atma.
Interfacing with the Brain

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Abstract
Science is constantly seeking to allow mankind to better itself and overcome the boundaries imposed by nature. However, with the evolution of technology and the growth of human knowledge, the paradigm is now changing: science aims to create a new human. By creating a new way of thinking towards the future, Transhumanism advocates the possibility of human evolution beyond its current physical and cognitive limitations by means of science and technology. The project atma. intends to transcend human capacities by pushing its boundaries, expanding the core faculties of the mind and the way we think, feel and sense.

By analysing the potential of the human mind, the work aims to explore, transcend and enhance, aspiring to an utopic future based on the possibility of total neural control. According to the transhumanist values and scientific research, the project's tender consists in interfacing with the brain, through a brain machine interface system that enables a computer or other digital device to communicate with the intellect. This way, the interface's main goal is to map the human conscious, preconscious and unconscious mind, by analysing in real time all neural activity. This conceptual approach not only proposes the interpretation of the collected data, but also the possible control over the brain, from giving the possibility of controlling your own emotions to deleting your own thoughts.

As a result of this approach, atma. seeks to explore the possibilities that the transhumanist philosophy provides and to emphasize what we have the potential to become. In doing so, atma. elevates the idea of not being limited by traditional methods, instead we can also use technology to enable us to go beyond what some would think as "human". This technological means now give humans effective cognitive abilities that far exceed those of biological brains.

Keywords: Transhumanism, Cognitive Enhancement, Neurotechnology, Interface, UX Design

1. Post-Human & H+

Crucial to the development of this project are the notions of Post-Human and Transhumanism. The growth of these concepts as philosophical and scientific movements implies the configuration of different perspectives. All of these perspectives are organized around the notion of "human being" and the need to redefine this term so that today it can be faced as an open notion. The goal, in addition to analyzing the term from an evolutionary perspective, is to face it in constant interaction with the technological and scientific advances, as well as dissecting how the development of the human being affects the space in which it is inserted. This way, Transhumanism is defined as a cultural and intellectual movement that advocates the possibility of human evolution through science, reason and technology. With humanistic roots, its focus is on human enhancement, that is, on improving, expanding and surpassing the limits of the human being, to eventually give rise to a post-human form of life. All of this through recent or future technologies to allow the elimination of aging as well as the great expansion of human cognitive, physical and psychological capacities.

1.1. Cognitive Enhancement

The human's current form is still limited by the boundaries imposed by nature, not only by its physical form but also by its own cognition. Yet, there is a more profound sense in how the constraints of our intellectual system limit our processes of mental activity. Hence, the range of thoughts, feelings, experiences, and activities that are accessible to human organisms do not represent its full potential and they are certainly not as highly developed as they could be.

Being part of the human notion itself, cognition is responsible for the process of acquiring, applying and retaining information and includes crucial intellectual functions and processes as attention, perception, memory, reasoning, judgment, imagination, thought and production of language. This way, improving human cognition affects a wide range of mental abilities, having a great impact on both individual and social level.

According to this perspective, cognitive enhancement may be defined as the amplification or extension of core capacities of the mind through improvement or augmentation of information processing structures. As cognitive neuroscience has advanced, the list of potential enhancements has firmly expanded, being the possibilities created by technology and science the most dramatic advances.

An enhancement is an intervention that improves the human organism in some way, so that a cognitively enhanced person is somebody who has benefited from an intervention that improves the performance of the cognition without correcting some specific dysfunction of that organism. Cognitive enhancement takes many and diverse forms. Various methods of cognitive enhancement constitute the spectrum that includes not only the traditional means, such as medical interventions, education and training (as well as the use of external information processing devices, labeled as ''conventional'' means of enhancing cognition), but also unconventional means as mind uploading, neural implants, created nootropic drugs and gene therapy.

Mind uploading (sometimes called "downloading" or "brain reconstruction") is the process of transferring an intellect from a biological brain to a computer. One way of doing this might be by first scanning the synaptic structure of a particular brain and then implementing the same computations in an electronic medium. A brain scan of sufficient resolution could be produced by disassembling the brain atom by means of nanotechnology. https://www.nickbostrom.com/views/transhumanist.pdf

1.2. Interfacing with the Brain

Humanity is still limited and constrained by its biological boundaries. There are things that are impossible for us because, simply put, we lack the brainpower. The impossibility we are referring to is more like the impossibility for us humans to access our unconscious mind, control our emotions or delete our memories. Given these limitations, this project is based on the premise of extending neural capacities to transcend human limitations through cognitive enhancement and cerebral, psychological and emotional correction.

