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The Development Of Assistive Spoon Stabilizer For Hand Tremors Patients

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Abstract

Tremor is the most common movement condition, characterized as a rhythmic and involuntary movement of the any-body component. People or individuals who suffer from tremors need an assistive device for them to live a normal life. However, the individuals with tremors will not benefit from the normal spoon because it does not respond besides the existing assistive spoon device is too expensive and not affordable to be bought by the patient. To overcome this limitation, we proposed a new assistive spoon stabilizer that can be responding to be used by patients with hand tremors. The assistive spoon can contribute to the hand tremor society because by having this product, the patient who suffers from hand tremors can eat with a spoon without having difficulties. The project involves a processor of Arduino Nano as it combines with a gyro sensor to identify the angularity of the spoon. It also consists of two servo motors to stabilize the x-axis and y-axis angle of the spoon from the patient hand. Using the assistive spoon stabilizer device can help the community to be more independent because this product is affordable to be bought by the patients compared to the existing assistive spoon in the market which is expensive.

Keywords: Assistive Spoon, Hand Tremor, Movement Disorder, Arduino Nano, Gyro Sensor.

1. Introduction

Tremor is the most common movement condition, characterized as a rhythmic and involuntary movement of any of body components. Because all individuals have variable degrees of physiological tremor, it's critical to distinguish between normal and pathological tremors. Tremor is not inherently harmful, but it can significantly limit one's capacity to function at home and at work (Elias & Shah, 2014). Rest and activity tremors are the two types of tremors. When the injured body portion is totally supported against gravity, a rest tremor ensues. Postural, isometric, and kinetic tremors are all types of action tremors that are caused by voluntary muscular contraction (Smaga, 2003). An individual may have postural tremors without rest tremors, as well as other characteristic Parkinson's disease symptoms. The degree of Parkinson's tremor varies and rises with mental exertion. The tremor normally develops bilateral some years after the commencement of the disease; the limbs do not shake in unison, suggesting when they're under the control of separate tremor generating (Bötzel et al., 2014)(Raethjen et al., 2000). There have been reports of tremor control weakening in time, necessitating repeated resetting (Bhidayasiri, 2005). As results, writing and other fine motor activities are injuries sustained, but rough actions such as drinking from a cup or glass are also adversely affected, resulting in significant difficulties in daily life. It may be difficult for patients with essential tremors to eat.

2. Literature Review

2.1 Hand Tremor

Rest tremor, postural tremor, and intention tremor are the three different types of tremors. The basic disorders that trigger any of these kinds of tremors are varied. Whenever the arm is placed down or at rest, a rest tremor develops. This tremor is typical of Parkinson's disease, which is characterized by unilateral tremors initially. One or more fingers, the hand, the foot, or the chin might all show signs of rest tremors. As a result, when the patient maintains his arms outstretched, a postural tremor frequently occurs. Then there's the finger-to-nose test, which displays an intention tremor as the finger approaches the target, like the nose. Cerebellar dysfunction causes intentional tremors, which can be unilateral or bilateral (Bötzel et al., 2014).

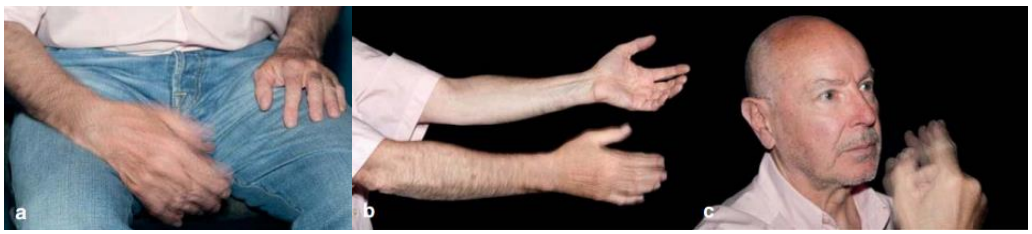

Figure 1: Types of Tremor (a) rest tremor, (b) postural tremor, (c) intention tremor

