MECHATRONIC SYSTEMS CONTROL VIA NEURAL INTERFACE

Neurogress

Neurogress
c/o Aleksandr Ovcharenko
Chemin des Mines 9
Geneva, 1202 Switzerland
Email: info@neurogress.io
Tel: +41-76-613-6618

Table of Contents

Introduction

Neurogress (Geneva, Switzerland) develops software for neurocontrolling electronics and machinery.

What is neurocontrol? This is a technologically facilitated process which allows a person to directly manipulate a device using brain waves. Until recently, the ability to control objects using the power of thought was limited to the shape of our body. This is no longer true. A neurocontrol device gives humans the ability to control the world directly using thought. Our thoughts may soon directly translate to action.

The potential uses for neurocontrolled devices are vast. Building on this software platform, Neurogress already integrates its software and mechatronic control into thought controlled prostheses and robots. However, Neurogress ultimately aims to develop an entire ecosystem of neurocontrolled devices based on its software platform.

These emerging devices will be informed by aspirations and design requirements drawn from diverse fields of human endeavor. Software and hardware developers are the starting point, but the perspectives of designers, artists, technology enthusiasts and philanthropists will all play a part in enriching Neurogress' vision.

The end goal for Neurogress is not just to encourage developers to bring innovative new neurocontrolled devices to the market, but also to revolutionize how people interact with technology. Through gradually eliminating reliance on cumbersome physical interfaces, Neurogress aims to transform how people bring their creative and intellectual pursuits to fruition.

1. The Neurogress Neurocontrol System

1.1. A critical weakness of neural interfaces and Neurogress' solution.

There is an abundance of neural interfaces in the present market. This is a mature technology and any of these currently available devices can read basic brain signals. What they're *not* capable of, however, is a high level of specificity in reading and responding to brain commands. This is a critical constraint in devices on the market today. They simply cannot be used to achieve complex objectives.

Figure 1. A standard neurointerface

Neurogress is developing neurocontrol software which solves this limitation.

This is achieved through incorporating artificial intelligence into the process of interpreting a brain signal and converting it into action. By introducing software which actively generates an evolving algorithm for interpreting an individual's brain signals, the potential for sending detailed, precise commands to a device is greatly increased.

In this manner, the company intends to provide a solution to a fundamental problem that has hitherto constrained the current market for neurocontrol devices.

1.2 Application potential – the immediate possibilities

Getting rid of 'pseudointerfaces':

Since the invention of the first stone cutting implement, mankind has controlled its tools and objects by hand. This of course has evolved to include the use of levers, pressing buttons, and any number of interfaces designed to give us greater control.

Later, as our world became more abstract and complex, we developed a new suite of tools. Typing, searching for information, finding new ways to multitask; all these new demands led us to recognize that many tasks could be performed faster and more efficiently using voice recognition technology. Today this is used in a wide variety of client services.

What is the next step in the evolution of controlling the world around us?

Neurogress believes this next step is to change our environment with the power of thought. This would allow society to take that radical step of removing the barrier between thought and action. The pseudointerfaces that mankind has created over the years to control devices and objects will rapidly become redundant.

To achieve this, Neurogress is developing neurocontrol software that is based on artificial intelligence. This software will allow people to neurocontrol any gadgets with precision and without the need for a manual control interface.

Eliminating the need for manual control would have immense immediate applicability to home appliances, unmanned aerial vehicles, robots, augmented reality devices and other mechatronic devices.

Improving quality of life for people with disabilities:

Despite society's considerable technological advancements, those who experience significant physical and mental challenges are still frequently unable to participate in the daily activities that most people take for granted. This is of course to the detriment of the well-being and happiness of people living with disabilities. It's also a loss for society as a whole, which is denied the opportunity to be enriched by many people who have much to offer.

Neurogress believes that, in the twenty-first century, great strides should be made in resolving this fundamental inequality.

One segment of the disabled population who can directly benefit from Neurogress work are people who have completely or partially lost limbs. The loss of an upper or lower limb as a result of an amputation is a serious problem for a person. It can significantly reduce a person's quality of life, can critically curtail their physical activity and frequently leads to long-term emotional and psychological challenges.

The use of artificial limbs (frequently referred to as a 'prosthesis') to replace or augment natural parts of the human body has been in place for a long time. The sophistication of these devices has evolved immeasurably. Today, a prosthesis may employ an array of technologies drawing from informatics, electrical engineering and biomedical engineering.

Such technologies differ in type:

- Invasive (electrodes are implanted into a human body)
- Miosensors (electrodes are placed on the human skin
- Noninvasive (based on the technology for recording the brain electrical activity with external devices).

Today, even the best and most expensive artificial limbs have significant restrictions on the functioning.

Invasive technologies:

The invasive control technology involves implantation of electrodes into the brain and provides direct neural communication. A surgery is required to implant sensors of this type. A sensor is installed in the cerebral cortex to measure the electrical activity of individual neurons. The signal received is very sharp and accurate, but invasive intervention has implications for human health and life.

It also entails a number of inconveniences relating to neurosurgeon's consultations, the probability of inflammation, the necessity to take medication and potential epilepsy complications. Despite the high efficiency and cleanliness of the signal, this type has one more serious drawback: the neurons lose sensitivity overtime so implants will have to be re-installed in a different part of the brain to ensure continued use.

Miosensors:

In the case of using mioelectrical sensors, users experience a delay in executing a brain command. The brain first sends the command to the muscle sensor. Then the sensor transmits a command to the engine, and a gesture is initiated. The response is, therefore, far from swift. The low command transfer speed does not allow its user to even approximate a normal speed of movement.

Noninvasive technologies:

In a noninvasive application of prosthesis control, electrodes are placed on the head. As a result, there are no restrictions on the loss of sensitivity. However, a key limitation to date has been that such systems are unable to recognize the specific action for controlling the prostheses that is produced by the brain signal.

Other limitations which apply to all three approaches:

The price of fully-integrated bionic prosthetic limbs ranges from $14,000 to $40,000 per device. This is without taking into account exclusive models, the price of which can reach up to $150,000.

Major world manufacturers of prosthetic devices include:

- Bebionic (RSLSteeper, part of the Otto Bock Group, Germany) - BeBionic3 model (aluminum alloy, carbon; 14 grips) - from $25,000 to $35,000
- Touch Bionics (acquired by Ossur, Iceland) - I-Limb Quantum model (titanium alloys, carbon and others; up to 28 grips) - approximately $25,000
- Otto Bock (Germany) - Michelangelo model (aluminum alloys, silicon nozzles) - from $14,200 to $41,700.

Fitting of modern prosthetics can take months or even years. It may cause diseases and physiological changes requiring additional treatment and management. The biggest challenge in fitting a modern prosthetic is the “prosthetic socket” – the part of the device which links the device with the disabled person’s body. Its production typically involves such technologies as molding and casting, which are inherently costly, imperfect and difficult to customize.

The Neurogress solution:

In order to avoid the risk of negative consequences after surgery, Neurogress set about developing an approach which relied purely on noninvasive sensors. Sensors are installed without intrusion into the human body, which leads to reduced risk and greater ease of use.

Once the neurocontrol software has been implemented training can commence. Benefitting from AI augmented learning, a typical recipient will require two to three weeks to learn to control the limb. This is a vast improvement over the four to eighteen months of training that is typically required to use a regular prosthetic device. Furthermore, the device can offer up to 28 different configurations of grips, which is at the upper end of what any prosthetic device can currently achieve and more than enough for full-fledged activities.

The cost of Neurogress’ prosthetic device solution in a collaboration with potential manufacturers is projected to be from two to five times cheaper than those of its competitors.

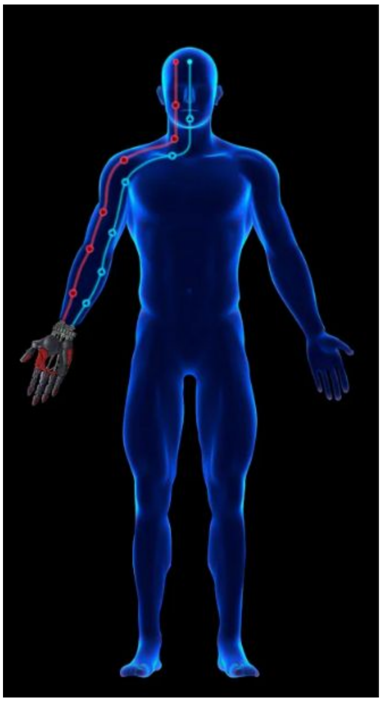

Figure 2. The active control mechanism for a prosthetic device

The speed with which commands can be issued to a prosthesis is one of the most critical issues facing the company's developers and engineers. Currently, the planned time lag is 0.5 seconds, but the ultimate goal is to reduce this to 0.05 seconds. Additional testing and refinement is being carried out at the company's laboratories to reach this critical goal.

