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PARKINSON'S SPOON

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Abstract

The technology for assisting people who are functionally challenged has improved over the recentdecades. With today's technology, people with Parkinson's disease can, with a device on theirwrist, be able to draw pictures. Human limbs lost due to accidents can be replaced with bioniclimbs and with help from smartphones, blind people can by audio be informed what kind of objectthat appear in front of them. These are a few examples where technology has eased everyday lifefor people with impaired functionality. The purpose of this thesis is to analyze how an Arduinomicrocontroller can be utilized to help people with impaired motor skills during their eatingprocess. A prototype of a stabilizing spoon was constructed to work under real circumstances andintended to be a complement for people who are in need of assistance during their eatingprocess.To make this possible, a sensor with gyroscopes combined with accelerometers was usedto identify which direction the device's handle was being tilted, as well as how fast its positionwas changed. Two servo motors were placed orthogonally to each other to establish a system oftwo degrees of freedom. With this setup, the spoon was intended to maintain its spoon bowl in ahorizontal position. Experimental results of the spoon showed promising performance with somelimitations.

1. INTRODUCTION

Recent advancements in IoT (Internet of Things) technologies have enabled the production of cost-effective solutions to embed sensor networks and controlled systems. This has made it easier to deploy an IoT based infrastructure which can track, control, and monitor your devices. We have noticed a drastic improvement of intelligent biomedical assistance technology in the latest breakthroughs. New emerging technologies have made life easier for people who are functionally challenged, with novel devices such as biomechatronic components in place of human limbs and AI (Artificial Intelligence) based object classification devices for the visually impaired. With the help of such technologies and its protocols, we have designed and developed a

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stabilizing mechanism and integrated it in a spoon, to be used by patients needing assistance in their eating process. Parkinson's disease is a neurological degenerative disease that results in irrepressible shivers in the limbs, making it excruciating for the patient to lift food with a utensil. The disease's symptoms can vary from person to person and might even be overlooked for long durations if they are mild. The condition of the patient worsens over the years and might even lead to difficulty in walking and talking. The exact cause of the disease is still unknown, due to which it does not have a cure. The only hope for these patients is the potential these biomedical assistance instruments hold. Stabilizing mechanisms are employed in various areas like photography (gimbals) and aircrafts to compensate for the unintended motion and vibration of the process. In this paper, we propose a methodology to implement these advanced controlled stabilizing mechanisms into a low-cost prototype. A Self Stabilizing Spoon, which keeps itself steady as the hands of the user shiver or have tremors. It adjusts the position of its head if its rear end receives any unprecedented tremor [Figure 1 & 2]. In today's market, such devices are only manufactured by big companies at exorbitant prices [10 & 11], which are not affordable for the common man.

2. RELATED WORK

[1] The work "Robust DOBC for stabilization loop of a twoaxes gimbal system." By Ren, Wei, et al. lays the foundation for the idea of stabilization and calibration in a gimbal like manner, with two degrees of freedom. A disturbance compensation strategy based on disturbance observer control (DOBC) is proposed to solve parameter perturbation, friction, coupling and external turbulence for two-axes gimbal control system. Uncertainties, friction, coupling shortcoming of gimbal system is summed up as a disturbance suppression problem, and achieving disturbance compensation through feedforward channel of DOBC. However, the compensation effects of DOBC are determined by modeling accuracy of the nominal plant and feedforward filter design. [2] The US patent "Stabilizing unintentional muscle movements." By Pathak, et al. has been a pioneer in the field of stabilizing spoons. It has depicted a model of a stabilizing mechanism, along with a remote non-contact position sensor, coupled with a processing unit. The work is extremely detailed and one of the first in the field. The prototype does not specify the type of

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microcontroller or processing unit to be equipped, but rather suggests an 8-bit ATMEGA8A programmable microcontroller as an option, along with an inertial sensor and a motion sensor, similar to the gyroscope and accelerometer used in our device. [3] The paper "Self-Stabilizing Spoon for Parkinson's Ailment" authored by Jaswanth, D. K., et al. introduces a concept very similar to ours, with the Arduino Nano as a controller. The stabilizing mechanism involves reading ADC values from a gyroscope and an accelerometer in the GY-273 module and applying equal and opposite calibration after converting these values. The motors used are analog (HS125MG) instead of digital ones. Our paper has applied an equivalent approach, and has taken into consideration the speed of tremors, resulting in instant calibration and the least possible latency.

[4] The paper "Preliminary design of an active stabilization assistive eating device for people living with movement disorders." authored by Turgeon, Philippe, et al. proposes the idea of a mounted damping mechanism facilitated by magnetic encoders along with a gyroscope and an accelerometer. The system is operated using Atmel's SAM E70 ARM CortexM7 as a microcontroller. The highly complex Cartesian velocity-based damping algorithm relies on the user to operate the device via an external handle connected to the motor assembly, gearbox, transmission, and encoders. The only drawback of this model is that the device loses its portability and simplistic approach required by patients of neurodegenerative diseases, as these are usually coupled with memory disorders like Dementia. This study provides valuable insights into the different motions and tremors faced by the patient during different actions.