Source: Bötzel, K., Tronnier, V., & Gasser, T. (Deutsches Arzteblatt International 2014)

A hand tremor is a tremor that travels from one hand to the other (Jankovic, 2008). The degree of Parkinson's tremor varies and rises with mental exertion (Bötzel et al., 2014)(Raethjen et al., 2000). There are two increases in the frequency of essential tremor between the ages of 10 and 20 and 50 and 60 (Louis & Dogu, 2008). Cerebellar dysfunction causes intentional tremors, multiple sclerosis is the most prevalent cause (Schniepp et al., 2013). Intensification physiological tremor can develop as a symptom of several medications or in the context of a metabolic illness (Louis & Dogu, 2008). Early signs of Parkinson's disease include diminished arm swings and stooped posture. Brain imaging shows a decline in serotonin function before movement symptoms appear (Chou, 2004). Essential tremor is a tremor of the index finger around the nose in the finger-to-nose test. Dysarthrophonia and swaying, broad-based stride are common symptoms of cerebellar illness in afflicted patients (Bötzel et al., 2014).

2.2 Assistive Technologies

"Any device or system that allows an individual to execute a task that they would otherwise be unable to complete" is what an assistive device is defined as. From a simple walking frame or crutches to prosthetic limbs, an assistive device can help. Assistive Technology (AT) refers to an assistive device that goes a step further and employs technology to help the user (Cunningham et al., 2009). Various alternate ways of reducing hand tremors were proposed. Several innovative gadgets with direct or indirect control, which may be classified as stationary or portable, have been demonstrated. Fixed devices are normally placed on the ground, a table, or a wheelchair, and are meant to assist individuals with hand tremors in doing certain tasks such as writing, eating, and so on (Abbasi & Afsharfard, 2018).

3. Methodology

3.1 Block Diagram

Based on Figure 2, the block diagram consists of a processor, input, and output. From the input, the device has a sensor which is an MPU6050 Gyro Accelerometer Sensor that can receive input from the patient hand three-axis. The output will reset the angle of the axis to 0o. The power supply is from a lithium battery to activate the device. The device is connected by power supply, it’s made with battery lithium 18650 3.7V and connected to a TP4056 lithium battery charger module so the device can be used as rechargeable. Then is it connected to the MT3608 boost converter module so the output voltage will come out as 5V. Push-button is used to control the voltage to supply the circuit and activate the device. The power 5V is supplied to the MPU6050 gyro accelerometer sensor, Arduino Nano, and MG90S servo motors. The Arduino Nano is then connected with a power supply, input from MPU6050 and output to two MG90S servo motors.