Consequently, the concepts of enhancement, transcendence and exploration of brain capabilities led to the goal of fully controlling neural activity, exploring the possibilities of cerebral and motor correction and expanding the way we interact with others, with the world and

with ourselves. Proposing the possibility of fully controlling the brain, emotional and psychological control could eventually lead to the creation of a utopian scenario based on the desire for happiness and its control.

In order to explore how current and future technology can connect to our senses, cognition and our life, we speculate the creation of a brain interface based on a BMI (Brain Machine Interface) system, which assumes direct communication between an external interface and an enhanced brain. According to this system, the interface is developed through three stages, from brain interpretation and analysis to the mapping and exploration of the human mind to achieve control over intellectual functions and processes.

Direct control of external devices through brain activity has been studied with some success for the last years, revealing significant results in the field of neurotechnology. The most dramatic potential internal hardware enhancements are brain machine interfaces. For instance, Parag Patil, neurosurgeon and neuro engineer, have demonstrated that multielectrode recording devices would most likely function in humans. Experiments in localized chemical release from implanted chips also suggest the possibility of using neural growth to promote patterned local growth and interfacing.

1.3. Inspiration

To design atma., we were inspired by various scientific projects in the field of neuroscience and neurotechnology. Our main reference is Neuralink, which is developing a Brain Computer Interface that enables a computer or other digital device to communicate directly with the brain. Their goal is to build a fully wireless system that enables communication through a brain implant, called the Link, with potential to treat a wide range of neurological disorders, to restore sensory and movement function.

As a second reference, we took inspiration from the Human Connectome Project, which is constructing a map of the complete structural and functional neural connections performed within and across individuals, iindividuals, offering a unique opportunity to understand the complete details of neural connectivity.

This project represents the first large-scale attempt to collect and share data of an importance and detail sufficient to begin the process of addressing fundamental questions about human connectional anatomy. This unique setting will permit wide use by the scientific community.

1.4. Words of a few relevant authors

We collected some articles on the subject that contribute to enhancing our project's values and not only to facilitate the understanding of the topic but also to substantiate our work.

The Transhumanist Manifesto, Natasha Vita-More:

"I am the architect of my existence. My life reflects my vision and represents my values. It conveys the very essence of my being—coalescing imagination and reason, challenging all limits. Transhumanism calls upon a heightened sensibility to reveal the multiplicity of realms yet to be discovered, yet to be realized. We are exploring how current and future technologies affect our senses, our cognition, and our lives. Our attention to and comprehension of these relationships become fields of art as we participate in the most immediate and vital issues for transhumanity: extending life, augmenting intelligence, and creativity, exploring the universe. Transhumanists encourage experimentation and attitudes of abundance and emphasize the infinite possibilities of self-transformation as we seek new values indispensable to our self-creation. We have no interest in focusing on self-defeating thinking or entropy. We are achieving refined emotions through provocative forward thinking and analytical techniques."

Transhumanist declaration, World Transhumanist Association:

"1. Humanity stands to be profoundly affected by science and technology in the future. We envision the possibility of broadening human potential by overcoming aging, cognitive shortcomings, involuntary suffering, and our confinement to planet Earth.

2. We believe that humanity's potential is still mostly unrealized. There are possible scenarios that lead to wonderful and exceedingly worthwhile enhanced human conditions.

7. We advocate the well-being of all sentience, including humans, non-human animals, and any future artificial intellects, modified life forms, or other intelligences to which technological and scientific advance may give rise.

8. We favour allowing individuals wide personal choice over how they enable their lives. This includes use of techniques that may be developed to assist memory, concentration, and mental energy; life extension therapies; reproductive choice technologies; cryonics procedures; and many other possible human modification and enhancement technologies."

Human Connectome Project:

"Navigate the brain in a way that was never before possible; fly through major brain pathways, compare essential circuits, zoom into a region to explore the cells that comprise it, and the functions that depend on it. The Human Connectome Project aims to provide an unparalleled compilation of neural data, an interface to graphically navigate this data and the opportunity to achieve never before realized conclusions about the living human brain."

Neuralink:

"We are designing the Link to connect to thousands of neurons in the brain. It will be able to record the activity of these neurons, process these signals in real time, and send that information to the Link. As a first application of this technology, we plan to help people with severe spinal cord injury by giving them the ability to control computers and mobile devices directly with their brains."

