Gyro Glove: Stabilizing the Lives of Those with the Hand Tremor
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Abstract:
One in all the most important challenge two-faced by the themes afflicted with Parkinson’s unwellness (PD) is hand tremor. This prevents them from performing arts routine tasks like feeding, writing etc. The primary step typically includes modelling and simulation, as access to patients is proscribed. With the roaring realization of a finger tremor machine, a wearable tremor suppression glove can be valid before testing on humans. The device is developed with the help of BLDC motor and a small controller for generating random vibration patterns by victimization Pulse Width Modulation and therefore the tremor is suppressed by actuators placed on the glove with MPU6050 feedback. The tremor reduction is feasible with the assistance of actuators; this technique will result in a paradigm that's capable of serving to tremor patients perform daily routines.

Keywords: Parkinson’s disease; Parkinsonian Tremor; Tremor Simulator; Tremor Suppressor, Gyroscope, Accelerometer, Wearable Glove.

I. INTRODUCTION
The Parkinson’s disease is rated as the second most typical degenerative neurological disorder that is caused by the impairment in transmitting signals from the brain. In the early 19th century, the first clinical interpretation for this disorder was stated by James Parkinson hence this syndrome was named after him. As per the survey in 2006, more than 10 Million people around the world is suffering from this disorder. The symptoms include increased involuntary movements/ tremors, rigidity of Active devices counteract tremors in real time. They utilize sensory or motion input from the body to get a counteractive response to the tremor. From here, products are often further separated into tools and wearable’s. Tools are defined as products that are intended for the individual to use to hold out a specific function. A wearable refers to a product that a private mounts or straps to their body to scale back tremors. Wearable’s can also be mentioned as an orthosis or orthotic, which is defined as an externally applied device wont to modify the structural and functional characteristics of the neuromuscular and skeleton. Passive devices for hand tremors square measure typically associate nursing engineering improvement or weighted object one altogether the foremost difficult tasks for people with hand tremors is dexterity, that's needed for conducting easy, everyday tasks like mistreatment. There are some existing wearable gadgets like S’up spoon, Liftware steady, Rocker Knife, Eat well set, Steady Rest

A. S’up Spoon
Passive devices for hand tremors are sometimes associate degree applied science improvement or a weighted object designed to assist the movement of the user. one among the foremost difficult tasks for people with hand tremors is adeptness, that is needed for conducting easy, everyday tasks like exploitation utensils. The S’up Spoon, could be a product that took the purposeful purpose of a spoon, and redesigned it to accommodate for people unable to carry their spoons steady. the primary feature is the thicker, sleek handle that will increase contact space with the hand. The second feature is that the hollowed cavity for the news a part of the spoon. this permits users bring food to their mouths while not spilling. Another feature is increasing the mass the concept is that through conservation of momentum, increasing the mass of a system can decrease the speed. during this case, solutions like those of Keatley Weighted Utensils, have altered the load of their utensils to concerning eight ounces. The supplementary weight slows hand movements, therefore moistening the results of the individual’s tremors once uptake.

B. Liftware Steady
Liftware Steady is a smart modular utensil with a variety of utensil attachments for eating. The device, uses active stabilization on the utensil end using advanced sensor and motor-based cancellation technology. Sensors within the handle measure the magnitude and direction of the motion generated and adjusts the utensil end appropriately to keep it as level as possible. The highly sophisticated system is able to reduce tremors to the utensil by 70%. The Liftware Level is a second product by Lift ware that stabilizes hand and arm tremors with a more versatile joint to connect the utensil end to the handle.

C. Rocker Knife
This gives totally different geometries to assist a person's ability to chop food. It uses Associate in Nursing curving blade that is rocked back and forth. A T-shaped handle is hooked up to the backside of the arc, putting the user’s hand higher than and off from the cutting surface. This style is way easier for a personal with hand tremors to grip, moreover as use to chop food things.