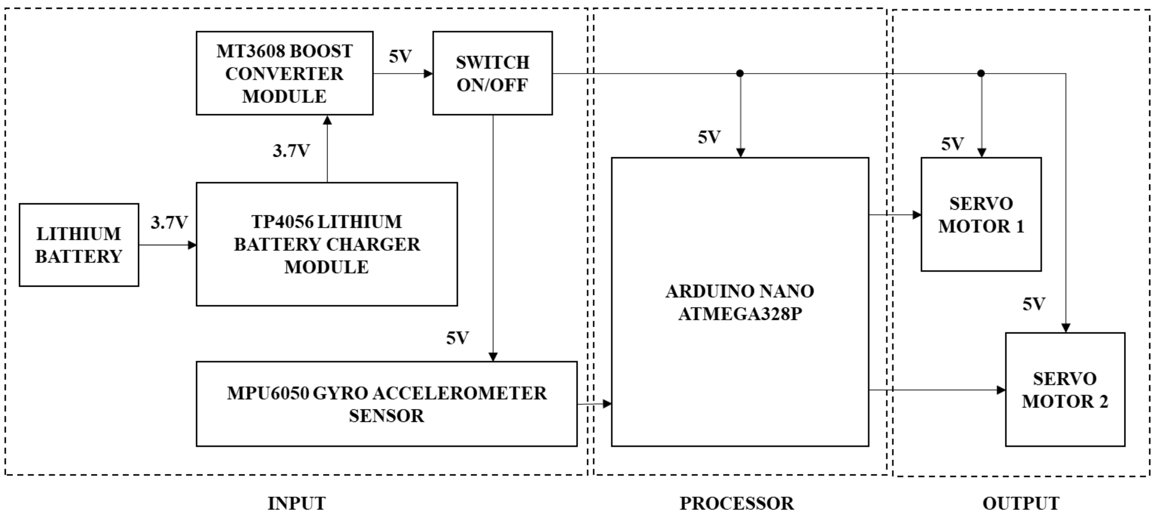

Figure 2: Block Diagram of The Assistive Spoon Stabilizer

3.2 Flowchart

Figure 3 shows the flowchart of the assistive spoon stabilizer. The flowchart shows the standard of procedure of the project. Below is the procedure shows the step on how to operate the device and how it works:

1. Turn ON the power button.
2. Read the angle from the x-axis (horizontal).
   a. If the degree is more than 0^o, motor 1 will rotate clockwise
   b. If the degree is less than 0^o, motor 1 will rotate counter-clockwise.
3. Read the angle from the y-axis (vertical).
   a. If the degree is more than 0^o, motor 2 will rotate clockwise
   b. If the degree is less than 0^o, motor 2 will rotate counter-clockwise.
4. If the power button is OFF, it will end the process.

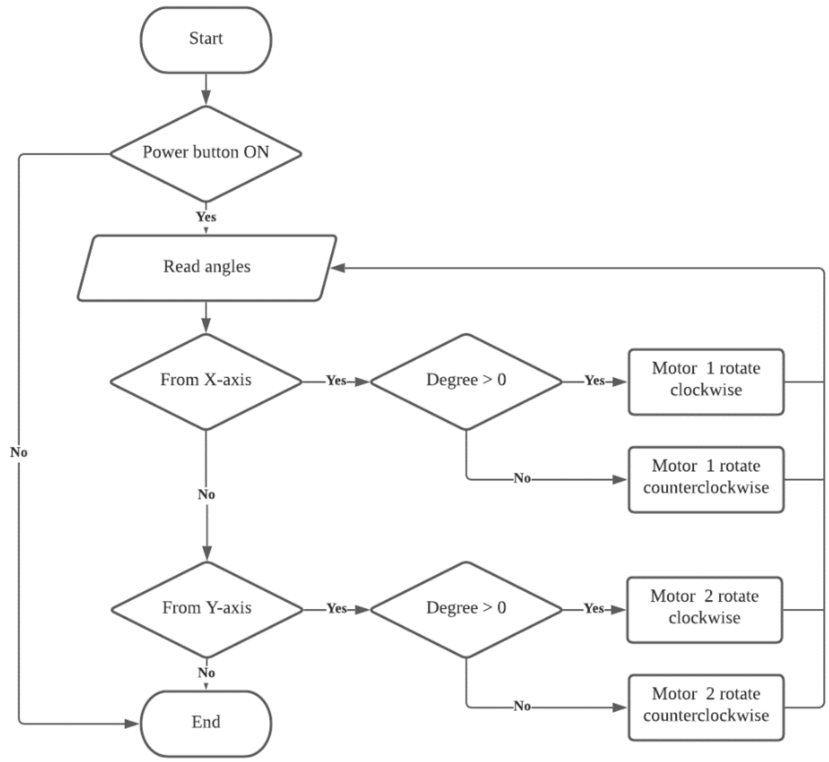

Figure 3: Flowchart of the Assistive Spoon Stabilizer

3.3 Circuit Installation

The straight female header connector is soldered on the prototype board aligned such as in the breadboard to form a connection of the circuit using jumpers. The Arduino Nano Atmega328 and MPU6050 Gyro Accelerometer Sensor are connected on the soldered prototype board. Figure 4 show the wiring connection of the circuit fit perfectly inside the casing of the Assistive Spoon Stabilizer.

