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The Development of Cutlery Tool to Reduce Parkinson Movement

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Abstract. The typical feeding skills are considered to be eating from a spoonful, and imbibition from a cup and simple activities are difficult for Parkinson's patients. The present study investigates the development of this acquirement in Parkinson's patients of feeding spoon thought out improves on the concept design of feeding spoon, where it can be helpful for patients. In return this can help to improve the future work in designing and fabrication for any instrument to control tremor trembling allowing the patient to practice their delay rotten. Feeding spoon device can provide accurate and diagnostically relevant information about postural tremor. Its portability and ease of use could help translate such techniques into routine clinic use or to the community. With this study it is shown that 70% of improvement in skill assistance spoon feeding compared with ordinary spoon. It is apparent that the developed model can improve the feeding process and make it easier on the patient.

Keyword: Parkinson, vibration, tremor spoon

1. Introduction

Parkinson's disease is a progressive neuro-degeneration of multiple systems damaging motor and non-motor functions, affects individual and societal dimensions negatively [1]. Parkinson disease can disturb a patient's life. Patients will face problem in pick up and retention target because of tremor or vibration of hands which are the most obvious and important symptoms of tremor diseases [2]. Introduction Professional person involved in assessment and treatment of infant with feeding problems must have knowledge of normal development of oral motor and eating accomplishment [3]. There is uncontrollable hand tremor in some neurological diseases sufferers like Parkinson's patients. [4-5]. There are various character of tremor, which differ from each other according to the circumstance (posture, action or resting), the amplitude and absolute frequency, ranging from 3 Hz to 12 Hz [6]. Tremor is prominent in the distal part of an extremity. The rest tremor at the hand is usually produce a high fast vibration at the whole arm [7]. Thus, it makes the affected person enjoy difficulties which intrude with acting every day sports together with writing, lifting objects, placing the object at the target factor and so forth [8]. In most system that related to mechanical vibration and mechatronics system, there are sources of detrimental vibrations that may significantly influence the mission performance, effectiveness and accuracy of operation. There are many techniques that have been develop to reduce this vibration [9]. A vibrational-control system, either as an isolator or an absorber, is to be active, passive, or semi active

and passive depending on the amount of the vibration that need to be counter and the load or forces exerted on the device.

Previous study have been done to help Parkinson's disease sufferers and their difficulties with feeding. Studies with several projects were made regarding these type of spoon. First is self-levelling spoon. The invention is a spoon including a hand-grip able handle, a rotary coupler mounted to the handle, and a bowl mounted to the rotary coupler [10]. The bowl is relatively rotatable mounted to the handle through the rotary coupler, permitting the bowl to remain level even if the handle is rotated. In a preferred embodiment, the centre of gravity of the bowl is offset from the axis of rotation of the rotary coupler, and is most preferably near the bottom of the bowl. The centre of gravity of the bowl is low enough to for the bowl to remains parallel with the ground regardless of the rotation of the handle. The rotation of the head or bowl will be dependent on upon the force of the gravity. The position of the rotation does not affect the levelling of the bowl. The creation of this spoon is to prevent spilling the content of the lifting food during eating. With the design of hand gripped handle, free rotation coupler and bowl the reduction in vibration from patient can be reduce in use of spoon. Referring to the patent of self-levelling spoon, the main purpose of the spoon using is to develop a controllable position of the spoon since the attached mass at the end of the spoon will provided the balance of the spoon. The mass and rotary handle will take full advantages in design this spoon stability. When the handle is held in the hand in the act of manipulating the spoon, the bowl maintains a level position by reason of its weighted-bottom portion, the many advantages of which are sufficiently obvious without further description.

Another invention of spoon that can counter vibration is gyro spoon. Gyro Spoon is a spoon that can rotate 360 degrees so that the food inside will not be spilled. This helps people with Parkinson's disease and people with other disorders that cause them to have hand tremor, which leads to a difficulty in feeding themselves. The Gyro spoon helps alleviate that difficulty by using gyroscopic technology to keep the spoon part facing upward at all times. The technology in this spoon design is using concept of gyroscope. This spoon concept need some spacing and support. This is solid design of spoon with freely rotate bowl spoon head. This spoon go through analytical process and give the result that the reduction of vibration can be counter [7].