3. IMPLEMENTATION

The spoon is required to maintain a horizontal position, with respect to two axes. Two servo motors will be placed orthogonally to each other to establish a system of two degrees of freedom. With this setup in place, the spoon is intended to maintain its spoon bowl in a horizontal position.The microcontroller Arduino Uno sources remote power from a 5-volt battery connected to its VCC junction. The sensor interrupt is received through a digital pin, while the data is transferred through an analog pin, along with the pulse. The servo motors are aligned on top of one another, perpendicularly. This is done to provide two degrees of freedom. They are operated by designated digital pins. The sensor and

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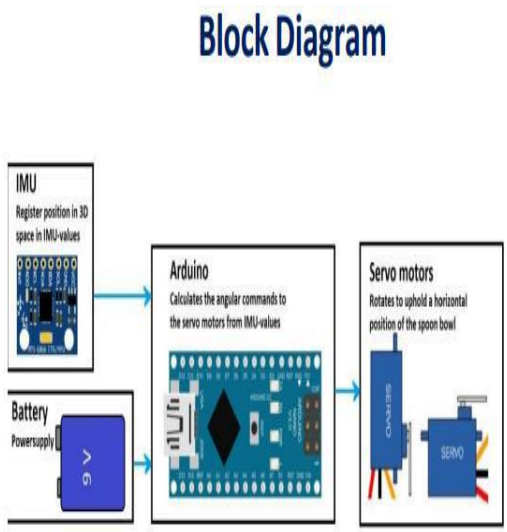
the servos receive their VCC and grounding through the Arduino or a connected breadboard. The circuit configuration is depicted, To achieve the desired results, the sensors and the electromechanical components are supposed to assess the environment first and learn what the frame of reference is for the user. The sensors get calibrated before they can be used for a period of 3000ms, where they read the angular readings and average them out for the period, these readings stand as the basis of the user's position. The MPU6050 sensor provides X, Y, Z, and temperature readings for the initial calibration period, where we store and calculate the first three and disregard the temperature values

4. EXPERIMENTAL RESULTS



5. CONCLUSION

Parkinson's has had a deep effect on patients' life, not just in a physical manner. The constant dependency on others' help for daily activities is emotionally taxing in an unimaginable sense. The developed prototype delivered desirable results and possessed the capabilities to make the lives of these functionally impaired people better than they were yesterday. The applications of the device are not limited to Parkinson's but can also be applied to patients with severe Cerebral Palsy or other neurodegenerative diseases. The prototype has some room for improvement and requires some changes if it has to be deemed usable for people with high-frequency tremors. The servo motors (SG90) are too slow to calibrate faster tremors, with no shortcomings in the algorithm. Although the device in its current state could be useful for people with limited motor impairments. A more advanced motor such as the MG90s or a separate DC motor would probably be more effective in practice. Cloud Connectivity in biomedical devices is an unexplored concept and this project forms the roots of this technology. As a true pioneer in the industry, this implementation has the potential to massively spread and make an impact on people's lives as the first device to integrate remote tracking for a disease with nerve cell damage.

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6. REFERENCE

[1] Ren, Wei, et al. "Robust DOBC for stabilization loop of a two-axes gimbal system." IEEE Access 7 (2019): 110554-110562.

[2] Pathak, Anupam. "Stabilizing unintentional muscle movements." U.S. Patent No. 9,925,034. 27 Mar. 2018.

[3] Jaswanth, D. K., et al. "Self-Stabilizing Spoon for Parkinson's Ailment.", (2020).

[4] Turgeon, Philippe, et al. "Preliminary design of an active stabilization assistive eating device for people living with movement disorders." 2019 IEEE 16th International Conference on Rehabilitation Robotics (ICORR). IEEE, 2019).

[5] Abrahamsson, Johan, and Johan Danmo. "The Stabilizing Spoon: Self-stabilizing utensil to help people with impaired motor skills." (2017).

[6] Ripin, Zaidi Mohd, Ping Yi Chan, and IzudinAlisah. "Preliminary Evaluation of Active Tremor Cancellation Spoon for Patients with Hand Tremor." IOP Conference Series: Materials Science and Engineering. Vol. 815. No. 1. IOP Publishing, 2020.

[7] Chowdhury Debjyoti, SriparnaSahu, and MadhurimaChattopadhyay. "Development of MEMS Accelerometer based Hand Tremor Stabilization Platform." International Journal of Biotechnology and Biomedical Sciences 2.2 (2016): 142-145.

[8] [invensense.com, 2015] invensense.com (2015). Mpu6050 Datasheet URL:

[9] Fedorov, D. S., et al. "Using of measuring system MPU6050 for the determination of the angular velocities and linear accelerations." Automatics & Software Enginery 11.1 (2015): 75-80.

[10] [liftware.com, 2020] liftware.com (2020). liftware.com URL: https://www.liftware.com/steady/.