

### SPOON FOR PEOPLE WITH HAND TREMOR

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### ЛОЖКА ДЛЯ ЛЮДЕЙ С ТРЕМОРОМ РУК

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***Аннотация.** Болезнь Паркинсона вызвана прогрессирующим разрушением и гибелью нейронов, вырабатывающих нейромедиатор дофамин. Из-за этого нарушается регуляция движений и мышечного тонуса, что проявляется характерным тремором, общей скованностью и нарушением позы и движений. Для паркинсонизма характерен тремор, возникающий в покое. Авторы разработали ложку для людей с болезнью Паркинсона, позволяющую держать её содержимое в неподвижном состоянии при воздействии на нее тремором рук.*

**Introduction.** Throughout the entire world, the number of patients with parkinsonism is 200-300 people per 100 000 people. This disease is characterized by rest tremor (initially and usually of the hands). It greatly complicates the quality of life. People suffering from Parkinson disease are not able to write and set a glass or a spoon to mouth. In our research we developed a spoon for people with hand tremor. The development included the following tasks:

1. analysis of the information on hand tremor;
2. study of the problems associated with taking food for people with hand tremor;
3. development of a functional 3D model of the device;
4. 3D model printing;
5. manual debugging of the details;
6. device assembly.

**Research and results.** Parkinson's disease is a chronic neurodegenerative disease. It is caused by a progressive loss of specific groups of nerve cells in the brain. It affects muscles and leads to abnormal body movements. The disease also affects the voice, speech, sense of smell and taste. The disease was first described by an English physician James Parkinson in 1817 in his "Essay on the Shaking Palsy". The disease can not be cured by modern medicine; however, the existing methods of conservative and surgical treatment can significantly improve a patient's quality of life and slow the progression of the disease [1].

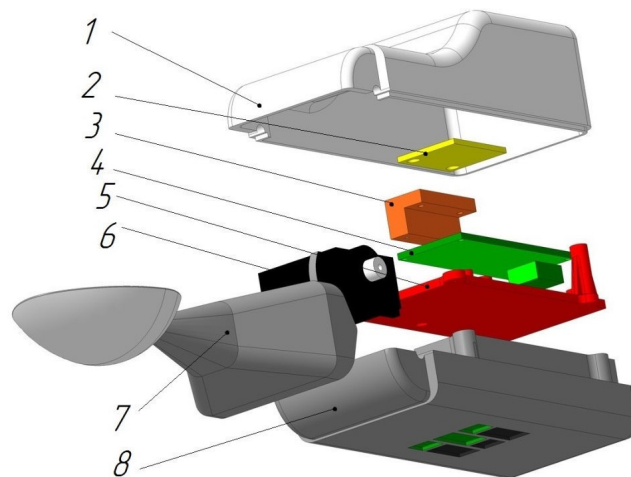
Parkinsonism is characterized by a tremor that occurs at rest (other types of tremor are rarely possible). Its frequency is 4–6 Hz. It usually begins in the distal (remote from the center) segment of one hand. Tremor

spreads to the opposite arm and legs with disease progression. Multidirectional movements of the thumb and other fingers outwardly resemble the count of coins or rolling of pills. Sometimes there may be head tremor like “yes-yes” or “no-no” and trembling of eyelids, tongue and a lower jaw. In rare cases, it covers the entire body. Tremor increases with anxiety, emotional excitement and subsides during sleep and voluntary movements. Unlike cerebellar tremor that occurs with movements and is absent at rest, patients with Parkinson’s disease have tremor at rest and the tremor decreases or disappears with movements [2].

Treatment of the disease. In addition to medical intervention to solve the problems associated with hand tremor, you can use biotechnical devices that can help people live with this disease. In particular, a spoon that enables people with Parkinson disease to eat without anyone’s help. The device Liftware Spoon attracted our attention because it represents an elegant combination of science and technology in one product. We became interested in developing of our own device capable of suppressing hand tremor [3].

Description of the device that is able to reduce hand tremor. Spoon is a device that allows keeping its contents in a stationary state. The spoon consists of a supporting part where electronic components are attached and a chamber on a ball joint. The motion sensor MPU-6050 (includes an accelerometer and a gyroscope to record hand movements) is connected to the Arduino NANO hardware platform which, in turn, processes the received signals and sends a signal to the servo unit. The device is powered by a Crown battery. The spoon should be light. So it was decided to make a plastic case and arrange all the components as compact as possible. We used a 3D printer to create the details.

Materials and methods for the device creation. To create a 3D model of our device, we chose KOMPAS-3D program due to its simplicity and accessibility. Thus, the hull of the spoon was designed as a 3D model in fig. 1 [4].



*Fig 1. 3D-model of the spoon*

The device consists of:

- 1 lower cover;
- 2 motion sensor MPU-6050;
- 3 mounts of the motion sensor;
- 4 arduino NANO;
- 5 battery cover and mounts for Arduino;

- 6 servounit;
- 7 moving part of the spoon;
- 8 upper cover.

Print of the device case and other parts. Having created the 3D model of the device case, we started its printing. We used a professional 3D printer with PLA plastic. The printing took 8 hours. After printing, the parts required a subsequent manual processing. It was necessary to remove the excess plastic which was used as a support for the walls of the parts while printing. After debugging, we assembled the device. The assembling included making holes for the screws to attach the components. Then we soldered the electronic components. The assembled device is shown in fig. 2 and fig. 3. The overall dimensions are shown in table 1.

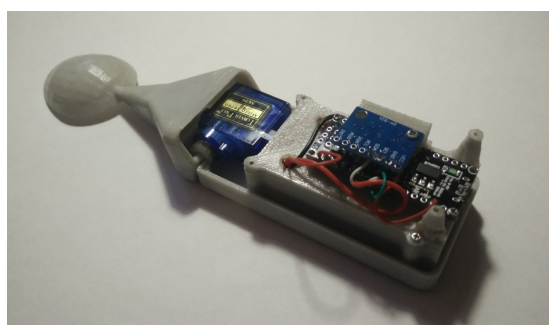


Fig. 2. Assembled device with the removed lower cover. Right view

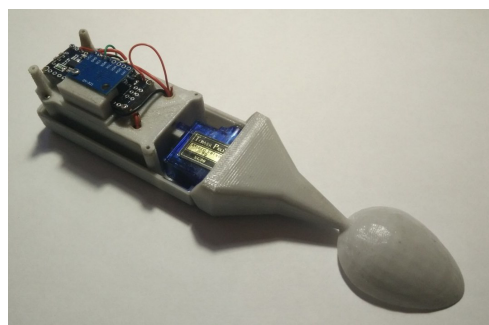


Fig. 3. Assembled device with the removed lower cover. Left view

Table 1

Overall dimensions and weight of the device

Overall dimensions	
Width, mm	40
Height, mm	35
Length, mm	180
Weight, g	≈100

**Conclusion.** Thus, to create a spoon for people with hand tremor we analyzed the information on causes and consequences of hand tremor, developed the functional scheme of the device and theoretically proved the principle of its stabilizing mechanism. The prime cost of the developed device is low. It is a cheaper analogue of already existing spoons and can easier penetrate the market and bring income.

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