Safer, more powerful and less expensive, non-invasive prostheses with the integrated neurocontrolled Neurogress software are well positioned to rapidly occupy a key segment of the available market.

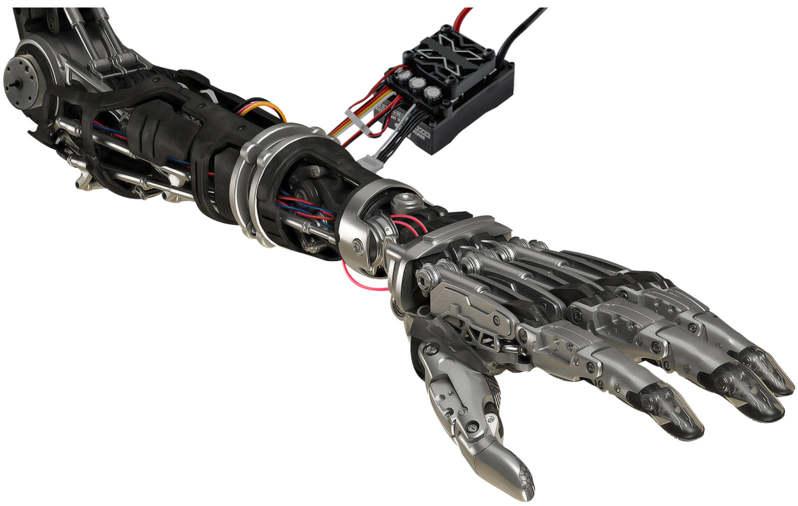

Figure 3. The prototype example of a neurocontrolled prosthetic device

Improving techniques for robot control:

Robots are increasingly becoming an integral part of human life. They are able to help people in many areas, ranging from house cleaning to space exploration. However, robotic systems are typically programmed in advance to perform certain basic actions, sometimes with additional direct control by joysticks, consoles, and other mechanical manipulators. This is a limitation which places significant restrictions on what we can achieve with robots. Manipulating a robot with a pseudointerface is awkward and haphazard. The process of configuring and fine-tuning the control interface is time-consuming and costly.

Neurogress solutions:

What industry, scientists and society at large dream of is the possibility of a robot which can be operated 'naturally'; which truly feels like a natural extension of the self. We want this vision of thought leading to action through a robotic presence. This is the solution Neurogress is striving for.

Using the neurocontrol software developed by Neurogress, it is now possible to control robots by the power of thought. The technology makes the control of robotic systems much easier and more accurate.

The company has begun to integrate its AI-based neurocontrol software in an android robot (a humanoid robot). Ultimately, our vision is that such devices will become valuable assistants to people in almost every area of their lives. Each person will have a personal assistant that will be controlled by the power of thought and the robot's actions will be monitored through virtual reality devices. You will be able to see and hear whatever the robot sees and hears.

1.3 Application potential – the broader view

The development of the neurocontrol software and its integration in prostheses and robots controlled by the power of thought are only the initial stage of the Neurogress project. There is vast potential for expansion. In the next stage, the company will integrate thought control with the Internet of Things, with the possibility for devices to be controllable by thought from any distance.

The company also plans to foster accessibility and innovation through developing training products and seminars. As more audiences are reached and included in this development process, we expect to see an explosion of new ideas and possible applications.

New neurocontrol devices will be developed on the basis of our current technology. As the ecosystem of neurocontrolled devices develops and matures, we will discover many new ways of getting things done more efficiently. Where we end up may surprise us all.

The possibilities for entertainment:

Neurointerfaces will be a game changer for those who play computer games. While thought controlled devices are on the market today, these are comparatively primitive. For the most part, they are based on a primitive reading of nerve impulses that control the eye muscles. While they offer a glimpse into the possibilities, they are just the beginning.

The new generation of neural interfaces promises a fuller reading of the brain electroencephalogram (EEG), and the Neurogress software promises to put commands into action more accurately and realistically.

Neurogress – MECHATRONIC SYSTEMS CONTROL VIA NEURAL INTERFACE

The company experiments with neurocontrolled robots and plans to integrate its neurocontrol software in collaboration with one of the manufacturing leaders to create a full-fledged robot-android that can be controlled via the neurointerface. This opens up exciting, futuristic possibilities. Imagine sitting at home, looking through neurointerface glasses, seeing what a robot sees and remote-controlling it. Imagine a race of flying or running neurocontrolled robots. Imagine a complete exoskeleton controlled by the power of thought. The potential scope for this technology is mind-boggling.

2 Technology

2.1 Neurogress neurocontrol system based on Artificial Intelligence

Process overview:

To overcome the obstacles outlined in Section 1, Neurogress has developed a neurocontrol system that is based on artificial intelligence. Figure 4 provides the functional diagram of neurocontrol for a mechatronic device. The standard sequence of activities is as follows:

- The signal/data is read from the brain via the neural interface in the form of the electrical activity of the neurons.
- The signals are recognized by the frequency of the waves. There are 8 main types of signals, and there may be combined control functions.
- Approximately 10% of the data remains unchanged, and 90% are used to train the system with different patterns.
- The results of multiple training are compared, and the best solution is remembered by the system.
- Resulting signals are then classified and used to transfer commands to different devices (a robot, a drone, a prosthesis, a computer and other appliances).

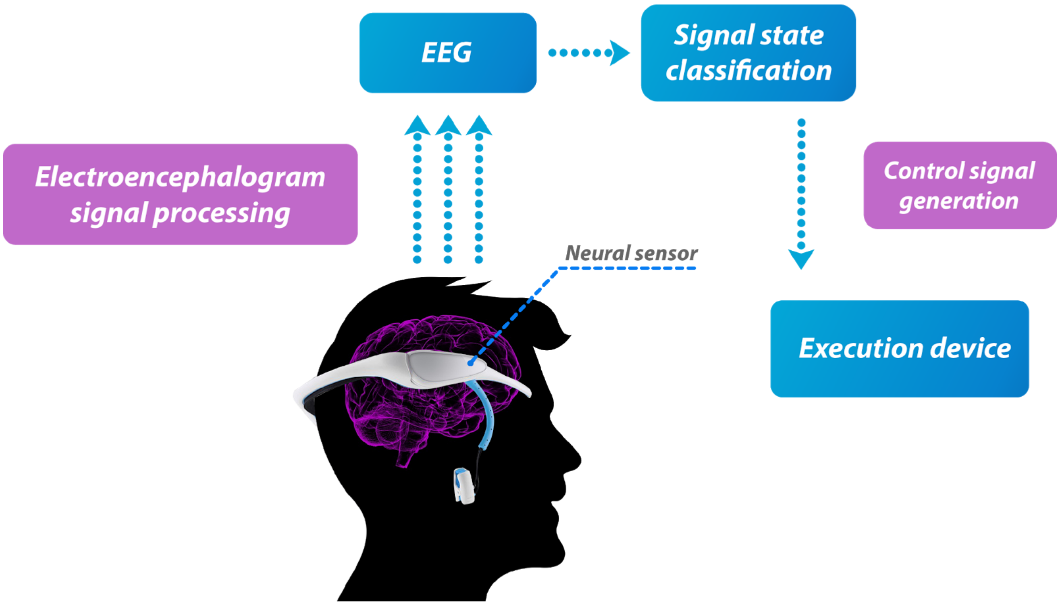

Figure 4. Neurocontrol of a mechatronic device

Detailed description:

Neurons compose the main cells of the central nervous system and they are key to understanding the process described above.

A neuron has several components: the axon, through which excitation is transmitted from the neuron to another neuron, and numerous dendrites, on which axons from other neurons end with synapses). Neurons transmit excitation only from dendrite to axon.

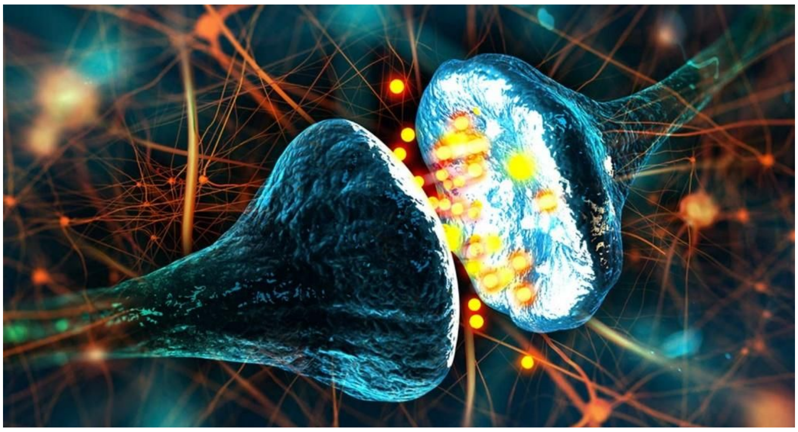

Figure 5. Visualization of neuron interactions

The main property of a neuron is its ability to excite (generate electrical impulse) and transmit (conduct) this excitation to other neurons. A certain degree of synchronization between neurons is set by various subcortical structures that perform the role of a "pacemaker". The generation of EEG signal patterns occurs in situations when a large number of neurons are synchronized and create sufficient electrical activity that a signal can be obtained from the surface of the human head.