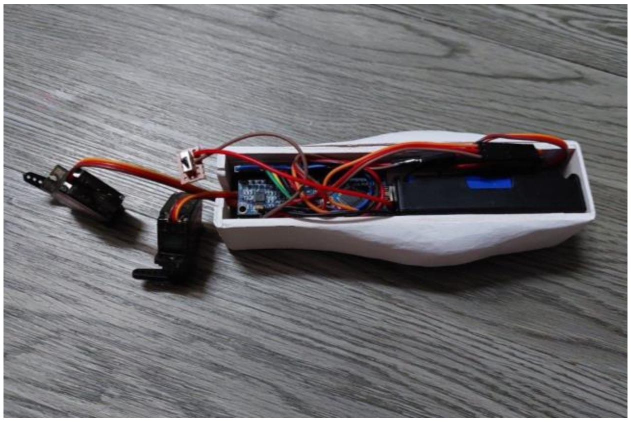

Figure 4: Wiring Connection inside The Assistive Spoon Stabilizer

3.3 Programming Installation

Because Arduino Nano has an old bootloader, it could not be burned using the normal method. Therefore, for burning programming into Arduino Nano, we need to use another Arduino board as a bootloader. In this case, I am using Arduino Uno as a bootloader to burn the programming into Arduino Nano. Below are the steps to burn programming into Arduino Nano by using Arduino ISP Software on Figure 5.

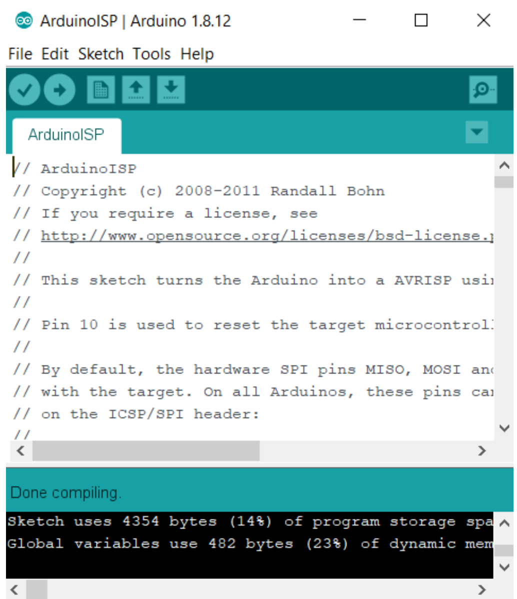

Figure 5: Arduino ISP Software

1. ArduinoISP programming can be found in the example of Arduino Software. Set programmer as “AVRISP mkII” and upload ArduinoISP programming into Arduino Uno board.

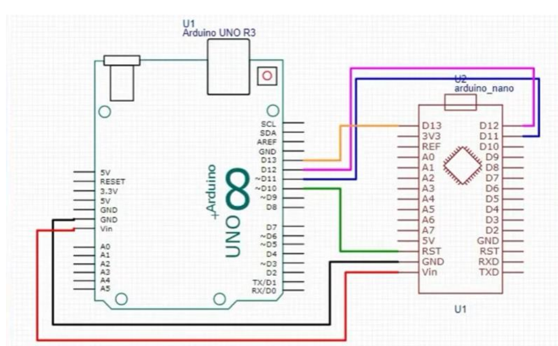

Figure 6: Bootloader Circuit

2. After uploading ArduinoISP programming into the Arduino Uno board, Arduino Nano is connected as Figure 6.
3. Then, open the Assistive Spoon Stabilizer programming and set programmer to “Arduino as ISP” meanwhile port from Arduino Uno and burn Assistive Spoon Stabilizer programming into Arduino Nano.

4. Result & Dicussion

4.1 Comparison Between Assistive Spoon Stabilizer and Normal Spoon

Based on Figure 7, the Assistive Spoon Stabilizer can be stabilized to approximately 0^{o} from the x-axis and y-axis. Meanwhile, a normal spoon does not have the ability to stabilize the spoon and hand binder which can suppress the hand of the patient and help the stabilizing itself.