Next, the invention of the spoon that can reduce the hand trembling motion also been develop by Liftware Company using active control system namely as Liftware spoon. Lift Labs is the company which has designed the spoon for those suffering from Parkinson's disease and essential tremors. The company was acquired by Google in September 2014, then Google launched its version of the spoon in November 2014 [11]. The second part is the actuator section containing two motors in the handle to move the spoon in the opposite direction of any detected tremor. They are steered by the on board computer in order to counteract the tremors and to stabilize the spoon. This paper intention the development of this acquirement in Parkinson's patients of feeding spoon thought out improves on the concept design of feeding spoon, where it can be helpful for patients.

2. Methodology

The spoon conceptual design presents base on the design analysis, the ergonomics study and experimental observation gain from literature review. However, Solidwork software played a raw in designing the spoon after selecting the best conceptual designed spoon among all the models, which is using spring stiffness to control the spoon vibration. In the other hand, the spring is supported the connection where it can extend with the string on the both sides of the spoon as it shown in Figure 1. Taking into consideration reducing the spoon moment by making it as short as possible to eliminate the intensity of vibration concentrated at the tip of the spoon. The spoon vibration control is mass balancing and spring system. This is the minimal type of vibration control since the application is only spoon. The conceptual design is evaluated and the best design in term of mechanism and spoon ergonomics is proceed to the fabrication process. The fabrication process is done by assembling the spoon by using 3D printed model. The spoon model was printed in various size of handle from the conceptual design because to select the best size handle that can be used without constraint by the patient.

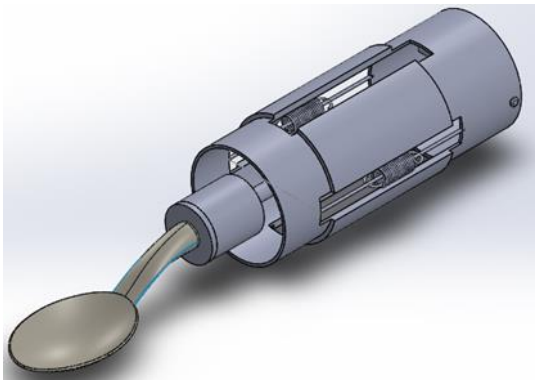


Figure 1. The conceptual design of spoon.

Using three axis accelerometer ADXL335 for data. Which is required 3.5 V or 5 V voltage supply, since it has dual connection to voltage. An Arduino board is used as the power supply and the connection is done by using analogue input from the Arduino. The data is collected by using two accelerometer, the accelerometer were attached at the hand of the patient and at the spoon head, where the reduction of vibration should be observed. The connection of the accelerometer was connected to 6 analogue signal input, the purpose here just to collect the raw data of the vibrational behaviour. Since the Arduino IDE cannot store the data automatically, the data is stored at using another program that is PLX-DAQ system. The data collected will automatically transfer into excel file. The experimental setup to collect data is shown in Figure 2.