The Neurogress system receives data on the difference of potentials between the original raw EEG signal and the zero point. The control goal in a particular biological system is a certain end state which the system must reach in virtue of its structural organization or a certain expected result of actions. The end state of the biological system is the best state of the system both as a whole and its individual constituents at all levels of the organization in the best control environment. Hence, we have a state space which the biological system changes to.

How the AI is trained:

In order to train the AI system to accurately recognize brain signals, a person is asked to repeatedly imagine a desired motion. This allows algorithmic image recognition systems to find a match between an intention and corresponding signs in the electrical activity of the brain.

Through a process of repetition, the algorithms learn to reliably recognize naturally produced signs of the person's intention to initiate movement. These signals are immediately transmitted to the execution device as commands to switch it to the desired mode: moving up, turning right, and so on. If there is an error in the software, there will be no irreversible consequences - the device will simply work less accurately. In this case, the device is stopped and returned to its initial state.

2.2 IoT integration

Process overview:

Integrating the platform with IoT will allow devices (such as robots, drones and appliances) to be controlled over large distances.

The sequence of activities is as follows:

- The neurointerface transmits the signals to a computer (a telephone, a tablet, etc.)
- The Neurogress software reads the signal and translates it into a desired action
- The command to perform the action is broadcast to the device over the Internet.

Given the wide satellite coverage of geographical locations, the probability of communication interruption is quite low. However, the option to use devices as local transponders is being considered as a fallback option. This would solve the problem of remoteness by permitting devices in a non-Internet location to generate a joint coverage radius.

Third-party development of IoT products:

In the process of developing the Neurogress ecosystem in mid-2019, it is planned to provide everyone interested with access to API (Application Programming Interface) to start development with any mechatronic gadgets.

For developers, the source code will be opened so that everyone can experiment with the neurocontrol of any device that Neurogress does not yet support - it will significantly accelerate the development of the platform and the ecosystem (and the industry) as a whole.

2.3 Security and privacy

Security is a critical part of this project. The software will therefore provide mandatory encryption of signals and associated anti-hacking technologies.

The role of blockchain:

Neurogress will determine which of the blockchain technologies best meets the needs of the project when it reaches the development stage. The current expectation, however, is that the platform and system will be based on the Ethereum smart contract. However, since Ethereum still has significant limitations in transaction processing speed, IOTA is currently considered for integration and implementation of the project strategic development in the field of smart gadgets, smart home.

Blockchain will bring several benefits to the project.

It will provide an ideal transaction processing platform for the project. Its decentralized structure will ensure safe payments and a guarantee of full user compliance with use agreements.

Blockchain also effectively addresses the problem of data storage security and privacy. Blockchain is a decentralized system that is resistant to hacking attacks. It is also structured in a way that permits transaction tracking.

Smart contracts for neurocommands also addresses any security concerns relating to the execution device. In the case of system failure and errors, blockchain technology will make it possible to track what kind of transaction it was and what action the command executed. This effectively precludes the possibility that neurocontrolled devices might be used for illegal purposes or to threaten people.

Another problem is the memory capacity needed to store large amounts of data. For example, in the next few years, a detailed molecular model should be built for Human Brain Project that will require hundreds of exabytes (1 exabyte = 10^{18} bytes) of memory. At the same time, the specialists predict that even in 2020 supercomputers will not have more than 200 petabytes (1 petabyte = 10^{15} bytes). In addition, the use of a large number of links between individual programs that make up the neural network requires a huge amount of energy, and it could cost billions of dollars per year. The use of Tangle IOTA technology, which has no commission for transactions, will significantly improve the economy of the project.

3 Business Model

3.1 Market and project monetization

Overview:

Developments in the area of neurocontrol are being carried out worldwide. The closest competitors include the American company Cyber Kinetic, Australian Immotio, and the Russian startup of Skolkovo.

Only a few estimates of the global neurotechnology market have been made so far, but the numbers are clear. The authors of the NeuroNet road map project that the world market of neurotechnologies will have reached $1 trillion by 2035. Much of this rapid growth can be attributed to the massive demand for artificial organs (ears, eyes and limbs) as well as neuromorphic computers and interfaces for neurocontrol of household devices (climate control, electrical appliances and so forth).

Monetization of the project in the short term (the next two years) will be achieved with the development of the following directions:

- Neurocontrol software (under the condition that the TGE funding collects less funding than desired for making the code open source)
- Collaboration with leading manufacturers for neurocontrol system integration into prosthetic upper and lower limbs and exoskeletons
- Collaboration with leading manufacturers to create thought-controlled android robots and other robotic machinery
- Development of the marketplace for software, hardware engineers
- Development of the marketplace for algorithm training
- Development of the Neurogress ecosystem

The company also plans to provide a marketplace for users to create and sell "handcrafted items" that can be controlled by Neurogress software. Developers will be able to submit applications for the Neurogress software and in this case monetization will be achieved through fees for the use of platform services. Note that a decision on whether the code will be released as API or open source will be based on the extent to which Neurogress reaches its TGE funding goals.

To maintain and increase enthusiasm in the user marketplace, the company plans to set up an ecosystem fund to which the company will allocate about 10% of its profits. The fund will be used for development of the ecosystem itself, to support developers and for educational purposes. Monetization will take place through the sale of places in training programs and through seminars designed to reach a wide audience interested in the technology.

The company foresees a significant increase in demand for Neurogress control systems which can be embedded in numerous high-tech areas of everyday life. There are at several marketplaces where Neurogress sees a clear fit for the neurocontrol technology and where the company aims to participate in order to integrate its neurocontrol software to ultimately occupy a significant market share.

The Prosthetics Marketplace:

It is estimated that[1] approximately 15% of the world's population experience a disability that is significant enough to inhibit normal physical activity and social inclusion. More than 50 million people become disabled each year and this number is increasing worldwide.

The global market for medical bionic products is projected to reach $17.8 billion in 2017. In 2012, the market value was estimated at $12.67 billion. This represents an annual increase of over 7 per cent. The exoskeleton market alone may reach $500 million in annual sales by 2020, $2 billion by 2025, and $3.5 billion by 2030. This is a huge and growing market.

Neurogress plans to collaborate with world-known leaders in the prosthetics field in order to integrate its neurocontrol software capabilities into prosthetic devices. This approach will make them non-invasive and will allow to alleviate the undesired discomfort people experience with invasive technologies.

The Robotics Marketplace:

The data available in open sources of information show that the global robotics market is estimated in the US hundreds of billions.

According to forecasts by the Tractica analytics[2], the world market for robotics will increase from $34.1 billion in 2016 to $226.2 billion by 2021, and it will show an average annual growth rate of 46%. In 2016, the robotics industry was at a turning point when the size of the domestic robot market first surpassed the industrial robot market.

The IDC analysts[3] predict that the global market for robotics and related services was $91.5 billion in 2016, and in 2017 will reach $97.2 billion. By 2020, it is expected to exceed $188 billion and by 2021 its size will reach $230.7 billion[4].

Neurogress aims to collaborate with the manufacturers to integrate its neurocontrol software into human controlled robotic segment.

The IoT Marketplace:

Estimates of the global IoT market vary, but the order of figures given by reputable consulting companies is in broad agreement.

The International Data Corp. (IDC)[5] projects that the Internet of Things market will continue to grow, exceeding $800 billion in 2017. This is an increase of 16.7% compared to 2016. According to the published data, the IDC analysts expect that, by 2021, the global IoT market may reach a level of $1.4 trillion. This market growth is attributable to continued investment of companies in hardware and software, as well as investment in services providing connectivity to IoT.

