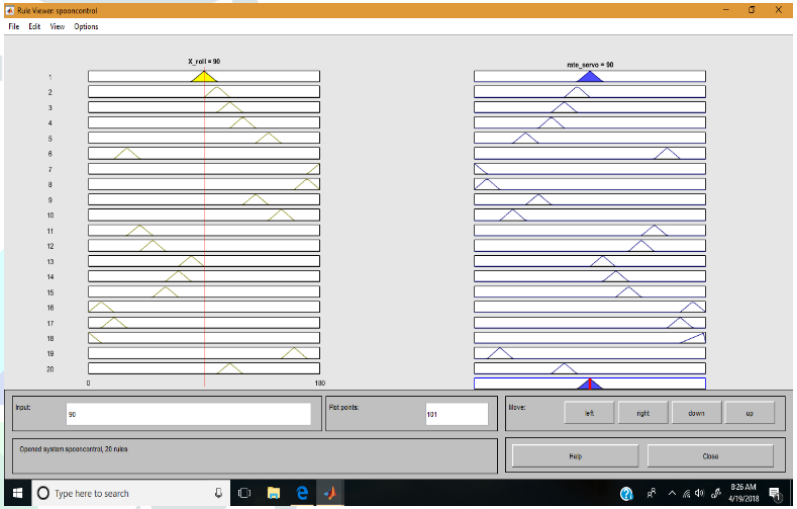
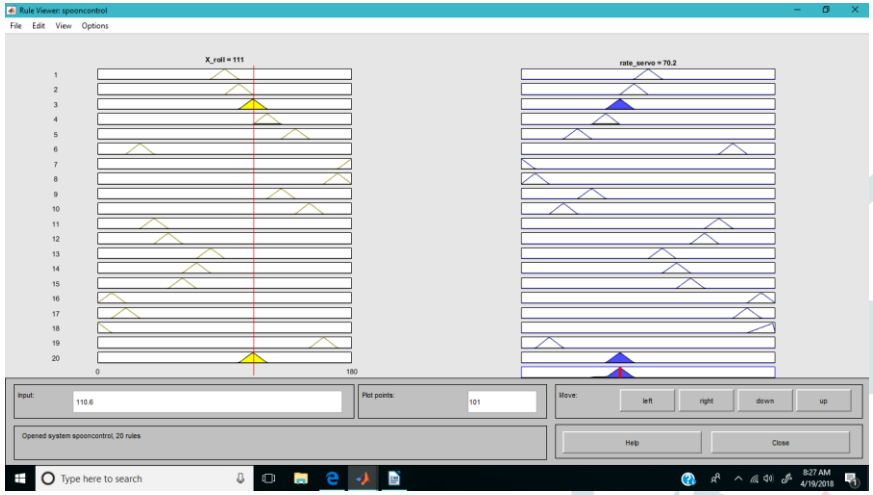


Fig.1 [Rule 1] Roll=90(No Deviation); Servo=90(None)



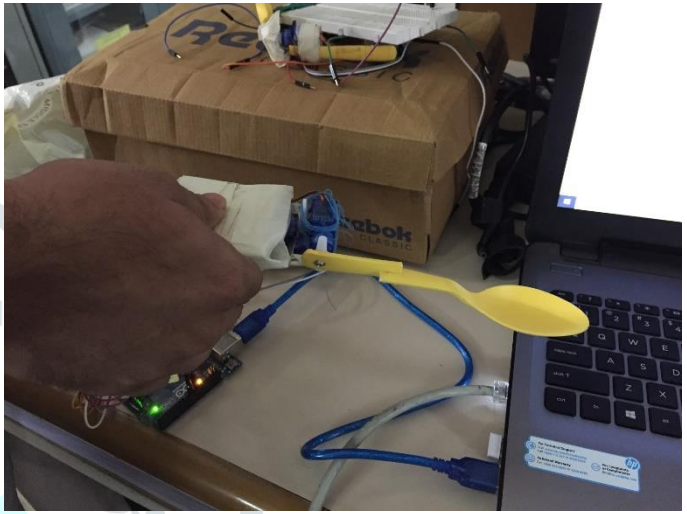


Fig.2 [Rule 3] Roll=111(More right); Servo=70.2 (More Left)

II. CONCLUSION

The "smart" spoon item can offset the movement, but it can't be completely eliminate. Tremor due to hardware limitations and signal processing algorithms used. However, the ability to determine the relationship between voluntary and involuntary movements. Improve by using other filtering methods. Hardware improvements can become a significantly different from the stable output of the "smart" scoop DC Brushless motors provide smoother, more precise motion. As a general. In short, it is clear that over time, component changes, etc. However, research on the “smart” spoon project will be successful, but time is very limited. And it is very difficult to lack information about the technology used in the Smart Spoon. Perform the required research, learn programming languages and filtering techniques, finally, it is capable of producing fully functional equipment. There are so many different filters. In fact, the available technology will always focus on the project and there is much more time to produce quality products.

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