2. Design Process

In this second part, we created a brief questionnaire to analyze the knowledge of a random sample of people regarding the project's theme and its possible ramifications. The questions address the participants' general notions of the transhumanist movement, its benefits, and, consequently, the interest in an utopian future from the perspectives of the movement in question. This was followed by an analysis that intended to understand the interest in the concept of the project, complemented by the presentation of Sigmund Freud's Theory of Psychoanalysis, which in turn was represented according to the metaphor of the iceberg. This theory divides the human brain into three levels — conscious, preconscious, and unconscious — and was evaluated with questions about the relevance of controlling areas of the unconscious, and the purpose for which these changes would be made. With the one hundred and sixty-six responses, we proceeded to a study that led to the creation of three personas.

The creation of personas was made according to the following five parameters:

— identification (name, age, gender, occupation, location, and characteristics);

— short biography so that the interests of the personas were justified and understood when

using the interface;

— goals you want to achieve;

— personality map;

— pain points.

For the definition of the personality of the three personas to be supported by a scientific basis, a personality map was designed according to the theory of the Big Five Personality Traits, which is based on five personality factors: openness to experience, conscientiousness, extraversion, neuroticism, and agreeableness. The first persona, Benjamin Brooks, a human being, was created to focus his main goals on achieving happiness and emotional comfort. His interest in using the interface is justified by the fact that as a child he suffered from negligent acts by his parents, which, consequently, had repercussions in his adult life. The second persona, Meghan Felicity, a transhuman, aims to increase cognitive ability, challenging her limits, to understand her entire brain. This interest in wanting to increase her cognitive abilities stems from her concerns about society and the growing world population, which kept her interested in the areas of genetics, biology, and technology, serving as a motivation to join the transhumanist circle. The last persona, Eva, an artificial intelligence, was created for scientific purposes. It aims to develop its abilities using the analysis of the human brain and the interpretation of neural and emotional activity, to assess the potential of the human intellect and to surpass it. Its purpose with the collection of information from the interface is directly related to Data Ingestion and Deep learning.

The creation and development of the personas was followed by user journeys and interaction flows. User journeys are a representation of a scheme that depicts the user's navigation in the interface. They are grouped into a set of five levels — phases, tasks, thoughts, emotions, and opportunities, which summarize the path it takes from the moment the navigation starts to the end, where, ideally, it will reach its objective. In the user journeys, several phases are complemented by the various tasks done while navigating the interface, to which thoughts and emotions are matched. For a better perception and visualization of emotions, a linear graphic was created to accompany the emotional state that mirrors the user's thoughts in each phase and corresponding task. As a complement to these four levels of information, opportunities that the interface offers are also available.

The interaction flows were developed based on the flow chart, which consists of a schematization of the interface's information architecture, where it is possible to visualize all the paths that are possible in exploring the interface. Like user personas and user journeys, interaction flows were created individually, to respond to one of the main goals of each persona. Briefly, the architecture of interaction flows is organized into four stages:

— analysis (from the placement of the neural implant to the analysis and interpretation of data);

— exploration;

— selection (according to the objectives to be achieved);

— improvement.

After completing the previous phases, and based on the previously elaborated flow chart, we created wireframes of what would be the visual and functional structure of the interface.