---

1 https://issek.hse.ru/trendletter/news/174161494.html
http://apps.who.int/gb/ebwha/pdf_files/EB134/B134_16-ru.pdf?ua=1&ua=1

2 https://www.tractica.com/newsroom/press-releases/the-global-robotics-industry-is-at-a-critical-turning-point-as-non-industrial-robots-overtake-industrial-robots-in-market-size-for-the-first-time-in-2016/

3 https://www.computerworld.ru/news/IDC-mirovoy-rynok-robototehniki-k-2020-godu-vyrastet-do-188-milliardov-dollarov

4 https://www.computerworld.ru/news/IDC-k-2021-godu-mirovoy-rynok-robototehniki-vyrastet-v-dva-s-polovinoy-raza

5 https://belretail.by/article/idc-mirovoy-ryinok-iot-v-godu-vyirastet-na

The estimates made by the TechNavio research company coincide with IDC forecasts, and according to its latest report[6] the global IoT market is expected to grow at an average annual rate of approximately 4% until 2021. The TechNavio report indicates that the global IoT market will have reached $1.37 trillion by 2021.

More optimistic estimates are given by the Gartner analysts[7], who estimate that at the end of 2017, the volume of the IoT market in monetary terms will be $1.7 trillion compared to $1.4 trillion in 2016. They estimate that by the end of 2017 there will be 8.4 billion devices connected to the network worldwide, an increase of 31 per cent compared to the previous year. By 2020, the number of IoT devices is expected to reach 20.4 to 20.8 billion pieces. Gartner predicts that the market will reach $3 trillion[8] by the year 2020.

Neurogress aims to be one of the leaders of neurocontrolled devices in the field of IoT.

The Drones Marketplace

Open source data shows an upward trend in commercial drone market, which is intentionally segregated from a multi-billion military drone industry. Tractica gives an over $8.7[9] billion figure in revenue for commercial drones in 2025. Goldman Sachs report[10] forecasts $100 billion market opportunity for drones— from commercial and civil government sectors. While the consumer drone market was the first one to develop outside of the military sector and estimated to reach $17 billion by 2020, drones are predicted to play a huge role in sectors such as agriculture and industry, performing airborne inspection, scanning for defects and analyzing crop health. Similar technologies may help in rescue services and many other fields, creating a market of $13 billion by 2020 with $3.3 billion in revenue.

Neurogress is eager to launch neurocontrolled drones as one of its first development projects in collaboration with drone manufacturers.

AR/MR/VR Marketplace

Estimates of the global AR/MR/VR market vary greatly, with agencies as Goldman Sachs presenting delayed and accelerated uptake scenarios, ranging from 23 to 182 billion US dollars correspondingly[11], and 80 billion in a base scenario. The same report shows that the installed base of VR/AR/MR devices will grow to 300 million units by 2025, being distributed between PC and consoles (10%), Mobile VR (20%), Standalone AR/MR (35%), Smartphones and tablets (35%).

---

6 https://www.technavio.com/report/global-computing-devices-global-internet-things-devices-market-2017-2021?utm_source=T4&utm_campaign=Media&utm_medium=BW

7 http://www.tadviser.ru/index.php

8 https://www.gartner.com/newsroom/id/3165317

9 https://www.tractica.com/newsroom/press-releases/commercial-drone-hardware-and-services-revenue-to-reach-12-6-billion-by-2025/&sa=D&ust=1514743974841000&usg=AFQjCNFCulGHE1EHi_igLVXpWu7WbRevhg

10 http://www.goldmansachs.com/our-thinking/technology-driving-innovation/drones/

11 https://www.google.com/url?q=http://www.goldmansachs.com/our-thinking/pages/technology-driving-innovation-folder/virtual-and-augmented-reality/report.pdf&sa=D&ust=1514674039269000&usg=AFQjCNEqu_N-OM4QZ9ffHcD0pXEH_SZEZw

No less optimistic scenario presented by IDC, that sets it estimates of AR/VR global market at $50 Billion by 2021.

Neurogress prepares to enter this exciting market as it sees clear fit for its development in the AR/MR/VR industry. The company is already developing the neurocontrol educational kit in VR.

Smart Home / Environment Marketplace

The Smart Home / Environment industry is a multitude of various devices related to our abode, including comfort, security, smart kitchen, various electronics control and others. Already measured in billions, Smart Home industry has great potential of reaching $130 billions by 2025 according to Grand View Research[12]. Some agencies, however, present even more promising figures of $138 and even $190billions scenario was proposed by Juniper Research[13].

Neurogress plans to play a significant role in this high-tech and comfort-oriented industry. The growth of markets described above is presented by the diagram for better visual understanding:

Market projections (billions of dollars)	2018	2019	2020	2021	2022	2023	2024	2025
The Robotics Marketplace	119.2	153.5	187.9	228.5	277.8	337.8	410.8	499.7
The Prosthetics Marketplace	5.6	6	6.4	6.9	7.4	7.8	8.4	9
IoT Marketplace	1,500	1,800	2,100	2,300	2,700	3,200	3,600	4,000
The Drones Marketplace	27.2	29	30	31.2	32.3	33.9	36.2	39
AR/MR/VR Marketplace	13.05	21.35	32.2	43.6	55.8	65	76.3	87.5
Smart Home Marketplace	30	37.8	58.6	72.43	101.6	137.9	153.6	170

3.2 NRG Tokens

Neurogress seeks to provide participants with highly favorable conditions for contributing to project development.

In addition to regular currency and major cryptocurrencies, tokens will be used as one means of payment for products and services of the platform (along with the fiat money and major cryptocurrencies). Profitability of users is composed of the income from the possible growth of the market value of the token due to the popularization of tokens as a means of payment for the services and products of the Neurogress platform and due to the increased Neurogress global market presence.

The use of the token will be carried out as an internal currency for payments in the marketplace. It will be used as follows:

- To allow purchases of software or devices in the marketplace.
- To pay for work of developers writing code for the needs of the Neurogress-based projects.

[12] https://www.grandviewresearch.com/press-release/global-smart-home-automation-market

[13] https://internetofbusiness.com/smart-home-revenue-2021/

- To carry out contracts in the platform between customers and contractors to provide services for writing additional software, design applications and / or device prototypes.
- To pay for the work of users and developers who participate in the improvement and training of algorithms used for the platform and Neurogress software enhancements, as well as to create a database of neuro-algorithms.

The company is going to open the API for developers, with the possibility of making the source code completely open source. The latter will occur if sufficient funds are collected during the TGE stage. If sufficient funds are not raised, the software will be distributed free of charge only to those token holders whose contribution exceeds 5,000 NRG tokens.

Neurogress aims to issue its own cryptocurrency within a year after the TGE. The exchange rate for the Neurogress cryptocurrency will be performed as 1 token for 1 coin. The cryptocurrency will support mining functionality, where the “Proof of Neural Activity” concept will be put as the mining algorithm core. In brief, the algorithm will be processing a user’s brain activity where the user will work with real or imaginary devices. This will provide a valuable input into neuro-algorithmic training and will ultimately enhance the neurocontrol software.

For more information about Neurogress cryptocurrency follow the upcoming project updates.

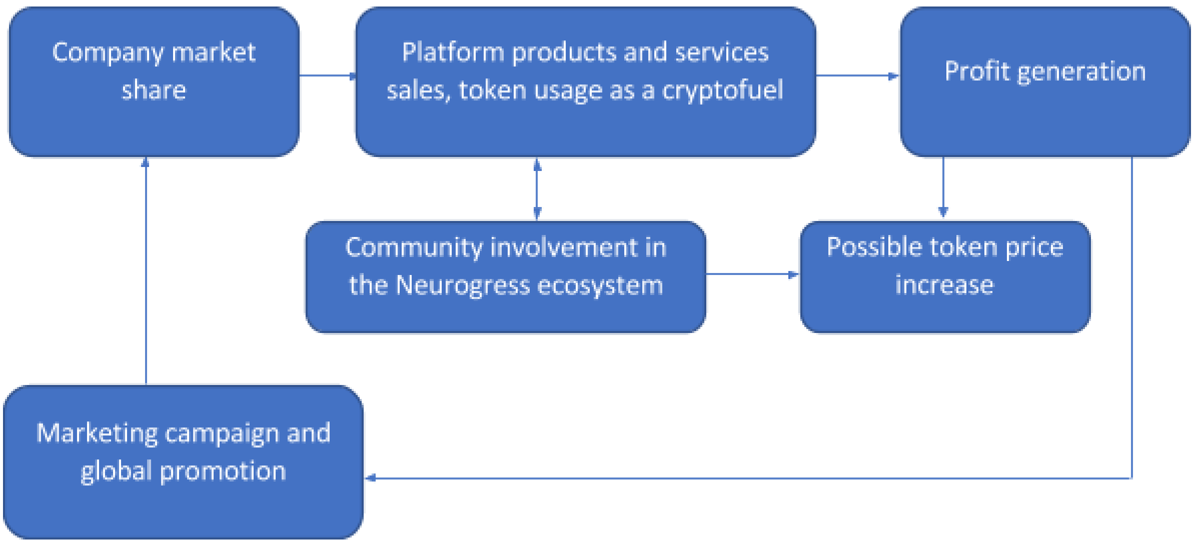

Diagram 1. Scheme of possible tokens value appreciation

3.3 Charity

Neurogress has a commitment to fostering equality of access to its technology. Finding ways to ensure access among those in greatest need will be integral to the Neurogress device ecosystem. To this end, the following options are under consideration:

- Ten per cent of the total amount collected on the TGE will be allocated to a charity fund. An estimated 1,000 prosthetic devices may be produced in collaboration with manufacturers and distributed free of charge using these funds.
- The launch of a charitable campaign to help an additional 3,000 people receive their prostheses free of charge.
- When making payments on the Neurogress platform, a default commission of 0.001% will be charged and transferred to the charity fund. In this way, free prosthetic and possibly other devices will be produced for disabled people in need on an ongoing basis.