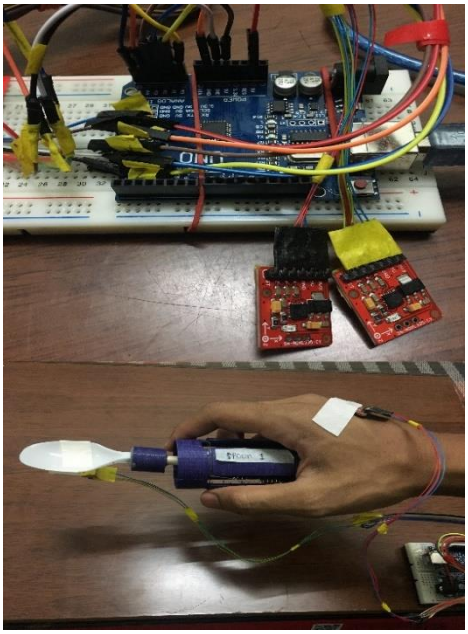


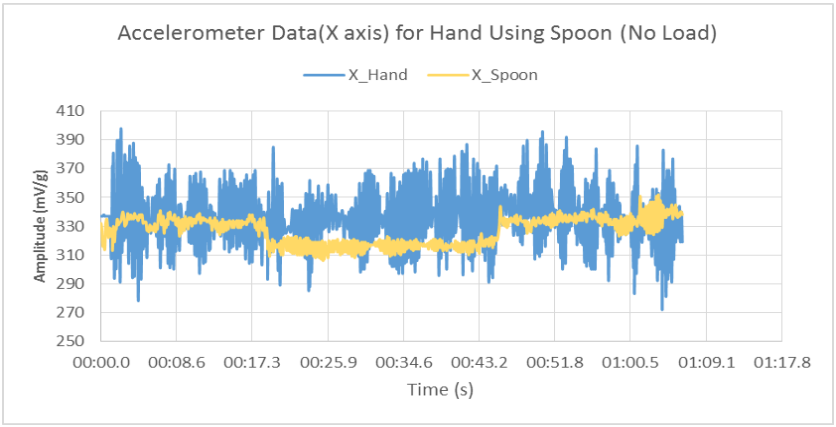
Figure 2. Configuration of accelerometer for data collection.

The data is collected using two condition that is when the patient hold the spoon without load and with load. This is done in order to find the accuracy of the mass and spring balance system. The spoon behaviour during first condition is different with the second condition because of the load applied to the spoon head.

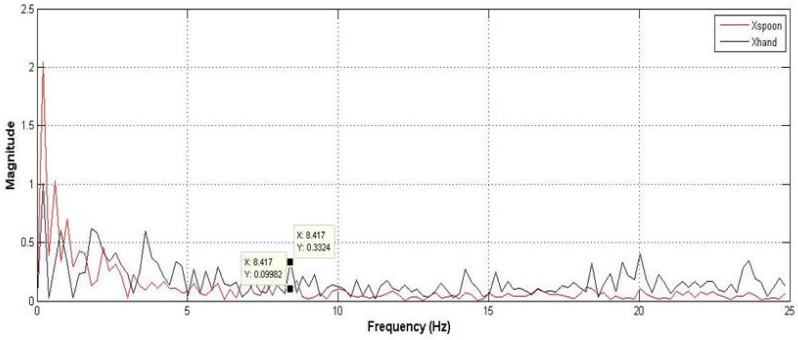
The hand behaviour also show some different since when the patient lift the arm, in order to stay elevated the hand required more power to counter the gravitational force. The right hand was the body part that involve in this testing.

3. Result and discussion

All accelerations values produce by the vibration of the hand is converted into time and frequency domain. After the data collection, the pattern of both accelerometer sensor reading is interpreted by using Microsoft excel and MATLAB software. During the data analysis, all the recorded data were being compared between accelerometer attached at hand and accelerometer attach and the tremor spoon that have been assemble with the passive counter vibrational system. The purpose of comparing between these two values is to gain the result of vibration reduction. No load condition means that the patient is holding the spoon connected with accelerometer without lifting any load from the bowl. This testing is conducted to validate the spoon in this condition. Only critical axis is consider in this experiment that is X-axis.



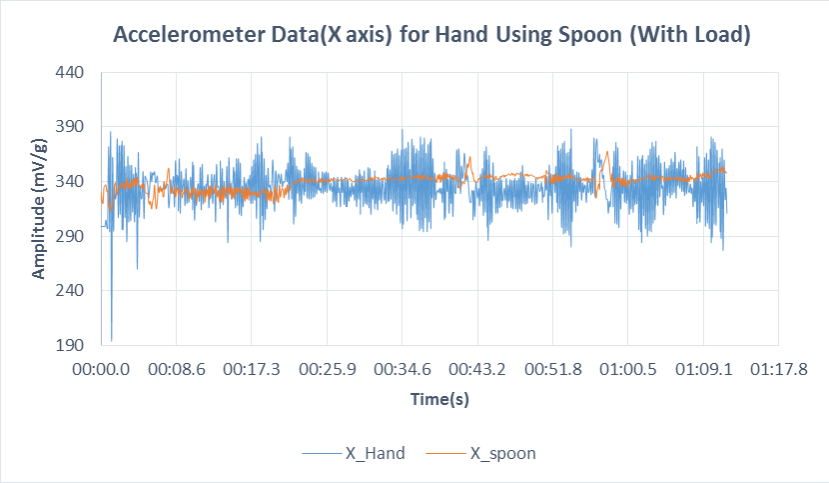
(a)