D. Eat Well Set
The Eat well helpful ware Set and therefore the keep Bowl. the 2 merchandise utilize slip-resistant and anti-tip options to boost their stability. The ware set has weighted and slanted bottoms with deep cavities to naturally congregate food. Their spoons are designed to match the contour of the bowls to ease scooping.

http://ijesc.org/
E. Steady Rest
SteadyRest, uses a plastic bracket secured to the articulatio radiocarpea, and extended to the palm of the hand. When holding an implement, the item is supported by the bracket at a notch at one finish. This basically moves the support off from joints within the fingers and therefore the articulatio radiocarpea to the forearm, bypassing the tremors in the hand. within the closed-grip position, the bracket extension adds rigidity to the hand. within the free grip position, the bracket adds a support purpose towards the tip of the implement, inflicting any hand tremors to minorly move the tip of the implement, instead of shake uncontrollably kind of like however weighted utensils dampen tremor, the Readi-Steadi may be a wearable orthotic that straps weights to the hand, wrist, and up to the elbow if desired. The Readi-Steadi system uses custom weights to reduce unwanted tremor movements. Meant to cut back gentle to severe tremors, the weights effectively cut back the magnitude of the tremor by deceleration down the arm.

III. PROPOSED SYSTEM
This paper describes the design of a proposed wearable glove to suppress the hand tremor for PD patients. This device can be used with patient writing, holding, feeding, cooking, drinking difficulties arose as a symptom of PD. It is designed such a way that the PD patients can use anywhere any time without an aid of individual. Since there is no harmful electronic equipment and mechanical constraints which make the system compact and portable. The Gyro Glove uses a rotating mechanism to stabilize the hand via rotating mechanism stability from angular momentum. rotating mechanism stability is outlined as “the resistance of a rotating body to a modification in its plane of rotation”. momentum refers to the motility equivalent of linear momentum, where angular rate is increased to the inertia of the spinning mass. within the Gyro Glove, the spinning mass and motor square measure mounted to the rear of the hand in an indoor assembly. As the hand experiences a tremor, the steadiness of the rotating mechanism helps to resist tremor movements by keeping the rotating mechanism spinning within the same plane. The mass is meant so little tremor movements square measure resisted by the rotating mechanism forces nevertheless permits for intentional and deliberate movements to occur. For testing purpose the work is divided into two- 1) Tremor simulation module 2) Tremor suppression unit. Fig [1] combination of Potentiometer and Electronic speed controller(ESC)the speed of the motor will be controlled. By varying potentiometer maximum and minimum value of tremor can be analyzed. For measuring the vibration in x,y,z coordinate or pitch, roll and yaw is sensed with MPU6050 sensor. The major hardware component in this unit are BLDC motor, Electronic speed Controller, Potentiometer, MPU6050 and Micro controller.

1) BLDC Motor

Figure.2. A222-1400KV Brushless motor

A2212 is a brushless out runner dc motor specifically made to power quad copters and Multirotors. It is a 1400kv motor. It provides high performance, super power and brilliant efficiency.30 A ESCs are often used to drive the motor. The motor has shaft diameter of 3.175mm with 27.5*30mm motor dimension.

2) Electronic Speed Controller[ESC]

Figure.3. Simok 30 A ESC

For driving theA222-1400kv BLDC motor Simonk 30A electronic speed controller is used to drive the motor. The ESC receives a pulse width modulation (PWM) signal that controls the ESC’s output to the motor, which controls the motor’s speed. When selecting the speed controller, two factors were required to make sure compatibility with the motor: maximum continuous current and input voltage. Continuous current refers to the present draw of the motor. Based on the stall current of the motor, which is that the maximum current the motor requires, the team was ready to select a suitable speed controller that could provide the motor with the required current. For an increased safety factor, it is better to choose an ESC that is rated for a higher continuous current than the stall current of the motor to avoid an ESC failure. The second factor, input voltage, refers to the required power supply voltage.

3) Micro Controller

Figure.4. ATmega329 micro controller
The Atmel 8-bit AVR RISC-based micro controller combines 32KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator.

4) MPU6050

The MPU6050 sensor module is complete 6-axis Motion Tracking Device. It combines 3-axis Gyroscope, 3-axis Accelerometer and Digital Motion Processor beat small package. Also, it has additional feature fon-chip Temperature sensor. It has I2C businter face to communicate with the micro controllers. It has Auxiliary I2C bus to speak with other sensor devices like 3-axis Magnetometer, Pressure sensor etc. If3-axis Magnetometer is connected to auxiliary I2C bus, then MPU6050 can provide complete 9-axis Motion Fusion output.