3. Production Design

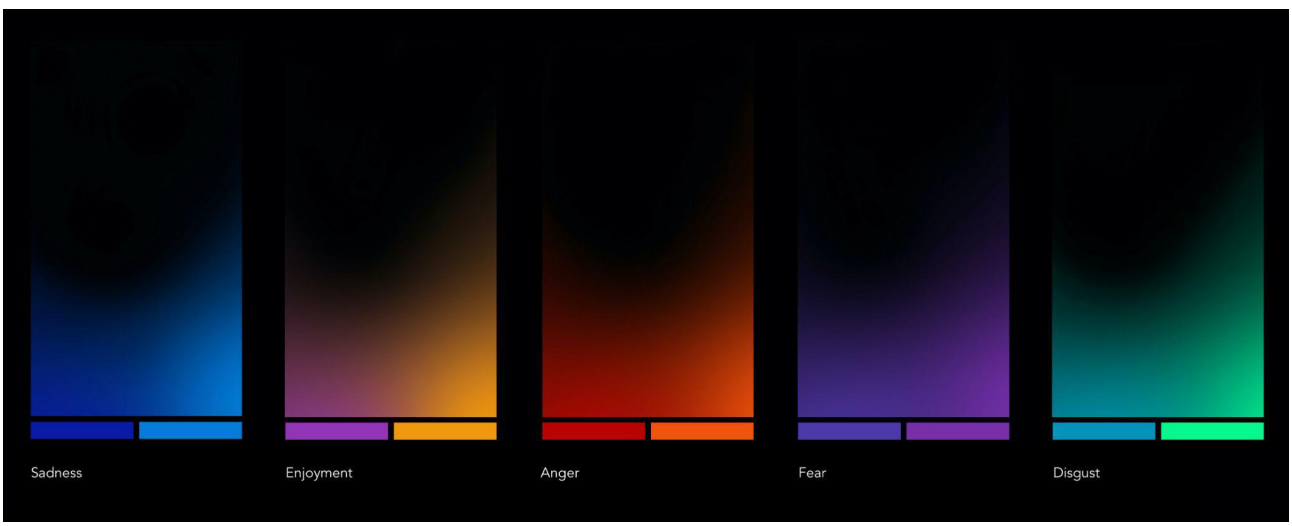
3.1. Visual Identity

The production of wireframes for the interface led us to create the project's visual identity. Establishing the connection between the human mind, the alteration, and control of different parts of our brain and emotional states, we decided to call our project "atma.". The word "atma" is a term used in Hinduism for the soul (spirit, or consciousness) and the principle of life. It also means that is immutable, indivisible, and eternal, the true nature of things. The concept generally used to define "Higher Self" or "Spiritual Being", which is beyond the body and mind, comes close to the concept of "atma."

About the logo, three versions were made that are used throughout the interface, in different situations. The first version, which corresponds to the application name in full, is used only in the connection stage between the neural implant and the interface. The second, which corresponds to a reduced version of the logo, is used in the rest of the interface, always located in the upper left corner of the screen. The third, which again corresponds to a full version of the logo but this time accompanied by a visual element, is used individually during the navigation. The visual element in the third image is a representation of the data analysis process that occurs in the succession of the [successful] connection between the neural implant and the interface. This visual element is also used inside the interface when the user wants to communicate with the personal assistant — when this action happens, the version of the logo found in the second image below gives place to this colored visual element, thus representing the interaction with the personal assistant. This visual element is associated with a color palette, which varies between colors such as blue, lilac, purple, red, orange, yellow, and green, which is associated with different emotional states.

Having as main reference the project "The Ekman's Atlas of Emotions" and the respective color coding associated with the interpretation of different emotional states, we decided to apply the same method of analysis and interpretation in our project, having five pairs of colors, each corresponding to a different emotional state — the joining of two shades of blue, one darker and one lighter, corresponds to a state of sadness; the junction of yellow and lilac corresponds to a state of enjoyment; red and orange correspond to a state of anger; two shades of purple, again one

Logotype



Colors and respective emotional states

darker and one lighter, correspond to a state of fear; and, finally, the joining of two shades of green, one of them being more bluish tones, corresponds to a state of disgust.

"The Atlas of Emotion was commissioned by the Dalai Lama, his purpose is " In order to find the new world we need a map, and in order for us to find a calm mind we need a map of our emotions". The simple, but not easy, goal of this Atlas is to help us be aware of our emotions. Awareness of our emotions means understanding how they are triggered, what they feel like and how we respond. Awareness itself is a strategy, it helps us understand our emotional experiences. We do not want to get rid of our emotions, we want strategies that help us respond in helpful, constructive ways. Here is a selection of resources that address the development of emotion awareness through contemplative practices, education, and embodiment." http://atlasofemotions.org/#actions/

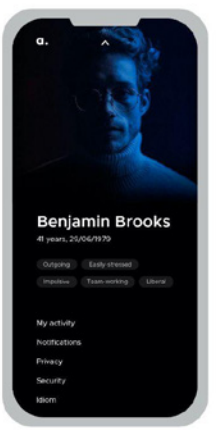
3.2. UI design & UX design

Navigation in the interface is only possible from the moment the user has the neural implant that, later, will give the possibility to start controlling the user's brain. The first moments after entering the interface concern, firstly, a connection between the implant and the system [1], which is followed by data analysis, brain mapping, and creation of neural networks [2], actions that are taking place in real-time. After this analysis, the Home page [3] is presented to the user. In this section, you will find a dynamic