A joint vote of the project participants may result in a combination of the above actions.

4 TGE Structure and the Project Roadmap

4.1 TGE Structure

Approximately 94,371 ETH are required to launch the Neurogress project. The funds will be allocated as follows:

- Software development (neurocontrol system) - 32.5%
- Administrative - 9.8%
- Marketplace development - 10.5%
- Ecosystem development - 15.9%
- Support of development community - 11.6%
- Consulting services and outsourcing - 6.4%
- Marketing campaign - 13.3%.

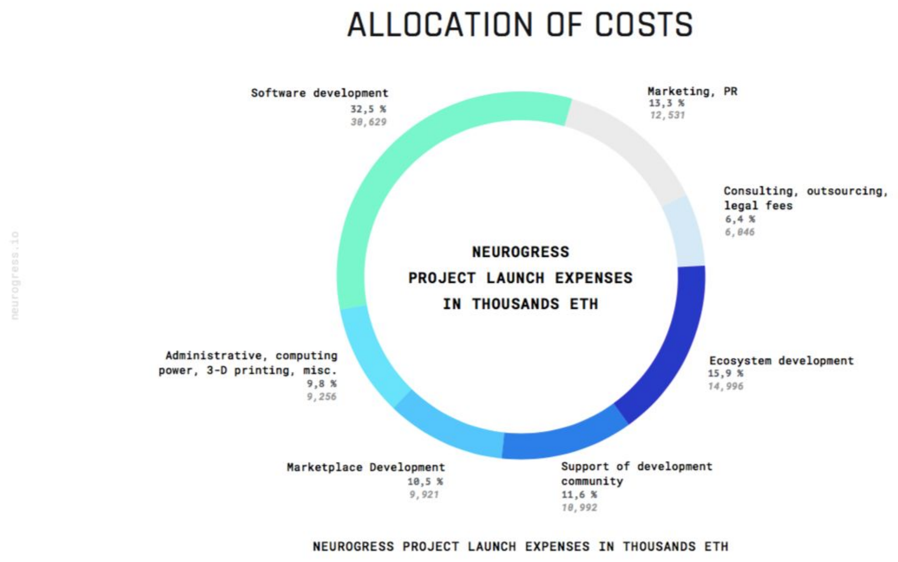

Diagram 2. Allocation of funds needed for the Neurogress project launch

The total volume of company tokens is 100,000,000 units. The company plans to reserve 50% of these tokens for project development with a condition of 40% lockout for 1 year after the TGE ends. This portion will not enter the exchange and will support long-term development.

The plan for using reserved tokens is as follows:

- 15 million (15% total) will be used to motivate developers and members of the Neurogress team.
- 10 million (10% total) will be used for developers of the ecosystem and the Neurogress marketplace.
- 10 million (10% total) will be invested in other (blockchain) projects that will be owned by Neurogress and used for Neurogress projects and infrastructure.
- 5 million (5% total) will be allocated to experimental trends related to Neurogress neurodevices.
- 10 million (10% total) will be placed in reserve as contingency.

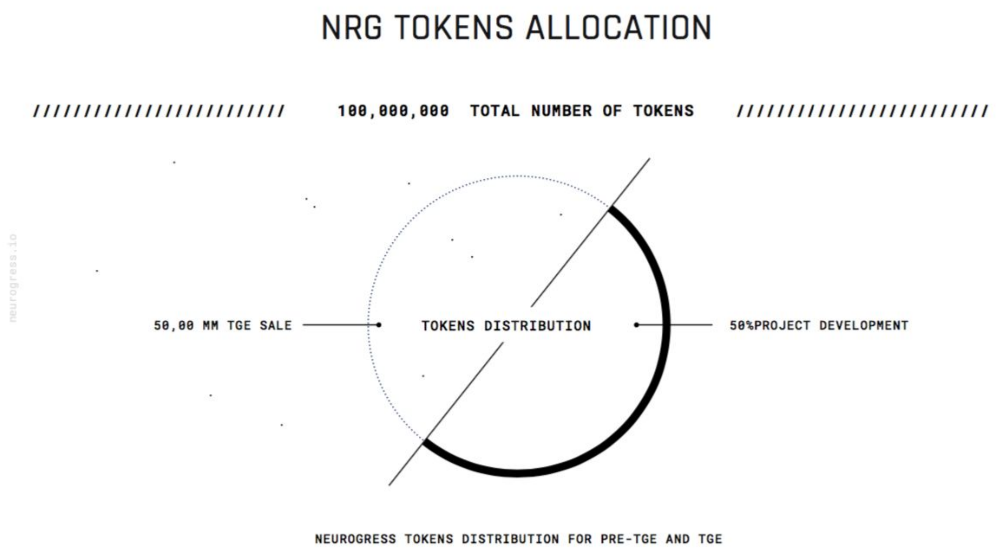

Diagram 3. Allocation of NRG tokens

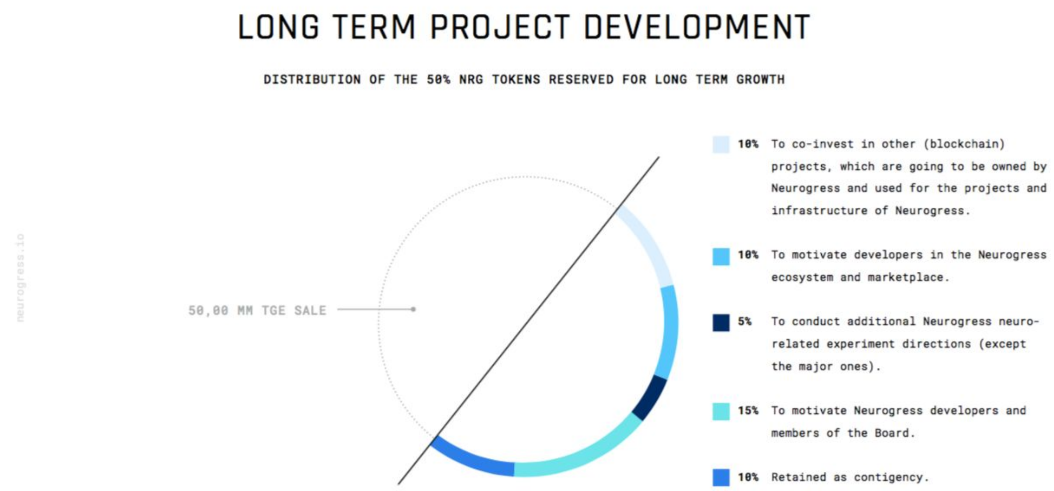

Diagram 4. Token reservation for the long-term project development

Neurogress average annual expenses should not exceed 15 million tokens.

The number of tokens for sale is 50,000,000 units. The placement is conducted in three stages: Private Placement, pre-TGE and TGE.