V. TREMOR SUPPRESSOR

From the Experiment of tremor simulation, the generated tremor is suppressed by a gyroscope. It’s achieved by a spinning discs operated by conserving momentum. Using gyroscope, the most intensio n is to counter act any vibrations from any direction produced by hand. Gyroscopic stabilization works by responding to an input torque with an equal and opposite reaction torque. When a torque acts on a gyroscope and attempts to maneuver it off of its spin axis, the spinning of the gyroscope generates another torque that acts orthogonally to the present input torque. This motion is understood as precession. Precession generates a further torque that resists the first input torque. It’s the generation of this resistance torque that’s opposite and proportional to the input torque that’s the idea of the ultimate design. To know the capabilities of the planning, it’s important to review the physics of the system. One among the elemental properties of how gyroscopes operate is momentum. That’s the merchandise of an object’s moment of inertia and angular velocity.

\[ L = I \times \omega \]  

The conducted analyses on different gyroscope configurations to work out a theoretical optimal design of a gyroscopic tremor suppression device. The part of the system to style was the gyroscope itself. This component is extremely important, because its properties determine many factors of the ultimate design like weight, comfort, noise, and effectiveness. So as for the device to be effective, the gyroscope had to possess an outsized enough moment of inertia in order that it could generate a stabilization force. The high operating RPMs, small deformities within the gyroscope could cause the gyroscope to oscillate at a high frequency. This might create prominent vibrations that make the device loud, uncomfortable, and fewer effective. The planning of the gyroscope uses the principles of moments of inertia to maximize its momentum while being as small and light-weighit as possible. So as to maximize the instant of inertia while keeping the load to a minimum, the team designed the gyroscope to be as efficient as possible. This was done by combining the form of a hoop, the geometry with the very best geometric constant, with a disk, which has the second highest constant of and provided a contact point to the motor shaft.

VI. DESIGN OFGLOVE

Portable and compact glove is developed with 3D printing technology. The part where printed using a 35% infill to make the system strong. Cradle, Hand mount, Base and a space for gyroscope is necessary.

1) Cradle

The most important component that was added to the design is the cradle. The cradle is a component that rotates within the base and allows the gyroscope to precedes. Initially, the cradle was designed as a simple swing with two support pillars. At the top of each of the pillar’s holes were created to connect to rotating pins to allow the cradle to swing with the gyroscope’s
2). Base
In order to make the base design fit comfortably on an individual’s hand, an ergonomic fitting would have to be created on the bottom side of the casing. Rather than limit the device to only having the one ergonomic bottom, to make the bottom of the base modular. To do this, inverted trapezoidal channels were added to the bottom of the base through which matching groves on a customize mounting plate can slide through to join the two components. This allows the device to be able to have multiple mounting surfaces on the bottom, including both test and ergonomic mounts.

3). Hand Mount
The purpose of the hand mount is to provide a comfortable way for the device to be mounted on a hand as securely as possible. It is important that the mounting surface be comfortable, because if it isn’t the user will not want to wear it. The device also needs to be securely attached to the hand because this has a direct impact on the effectiveness of the device. If it is allowed to shift and slide, the device will not be able to react properly to the movements of the hand. the bottom surface of the base mount down to match the top surface of the hand model. This created a solid, exact connection between the hand and the mount. The edges of this extrusion were then filleted to increase comfort. The initial design of the hand mount was created based on an average male’s hand, but the scaling of the hand mount can be customized, therefore allowing the device to fit 95% of hand size.

VII. CONCLUSION
The system is designed to be built-in a glove so that it can be used for several tasks instead of one limited task such as in hand tremor spoons or pens. This device is a low-cost, about and can be afforded by many hand tremor patients. It is portable, light, and can be used anywhere and at anytime. Composed of light electronic components instead of heavy mechanical components on is tent with other tremor suppression products With this arrangement, the shafts of the motors were in the X direction and the vibrations were created in the Y direction which allowed the sensors to perform at the best sensors’ technical specifications Finally, with further improvements, this system can lead to a prototype that is capable of helping tremor patients perform daily routines.

VIII. FUTURE WORK
This prototype can be further modified to become smaller and more accurate with better tremor supersession. The Arduino-Uno3 module is based on the ATMEGA microcontroller (3 X0.8 cm), which is relatively large compared to other versions available from the same manufacturer such as the Arduino-Mini. It is not only smaller (0.8 x 0.8 cm), but also cheaper. Another suggestion for improvements can be to explore replacing the motors by MEMS magnetic actuators. The capability to integrate all of these devices in a small board should result in a very small and a good hand tremor suppression system.

IX. REFERENCES


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