[1] Connection

[2] Data analysis

[3] Home page



[4] User profile

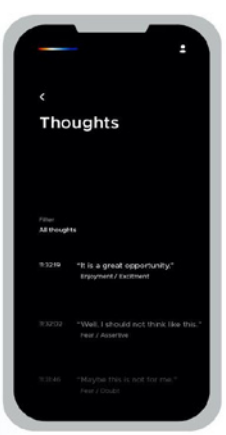
[5] Menu

[6] Menu > Conscious

[7] Menu > Preconscious

[8] Menu > Unconscious

[9] T houghts



[10] Interaction w/ assistant

[11] Memories

[12] Emotions

color background that changes depending on the user's emotional state and the color code mentioned above. As a complement to the information that is possible to extract from the colored background, there are also insights from the interface's assistant that are intended to help the user in exploring the interface and achieving his goals. Through the Home page, it is also possible to access a user profile [4], whose data is automatically collected in the first stages of the interface. The identifying photograph is also colored in one color, bridging with the colors and logic applied to the background of the Home Page. Regarding the Interface Menu [5], which can be accessed through the Home Page, it was built and ranked according to a scientific basis. Similar to one of the questions presented in the questionnaire that preceded the creation of user personas, the Menu organization was designed according to Sigmund Freud's Theory of Psychoanalysis and the iceberg metaphor. Starting from the logic that the human brain is divided into three fields — conscious [6], preconscious [7], and unconscious [8] — and subdivided into several categories, the Menu's organization is then made according to these divisions. Taking the user persona Benjamin Brooks and his goals as an example, the path that the user would have to take to, for example, reach happiness and comfort would be to access the third point of the Menu — the unconscious — which, later, will provide an extensive list of various features of the unconscious, where emotions [12] fall. From there, a graphic is presented that, like the Menu, was built on a scientific basis. According to the concept of psychological and emotional control, the goal is not only human emotional interpretation but also the induction of emotional states.

In a structure organized according to human emotional functioning, the objective is to represent how neurotransmitters (substances responsible for human emotion) act in the various areas of the brain to create various types of emotional states and their possible control. In other features of the other points on the Menu, such as thoughts [9], which are inserted in the conscious area of the human brain, the user has the possibility to access a real-time record of them, which is organized according to filters (all thoughts, the most frequent, weekly, daily) and to eliminate them. Another possibility that the interface offers is that, in the preconscious section, more precisely in the area of memories [11], you can share them on another device (eg, a smartphone), in order to visualize a certain memory that the user had. Like thoughts, memories are also presented according to the same organization and filtering logic, and there is also the option of editing a memory or even deleting it.

Apart from all these technical features, it is important to mention that in any section of the application it is possible to communicate with the personal assistant [10], although it is on the Home Page that communication is more complete given the presence of insights. Communication does not require any interaction by touch, voice or text, for the simple fact that the neural implant at the beginning of the entire process is able to detect a thought that recognizes that the user wants to communicate with the interface, thus making it inclusive for any user.

3.3. User Testing

After creating a functional prototype of the interface, we collected feedback that was divided into some questions related to navigation. With these interviews, we wanted to clarify whether the user experience would be clear and if we had met the goals that we had set ourselves to achieve. The audience we asked about the interface was young and had prior knowledge about interfaces, applications, and interactivity.

The first issue was related to the printing of the interface, which, in general, was characterized as very intuitive, easy to navigate, and with very intelligent use of color. In a second question related to the highest points of the interface, the answers varied, again, between being quite spontaneous, with the use of positive color, and the use of graphics that made the design even more appealing to the experience. The last question was directed to the negative points, where the answers pointed to the need for greater investment in understanding the interactivity between screens, since, on the one hand, it is quite simple and easy to use, on the other hand in some situations it requires a greater investment by the user.

4. Conclusion

This paper has presented a sample of our work designing a speculative digital user-based interface revolving around the theme of cognitive enhancement. This alternative de-

sign concept seeks to explore the transhumanist values as well as the possibilities intrinsic to surpassing the current human cognitive capabilities.

Our research gave us an insight about future possibilities, and made us wonder what makes us human now in addition to what we can become through technology. Questioning how the unstoppable progression of technology may impact humanity, we found that the possibilities around this notion are almost endless.

We elaborated a user-based experience whose main goal is to interface with the human brain and explore the expansion of the intellect. Our work represents a rather unique speculative design practice composed by proposals that interrogate the limitations of human evolution and current technology, and to experience and experiment with the possibility of those alternatives.

Conflict of Interests and ethics

The author(s) declare no conflict of interests. The author(s) also declare full adherence to all journal research ethics policies, namely involving the participation of human subjects anonymity and/ or consent to publish.

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