Anti-Spill Cup

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Abstract– Essential tremor is a neurologic disorder of the movement, very common, complex and progressive. The two most common types of tremors are essential tremor and Parkinson's disease. Approximately 60,000 Americans are diagnosed with Parkinson's and more than 10 million people worldwide live with Parkinson's, 70% of those affected by Parkinson's have tremor [1]. ET is categorized as an involuntary movement that most often affect hands but also the head, neck, tongue, voice, mandible, and legs. This movement occurs in the form of rhythmic jerks more known as vibrations. In its simplest form, a vibration is considered as the oscillation or repetitive movement of an object. Mechanically speaking, happen around a fixed point and are produced by an exciting force applied to the object externally or internally. In the case of the ET the force is applied by the muscles involuntary contractions. The intensity of the oscillations is indicated by the amplitude and it depends on how advanced the tremor is and its progression rate. Excessive shaking can make certain voluntary actions such as writing, eating and holding a cup full of liquid difficult to accomplish, developing frustration and anxiety on the affected individual. An efficient approach to address one of the setbacks caused by this disease is to design and implement an Anti-Spill Cup. The purpose of the product is to counter act the tremor, maintaining the cup at equilibrium while hand vibrations occur thus decreasing the likeliness of the liquid being spilled. The approach utilized is signal cancellation. The hand oscillations are measured by the means of a sensor (accelerometer). This signal is at that point fed to a microcontroller where an algorithm is written to offset the tremors vibrations. An actuator signal is generated by the microcontroller which is then fed to an actuator (servo) that will induce motion to the mechanical system for controlling and stabilizing the cups trembling.

Keywords: Essential tremor, Anti-spill cup, frequency, oscillations, vibration, signal cancellation, microcontroller, Actuator.

I. Introduction

Tremor is defined as "…unintentional, rhythmic muscle movement involving to-and-fro movements (oscillations)" as reported by the National Institute of Neurological Disorders and Stroke. Tremor is most common in such diseases as Parkinson's; creating a public view of tremor only retaining to elderly people, but this is not the fact. Essential tremor is the most common type of tremor, which affects 0.4% to 6% of the world population, development is most common for those aged over 40, but occurs in younger people. Hand tremor can make such tasks as writing, eating and drinking difficult and sometimes mess, in part due to the shaking of the hand.

The projects goal is to build an Anti-Spill Cup, the cup shaped comparable to a coffee mug contains the accelerometer and servo motor installed on the handle, with the microcontroller on the base of the cup attached to the servo motor.

II. Objective

The objective of this project is to develop a motorized and microcontroller based cup that will stabilize the liquid present in a cup from excessive shaking caused by tremor. Essentially, the cup will reduce the vibrations received and reduce the amount of liquid leaving the cup from received vibrations. The anti-spill cup will be easy to use and not bulky by nature of its components. The cup will allow those suffering from tremor to drink with a lessened spill rate. Due to the economical nature of elderly people, the Anti-spill cup should be affordable.

III. Background Study

There is no cure for tremor, however there are many treatments that can reduce its affect. There are drugs that lessen the extent of shaking and surgeries such as Deep Brain Stimulation that use implantable electrodes that send high-frequency electrical signals to thalamus, effectively disabling the tremor. The second surgical option is Thalamotomy, drilling into the skull and inserting electrodes onto the thalamus and creating a lesion, eradicating all tremor. There are sincere side effects from these surgeries, such as problems with motor control of speech, visual and learning difficulties and issues with balance. [3]

IV. Requirements and Constraints

1. Marketing Requirements

1.1 **User-friendly:** The device must be easy to use by elderly people, no training required to operate properly.
1.2 **Portable:** The device should be relatively small in terms of a cup, considering the components being used.
1.3 **Safe:** The device must be safe to use, in terms of water exposure, to not cause harm to user
1.4 **Cost effective:** The device should be inexpensive to be affordable by elderly people
1.5 **Usability**: The machine should be able to be used four times a day without being charged. Should be able to fit universal cup sizes.

1.6 **Tremor control**: The machine will reduce the tremor vibrations on the liquid inside the cup.

2. Engineering Constraints:

2.1 **Sizing:**

- All components need to be relatively small, cannot be large because it will difficult to handle.
- Motor must be small size and high torque
- Microcontroller cannot be too large, no need for multiple pins

2.2 **Sensor location:** The location of accelerometer is essential to appropriate readings and function of the cup.

2.3 **Device Input:** All components must be powered by a 3-volt battery and be fully operable at that voltage.

2.4 **Economic:** The cost of the device must be relatively low cost to insure affordable by older consumers.

2.5 **Health and Safety:** The device must be able to deal with liquid and not shock the person holding the device if components were to meet liquid.

V. Cup Design

Cup size: Fits 14-16 fl. Oz. of liquid

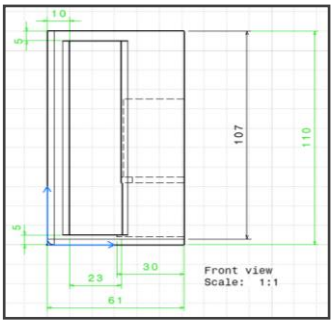


Figure 1: Handle Front View

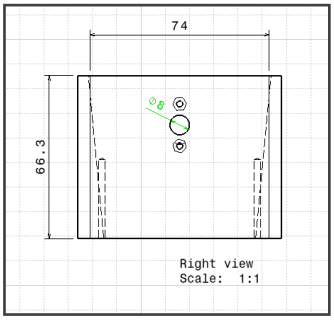


Figure 2: Cup Right View

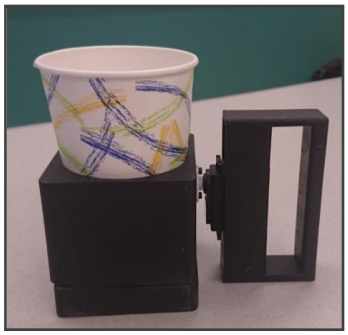
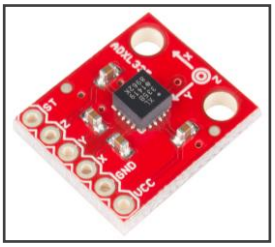


Figure 3: 1st Cup Prototype

VI. Component List

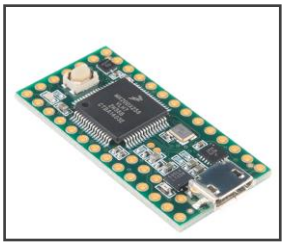


Accelerometer:
Operating Voltage:3-V(to be powered fully)
Variable g selection
High response.

Figure 4: Accelerometer

HS-485HB Servo
Operating Voltage: 4.8V - 6.0V (to be powered fully)
High torque, small size, diameter 30mm, length less than 10mm.

Figure 5: HS-485HB Servo



Teensy 3.2 Microcontroller
72 MHz Cortex-M4 Processor, mminimum input voltage-3V

Figure 6: Teensy 3.2 Microcontroller

VII. Conclusion

The medical industry is always improving surgeries and medicine to lessen the effect of tremor; even completely eradicating its affects from the body. It is obvious that there is a need for a cup that allows those from suffering from tremor to drink without embarrassing messes. The aspect of this project is to improve the lives of those living with tremor. With a cost effective design that has a easy to use interface and the ability to reduce tremor, the Anti-Spill Cup will be a helpful addition to those suffering from tremor. The development of this cup can encourage other such devices to help improve the tasks involving excessive shaking.

VIII. References

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