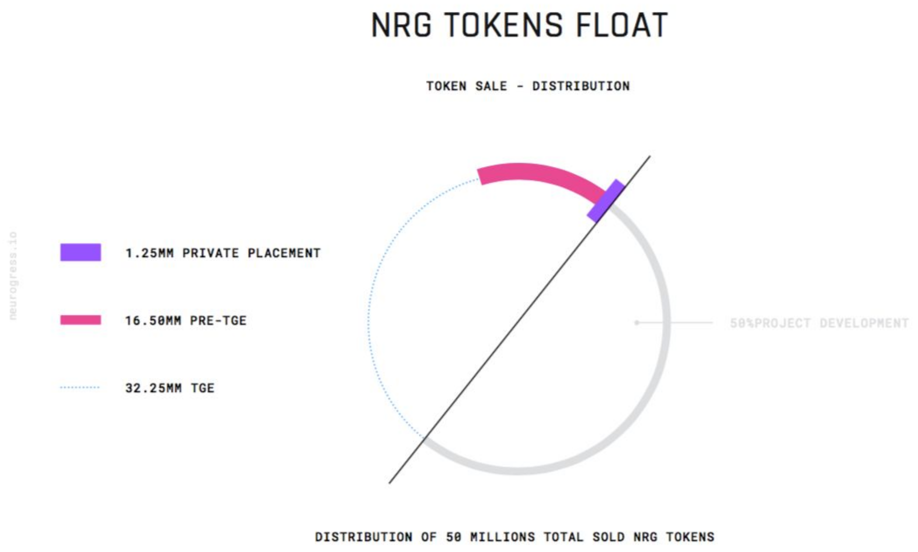

Diagram 5. Distribution of NRG tokens for sale during the three stages

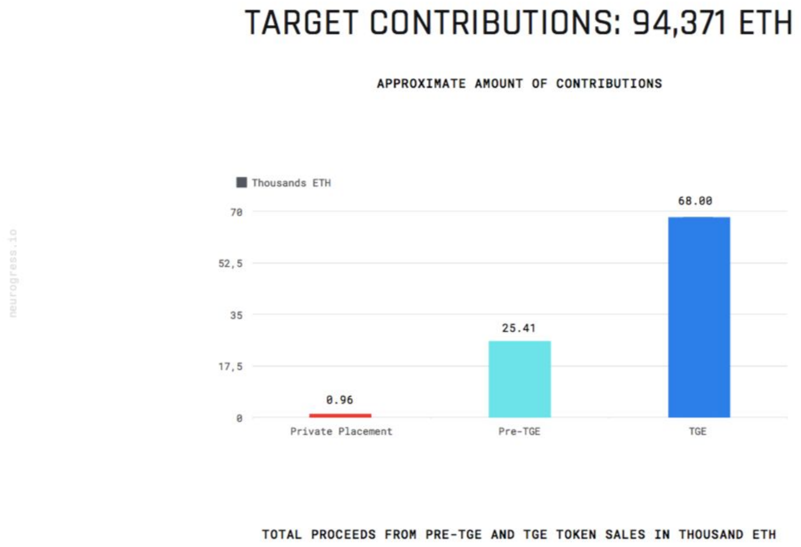

Diagram 6. Approximate amount of contributions during the three stages

When purchasing project tokens during the Private Placement stage, participants receive an additional bonus to TGE base price of 200%. During the pre-TGE stage this will be 50%. At the TGE stage bonuses will be distributed as follows:

- First 6,450,000 tokens - 20% bonus
- Second 6,450,000 tokens - 15% bonus
- Third 6,450,000 tokens - 10% bonus
- Fourth 6,450,000 tokens - 5% bonus.

The remaining 6,450,000 tokens will be sold with the base price of 0.0023098 ETH per token.

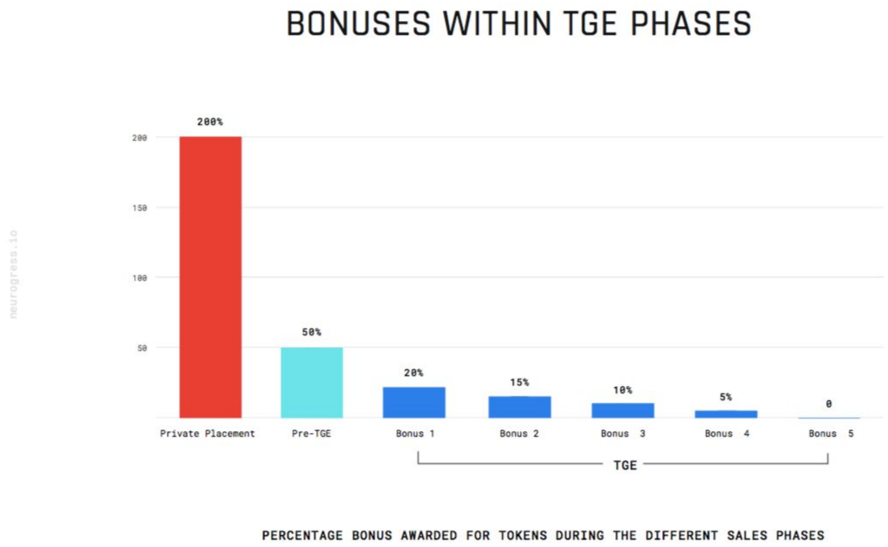

Diagram 7. NRG token bonuses distribution

Neurogress plans to implement the following developments based on the corresponding funding raised via the TGE:

- 35,000 ETH: The development of neurocontrol software. The software will be kept in-house and sold separately*.
- 47,000 ETH: Marketplace implementation, neurocontrol software API will be provided to developers.
- 62,000 ETH: Software interoperability with existing devices for neurocontrol and collaboration with manufacturers for new neurocontrolled devices.
- 83,000 ETH: Development of the Neurogress cryptocurrency based on the "Proof of Neural Activity" concept.
- 94,371 ETH: Creation of algorithms bank with the possibility of users to train them. Neurocontrol software code will become open source.

** – Token holders with the quantity of 5,000 NRG tokens are eligible for the free version of the neurocontrol software.*

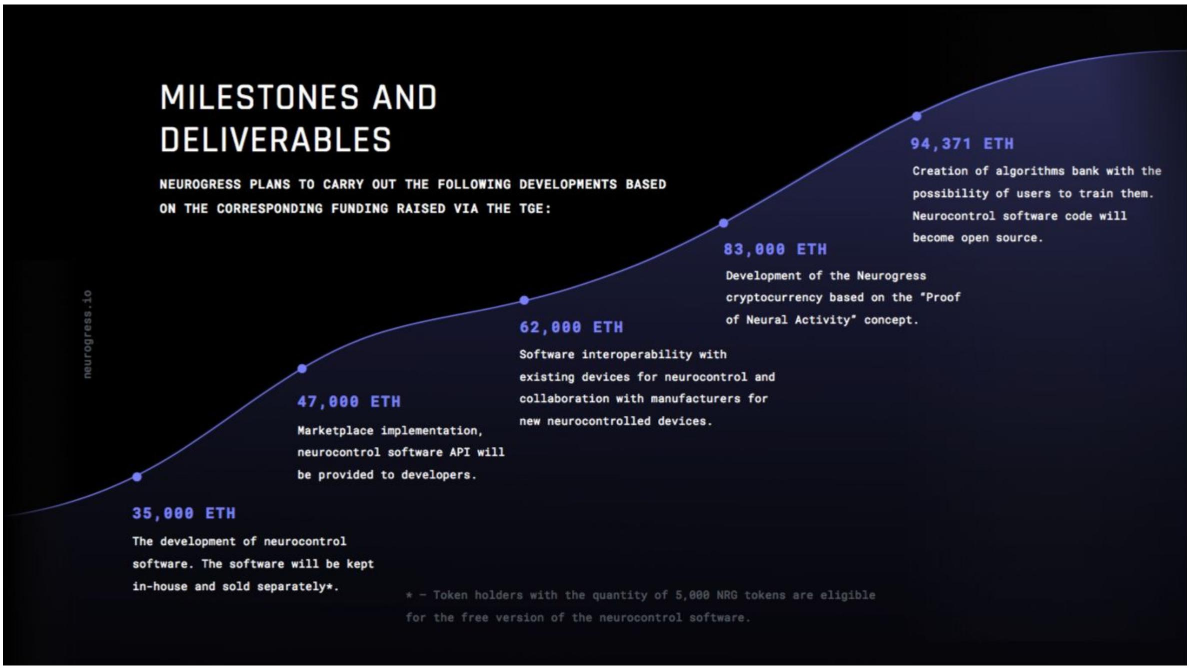

Diagram 8. Milestones and deliverables

Token placement details:

	Private Placement	**pre-TGE**	**TGE**
Period	Before 25.01.2018	10.02.2018 – 25.03.2018	01.05.2018 – 30.06.2018
Placement	1,250,000 (2.5%)	16,500,000 (33%)	32,250,000 (64.5%)
volume	962 ETH	25,408 ETH	68,000 ETH
		pre-TGE is considered successful if at least 2,540.8 ETH have been collected. Otherwise, all funds collected will be returned to the participants.	TGE is considered successful if at least 11,220 ETH have been collected. Otherwise, all funds collected will be returned to the participants.
Rate	1 NRG = **0.0007699** ETH	1 NRG = **0.0015399** ETH	1 NRG_1 = **0.0019248** ETH 1 NRG_2 = **0.0020085** ETH 1 NRG_3 = **0.0020998** ETH 1 NRG_4 = **0.0021998** ETH 1 NRG_5 = **0.0023098** ETH – base price
	1 ETH = 1298.9 NRG	1 ETH = 649.4 NRG	1 ETH = 519.5 NRG_1 1 ETH = 497.9 NRG_2 1 ETH = 476.2 NRG_3 1 ETH = 454.6 NRG_4 1 ETH = 432.9 NRG_5
Protection of funds	Multi-signature wallet NRG tokens are issued only to participants	Multi-signature wallet NRG tokens are issued only to participants	TGE funds are escrowed Multi-signature wallet NRG tokens of the team are not transferred until the TGE ends and have a 1 year lockout smart contract period