Figure 7: Comparison Between Assistive Spoon Stabilizer and Normal Spoon

4.2 Data Analysis

The results of Controlling the Assistive Spoon Stabilizer have taken from different angle in degree and the analysis showed in Table 1.

Table 1: Results of Controlling the Assistive Spoon Stabilizer

Axis	Input (^{o})	Output (^{o})	Output Average (^{o})
Horizontal (X-Axis)	3^{o}	0.6^{o}	$\frac{0.6° + 1.1° + (-1.2°)}{3} = 0.17°$
	35^{o}	1.1^{o}	
	-20^{o}	-1.2^{o}	
Vertical (Y-Axis)	-0.4^{o}	-0.2^{o}	$\frac{(-0.2°) + (-0.8°) + (-4.5°)}{3} = 1.83°$
	-26.5^{o}	-0.8^{o}	
	44.2^{o}	-4.5^{o}	

Figure 8 shows the graph of input versus output in degree (^{o}) from the results of controlling the Assistive Spoon Stabilizer from the horizontal axis.

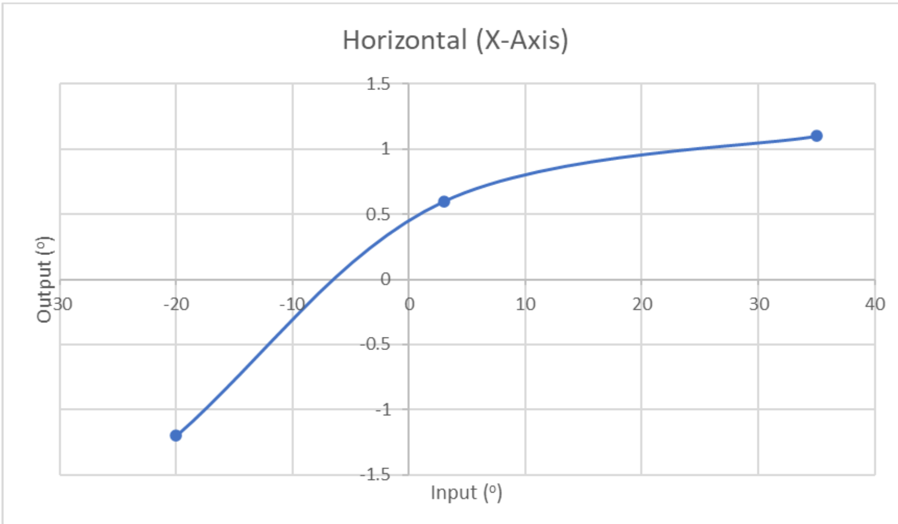

Figure 8: Graph Input Versus Output from Horizontal Axis

Figure 9 shows the graph of input versus output in degree (°) from the results of controlling the Assistive Spoon Stabilizer from the vertical axis.