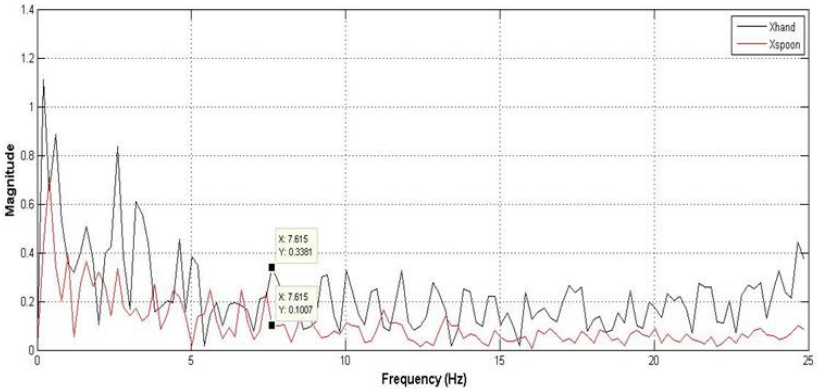
(b)

Figure 3. X-axis no load condition data plot (a) Plot of data sample in time domain (b) frequency domain.

With load condition is the testing of the spoon where the patient try to lift load using the spoon from the bowl. This testing was done to test the spoon behaviour of vibration reduction after load is being applied at the spoon head.



(a)



(b)

Figure 4. X-axis with load condition data plot (a) Plot of data sample in time domain (b) frequency domain.

Table 1. The interpreted data of the spoon accelerometer reading.

Axis	Amplitude				Frequency (Hz)	Magnitude different	Reduction
	Hand		Spoon				
	Max	Min	Max	Min			
X (No load)	398	272	352	306	8.417	0.23258	Yes
X (With load)	388	194	368	313	7.615	0.094	Yes

From time domain graph plot in Figure 3(a) raw data observation accepted from accelerometer attach at hand is more vibrant with amplitude rate that higher in the range of 398 mV/g to 272 mV/g. This show in the posture condition the rate of vibration transfer from source to the spoon in much lower because of the counter vibration of the mass. Rate of vibration at spoon is in the range of 306mV/g to 352 mV/g, this value is the magnitude of the spoon time domain graph. Difference between both amplitude of the two accelerometer in hand and spoon is 26 mV/g and 46 mV/g. The analyse frequency

is at the peak of 8.417 Hz because of the frequency range for hand tremor is 6-12 Hz. The peak at this frequency is the highest magnitude gain from the frequency domain, for the hand frequency the peak magnitude value is 0.3324 and for the spoon the peak magnitude value is 0.09982, the different is 0.23258 and from the frequency domain the reduction of vibration is observe.

From the Figure 4, the time domain plot from the raw data collected using the accelerometer sensor show that, the vibration from hand is much higher than vibration at the spoon, the amplitude magnitude recorded at the hand accelerometer is in the range of 388mV/g and 194 mV/g. By comparing with the amplitude magnitude at the spoon result from the vibration transfer from hand to the spoon the value is in the range of 368 mV/g and 313 mV/g. Different between both amplitude of the two accelerometer is 194 mV/g and 55 mV/g respectively. The peak of this frequency is the highest in magnitude for the range of hand tremor frequency. For the analyse frequency, the peak value for both hand and spoon is 0.3381and 0.1007 respectively. The peak of this frequency is the highest value gain from the frequency domain, the different is 0.094 and from the frequency magnitude different, the reduction of vibration is observed.

4. Conclusions

The spoon successfully reduced the vibration and reduced the spillage of load during the patient uses the spoon. But there were several limitations for the patient used the spoon. The limitation was the spoon cannot be operated by someone with a very serious hand tremor, because the passive counter vibration system does not accurate enough to counter very fast vibration. Other than that, the development of the spoon model has been able to introduce the concept of passive reduction system even the best result obtains only at one axis. Based on previous research, usually the vibration generated by the hand tremor patient is between 6-12 Hz. The design is still not reliable to reduce the vibration or trembling motion occur. Based on the analysis, comparison and conclusion that have been made for this study, here are recommendation to be considered. The passive counter vibrational system may not so accurate to counter the trembling motion. For great result to reduce the motion is by implementing sensor to detect the hand vibration. To obtain best result, for future work a proper rig test system that behave same as the hand of the tremor patient can be develop in order to reduce unintended movement, rotating axis and the proper value of data.

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