4.2 Roadmap

The project is going to be gradually developed in several stages according to the roadmap listed below:

Inception

2018

October - testing of neurocontrol software on a dummy prosthetic arm; statistical data gathering for neuro-control software

November - testing of neurocontrol beta version software on mini-robots; start of neurocontrol software integration into robotic arm; statistical data gathering for neuro-control software

December - testing of neurocontrol beta version software on conscious movements of mini-robots; statistical data gathering for neuro-control software based on AI

Aurora

2018

January - start of neurocontrol software integration into the parts of robot-android hardware; statistical data gathering for neurocontrol software based on AI

February - **Pre-TGE**, testing of neurocontrol beta version software on 4 movements of a dummy prosthetic arm; development of enhanced signal pattern recognition algorithm

March - conducting additional experiments for data gathering to train AI in the neurocontrol software

April - testing of neurocontrol beta version software on 8 movements

May - **TGE** robotic arm control system testing

June - testing neurocontrol system on drones

Ikigai

2018

Q2 - the developers access to the Neurogress API or to the entire code (open source), if the project collects sufficient funds during the TGE phase

Q3 - testing software on a sample game robots through numerous conscious movements;

Q4 - launch of the commercial version of the neurocontrol software

Yugen

2019

Q1 - launch of the Neurogress online platform; testing neurocontrol software for 28 movements

Q2 - beta synchronization with phones, tablets, gadgets (IoT)

Q3 – launch of neurocontrolled prosthetic hands in collaboration with a manufacturer

Q4 - developers' access to the API to start development with all kind of mechatronic gadgets

Eunoia

2020

Q4 - formation of the marketplace driven by Neurogress platform

Q1 - testing the beta version of the neurocontrolled robot-android in collaboration with a manufacturer; introduction of neurocontrol management of objects on various screens

Q2 - testing software with various household appliances

Q3 - beta version designer tool launch for assembling various neurocontrolled gadgets

Q4 - testing the intelligent house management solution based on the Neurogress platform's ecosystem

Aeipathy

2021 2022

Q1 - testing of neurocontrol system in conjunction with VR / AR / MR

Q2 - commercial launch of the neurocontrolled robot-android in collaboration with a manufacturer

Q3 - testing neurocontrol for industrial use

Q4 - the first industrial use of neurocontrol software on the Neurogress platform

Q1 - introduction of neurocontrol for driving purposes

Q2 - adding a marketplace for algorithms and algorithms training

Ineffable

2022 2023 2024

Q3 - active participation in cyber-sports promotion

Q4 - addition of the VR / AR / MR neurocontrol algorithm training to the marketplace

Q1 - creation of a cyber-sports robots team

Q2 - becoming a member of the Cyber-Olympic Committee

Q3 - testing Neurogress platform using VR / AR / MR

Q4 - organization of neurocontrol educational center in VR

Q1 - beginning of joint research with neuropsychological rehabilitation centers

Q2 - professional neurocontrol system development for the participants of cyber-Olympic games

Q3 - testing the use of neurocontrol in airplanes and other flying vehicles

Serein

2024 2025

Q4 - founding the Institution for Neurocontrol

Q1 - the use of neurocontrolled robot-androids in space

Q2 - testing of the brain-related health control system

Q3 - development of cyber suits based on neurocontrol in collaboration with manufacturers

Ubiquity

2025 2026

Q4 - neurocontrol reverse learning effect studies for applications in educational institutions

Q1 - starting to utilize neurocontrol in peacekeeping operations

Q2 - creation of a device prototype for reverse learning

Q3 - testing of neurocontrol for complex surgical operations

Singularity

2026 2027

Q4 - adding a marketplace for reverse learning applications

Q1 - creation of training centers for the combined neurocontrol and reverse learning

Q2 - holding the championship in reverse education

Q3 - beginning of studies in mutual thought-powered education

5 Team

Our team is situated all around the world, with the majority of developers based in Switzerland.

Konstantin Gorbunov

www.linkedin.com/in/kosgon

Founder, Chief Executive Officer

Education: Siberian University of Consumer Cooperation, B.S. (Enterprise Management and Economics)

Konstantin has a track record of more than 17 years of experience in executive and management positions. He has been involved in building and operating companies in different industrial and investment areas (manufacturing, logistics, telecommunication, real estate) since the year of 2000.

In the project, Konstantin takes a leading role in organizing the team of researchers and developers, as well as seeking investors and partners.

Aleksandr Ovcharenko

https://www.linkedin.com/in/shurikasa/

Chief Technology Officer

Education:

- Rensselaer Polytechnic Institute, Ph.D. (Computer Science)
- University of Ulsan, M.S. (Computer Engineering)
- Novosibirsk State Technical University, B.S. (Applied Mathematics and Computer Science)

Aleksandr has a rich background and experience in the area of IT, With a strong focus on software development. Aleksandr also takes part in the Blue Brain Project where he works on parallel neural simulators such as CoreNeuron, STEPS. He also takes care of advancing neural network topology computations based on graph theory.

In the project, Aleksandr is responsible for technology processes and is engaged in supervision of product research and development.

Nikita Replyanski

https://www.linkedin.com/in/francescocasalegno/

Chief Design Officer

Art Director, Product Designer, CG Artist. Nikita works as a designer of hi-tech prosthetic limbs and other wearable technologies since 2013. He has experience in the industries of computer graphics, art, design and video games development for about 10 year.

Large experience of management design teams for international projects.

Nikita's personal mission is to populate science, transhumanism, posthumanism and blockchain technologies using the power of design and visual communication.

In the project, Nikita is responsible for product design, brand development and visual communication.

Francesco Casalegno

https://www.linkedin.com/in/francescocasalegno/

Machine Learning and Mathematic

Education:

- Ecole Polytechnique Fédérale de Lausanne, M.S. (Computational and Applied Mathematics)
- PolitecnTGE di Torino, B.S. (Applied Mathematics)

Francesco currently also works in the Blue Brain Project, where he contributes to the development of Machine Learning and Deep Learning applications to automate and speed up parts of the Blue Brain scientific and engineering workflows. He is also responsible for the verification and validation of numerical methods to be applied at very large scale (million of cores/threads) to model the brain. Previously, Francesco has been involved in simulation and processing of data with a probabilistic approach establishing in-orbit-calibration concept.

In the project, Francesco is responsible for machine learning algorithms and the mathematical part of computations.

Taylor Newton

https://www.linkedin.com/in/taylor-newton-8952b051/

Neuroscientist

Education:

- Ecole Polytechnique Fédérale de Lausanne, Ph.D. (Neuroscience)
- Stanford University, M.S. (Mechatronics, Robotics, and Automation Engineering)
- Brown University, B.S. (Theoretical and Mathematical Physics)

Researcher and a Ph.D. candidate in Neuroscience in the Blue Brain Project.

In the project, Taylor creates neural network models for statistical data analysis. He is also involved in software development and testing.

Bruno Magalhaes

https://www.linkedin.com/in/brunomaga/

Neuroscientist, HPC Software Developer

Education:

- Imperial College London, M. S. (Advanced Computing)
- Universidade do Minho, Licentiate (Systems Engineering and Computer Science)

Bruno has substantial experience in the area of IT as he has been working as an analytical programmer, software architect assistant and a database developer. In the Blue Brain Project Bruno has been researching new methods for scaling and parallelizing the software responsible for brain creation and simulation.

In the project, Bruno is responsible for computational optimization and software development.

Michail Hinterleitner

https://www.linkedin.com/in/michail-hinterleitner-44263a65/

Mechatronics Engineering

Education:

- Fachhochschule St Pölten, Railway technology and management of railway systems
- Fachhochschule Technikum Wien, B.S. (International Business Engineering)
- College for Electrical Engineering, Engineer (Electrical & Renewable Energy)

Michail has many years' experience in engineering and development of several types of power systems and mechatronics.

In the project, Michail is responsible for development and supervision of mechatronics and hardware.

Iurii Katkov

https://www.linkedin.com/in/yurykatkov/

External Software Developer

Education: Saint-Petersburg State Electrotechnical University, Engineering (Applied Mathematics)

With about 15 years of experience in IT, Iurii has been taking part in developing systems for data integration of neuroscientific data, gathering requirements, specifying use cases and implementing the front-end part of the Blue Brain Project.

In the project, Iurii takes care of software development of system interfaces.

Sam Yates

https://www.linkedin.com/in/sam-yates-ba762b8/

Software Development and Mathematics

Education: University of Adelaide, PhD (Mathematics)

Sam has provided valuable input in the area of high performance computing optimization, parallel computation and mathematics in the Blue Brain Project for two years. He currently also works as a software developer at the Swiss National Supercomputing Center (CSCS).