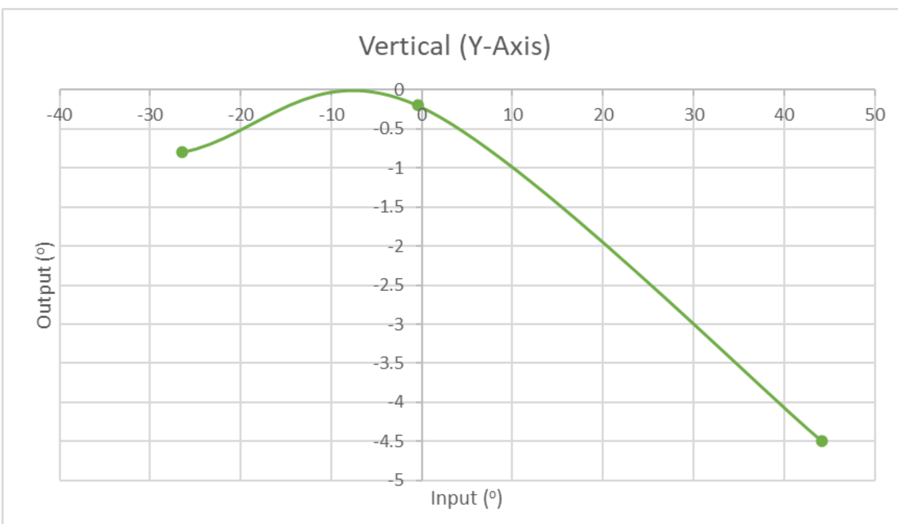

Figure 9: Graph Input Versus Output from Vertical Axis

5. Conclusions

At the end of this project, with the development of the prototype Assistive Spoon Stabilizer, it can be stabilized by a gyro accelerometer sensor that can receive input from the patient hand from the horizontal and vertical axis and the output will reset the angle to the axis approximately of 0o. The power supply is made from a lithium battery so the device can be rechargeable and activated the device. In addition, the device is consisting of a handgrip and hand binder to suppress the patient hand to prevent it falls from the hand of the patient while eating. The switch ON/OFF can be switched to enable or disable the sensor and then control the angle of the servo motor for the patient to eat the food with the spoon.

References

Abbasi, M., & Afsharfard, A. (2018). Modeling and experimental study of a hand tremor suppression system. *Mechanism and Machine Theory*, *126*, 189–200. https://doi.org/10.1016/j.mechmachtheory.2018.04.009

Bhidayasiri, R. (2005). Differential diagnosis of common tremor syndromes. *Postgraduate Medical Journal*, *81*(962), 756–762. https://doi.org/10.1136/pgmj.2005.032979

Bötzel, K., Tronnier, V., & Gasser, T. (2014). Differenzialdiagnose und therapie des tremors. *Deutsches Arzteblatt International*, *111*(13), 225–235. https://doi.org/10.3238/arztebl.2014.0225

Chou, K. L. (2004). Diagnosis and management of the patient with tremor. In *Medicine and health, Rhode Island* (Vol. 87, Issue 5, pp. 135–138).

Cunningham, L. M., Nugent, C. D., Finlay, D. D., Moore, G., & Craig, D. (2009). A review of assistive technologies for people with Parkinson's disease. *Technology and Health Care*, *17*(3), 269–279. https://doi.org/10.3233/THC-2009-0547

Elias, W. J., & Shah, B. B. (2014). Tremor. *JAMA - Journal of the American Medical Association*, *311*(9), 948–954. https://doi.org/10.1001/jama.2014.1397

Jankovic, J. (2008). Parkinson's disease: Clinical features and diagnosis. *Journal of Neurology, Neurosurgery and Psychiatry*, *79*(4), 368–376. https://doi.org/10.1136/jnnp.2007.131045

Louis, E. D., & Dogu, O. (2008). Does age of onset in essential tremor have a bimodal distribution? Data from a tertiary referral setting and a population-based study. *Neuroepidemiology*, *29*(3–4), 208–212. https://doi.org/10.1159/000111584

Raethjen, J., Lindemann, M., Schmaljohann, H., Wenzelburger, R., Pfister, G., & Deuschl, G. (2000). Multiple oscillators are causing parkinsonian and essential tremor. *Movement Disorders*, *15*(1), 84–94. https://doi.org/10.1002/1531-8257(200001)15:1<84::AID-MDS1014>3.0.CO;2-K

Schniepp, R., Jakl, V., Wuehr, M., Havla, J., Kümpfel, T., Dieterich, M., Strupp, M., & Jahn, K. (2013). Treatment with 4-aminopyridine improves upper limb tremor of apatient with multiple sclerosis: A video case report. *Multiple Sclerosis Journal*, *19*(4), 506–508. https://doi.org/10.1177/1352458512461394

Smaga, S. (2003). Tremor. *American Family Physician*, *68*(8), 1545–1553.