In the project, Sam is involved in software development and mathematical analysis.

Ahmet Bilgili

https://www.linkedin.com/in/ahmet-bilgili-0953832/

Software Developer

Education: Ege Üniversitesi, PhD (Computer Science, Computer Graphics)

While working in the Blue Brain Project, Ahmet has been engaged in software development, visualization and augmented reality. Currently he also works as a software developer of visualization systems in Siemens Corporate Research.

In the project, Ahmet takes care of software development in robotics and visualization.

Anna Berkovich

https://www.linkedin.com/in/anna-berkovich-0421272/

Public Relationships

Education:

- Maurice A. Deane School of Law, Hofstra University, J. D. (Specialization in International Law)
- Tomsk State University, B.A. (International Relations)

Ms. Berkovich is an experienced international development professional with a track record in building strategic partnerships, conducting complex negotiations and organizing high-level international events. Before joining the World Bank, she worked in various communication roles with a number of United Nations agencies, including the United Nations Population Fund, UN Women, UN Financing for Development Office and UNAIDS. From 2005 to 2010, Anna served as a diplomat at the Russian Mission to the United Nations focusing on poverty reduction, international migration, sustainable development and health issues. She is now the Coordinator of the First Global Conference on Taxation and Sustainable Development Goals with the World Bank Group in New York.

In the project, Anna is responsible for marketing and public relationships.

Stanislav Marycev

https://www.linkedin.com/in/stanislav-marycev-a7b97114a/

Financial System Analyst

Education:

- Edinburgh Business School, MBA
- Vilnius Gedimino Technics Universitetas, B.S. (Business Management and Administration)
- Certified Project Management Professional

For the last 6 years, Stanislav has worked as a financial system analyst at Ferring Pharmaceuticals.

In the project, Stanislav is engaged in financial analytics and project economic assessment.

Vitaly Grib

https://goo.gl/5ug1RW

Legal Advice

Education: Moscow State Law University, J. D. (International Private Law)

Vitaly is a lawyer for one of the leading law companies in Russia. During the last three years Vitaly has been involved in juridical activities, leading the projects for one of the most established industrial players in Russia and the world.

In the project, Vitaly takes care of legal procedures and juridical consultations in the area of TGE.

Yaroslav Belkin

https://www.linkedin.com/in/ybelkin/

Advisor, PR and Marketing Strategy

Education:

- Boise State University, B.B.A. (Marketing, Marketing Management)
- Volgograd State Technical University, B.B.A. (Marketing, Marketing Management)

Yaroslav is the Head of Marketing at Cointelegraph Events and Founder & CEO at Belkin Digital Marketing Agency. He has over 10 years' experience in digital marketing more than 70 projects for world leading brands. He is a blockchain enthusiast with extensive TGE marketing experience and has been a marketing strategy consultant for major companies, worldwide.

In the project, Yaroslav is responsible for marketing strategy and establishing external relations with potential partners.

Georges Al Medawar

https://www.linkedin.com/in/almedawar/

Advisor, Strategic Business Development

Education:

- Russian Presidential Academy of National Economy and Public Administration, M.S. (Global Public Policy)
- Lebanese American University, B.S. (Banking and Financial Support Services)

Georges has an interest in a wide spectrum of global issues but mainly concentrates on disruptive technologies. He addresses the challenges of future technological automation, mitigating social risks through the development of sound policies and vocational programs targeting job obsolescence and skill recalibration as part of societal sustainable development. Currently, he is involved in a research project having societal and economic implications to governance models.

In the project, Georges takes care of strategic business development for attracting potential investors.

6 SWOT-analysis of the Project

The following is a SWOT analysis of the project:

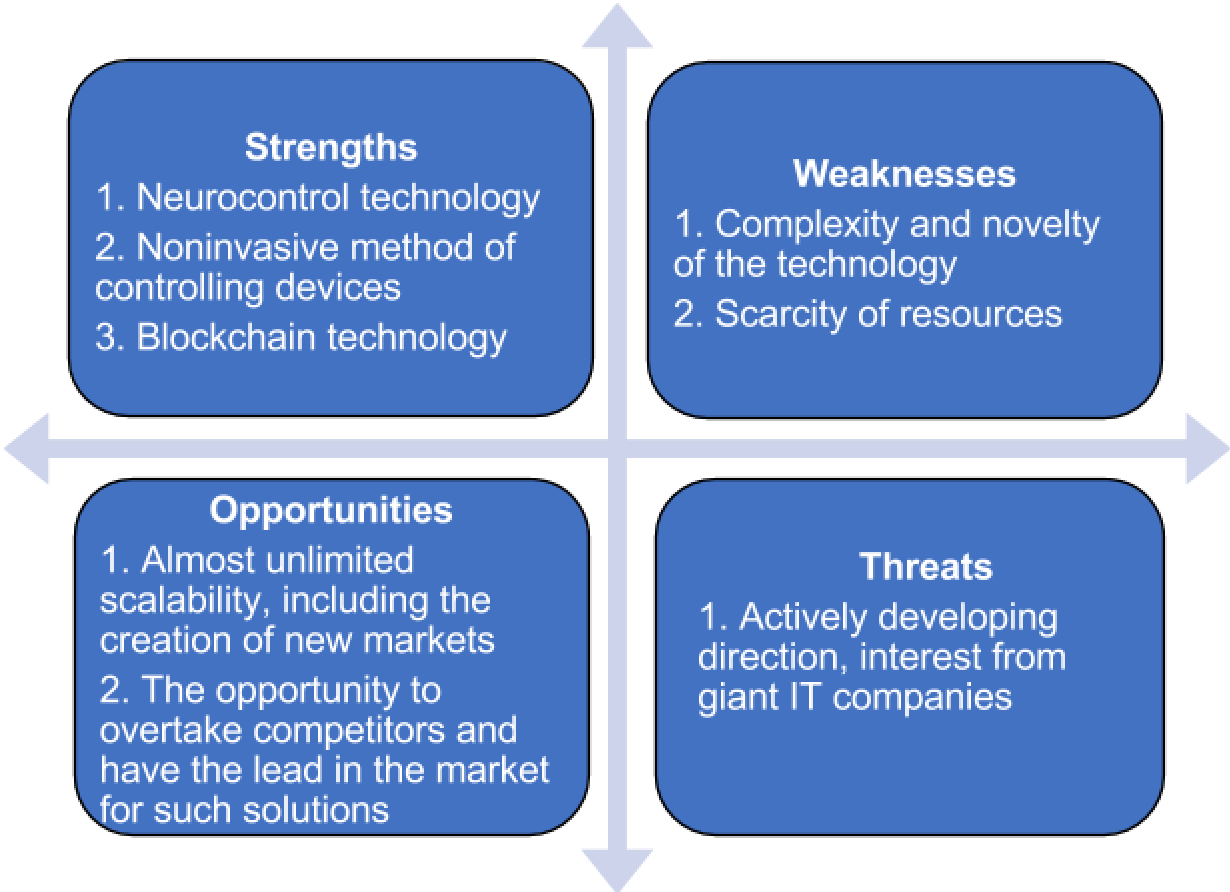

Diagram 9. SWOT-analysis of the project

The main weaknesses of the project relate to the technology used: it is not yet finalized and the company will have to expend resources to adapt it to current needs. In this regard, the competence of engineers is a key success factor, and their search and engagement in the project will be a priority for the project's senior management. Since the company has limited resources, it is forced to distribute them carefully and scrutinize budget decisions to reduce the possibility of error.

One of the factors threatening the development of the project is the interest that such giant companies as Google and Amazon take in the development of the neurocontrol industry. In order to be able to gain a foothold in the market, Neurogress must be faster than its competitors.

Undeniably, a significant strength of the project lies in the company's neurocontrol technology and the non-invasive method of installing the neural interface in the end user. Noninvasive neural interfaces, supplemented by neurocontrol software, are able to accurately interpret brain signals and convert them into action for the target device.

The use of the blockchain technology in the project is dictated by the company's need and willingness to make any transactions occurring in the system open and transparent to potential users of the Neurogress platform services. This will also ensure security and confidentiality of personal data as well as commands that are issued and transferred when using the software.

The potential of the project is correlated with its strengths. Neurocontrol provides an opportunity for unlimited scaling. It has potential for a huge array of devices and gadgets. There are no available analogues in the market and only limited research is being conducted in this area.

The company therefore has the resources and the opportunity to be one of the first to occupy a niche in the emerging market of neural devices. In light of this, there is a high prospect that the company will occupy 0.5 per cent of the global IoT market.

The opportunities are exciting.