6th Conference on Computation, Communication, Aesthetics & X
Madrid, Spain

Marta Flisykowska
marta.flisykowska@asp.gda.pl

Academy of Fine Arts
Architecture and Design Department
Gdańsk, Poland

Who nose?

How our noses could change if we lived on Mars. Transhumanist speculations

Keywords: Speculative; 3D Printing; Transhuman; Design; Experiment; Plastic Surgery; Mars; Biomimetics; Cosmonautics.

Abstract:

In 2017, NASA published results of the Human Research Program. The aim was to find out more about the impact of long stays in space on the human body, similar to trips to Mars made by a man. The human body will have to face new physical conditions on the Red Planet, such as lower temperature, less dense atmosphere, significantly higher radiation and many more.

Research conducted in 2017 by the University of Pennsylvania indicates that the human body has been evolving over centuries in order to genetically adapt to existing climatic conditions. The record of this process can be physically observed based on the example of our noses.

The impact of such conditions is visible and highly variable also in other organisms, including mammals that feature the best sense of smell.

The 3D printing technology is developing continuously and already today, we are able to print an ear that can be used for transplants. If this is the case, does it have to look the same?

Based on the research regarding the impact of climatic conditions on the shape of noses as well as state of the art regarding such areas as mountaineering, biomimetics, plastic surgery and taking into account mental factors, I am presenting my own nose designs. Utilising my knowledge and skills regarding design art, I am presenting my aesthetic speculations, interpreting the above visual and formal data.

Perhaps speculations on this issue will become an inspiration for science and will allow us to make breathing easier here on Earth — even before we set out to conquer Mars.

INTRODUCTION

The future starts today and it is also affected by past events.

One of the key tools in this scope consists of foresight studios and specifically the technological foresight. This is a set of tools and research methods that combines current activity (e.g. regarding science, business, society) with the uncertain but usually desired future (Voros, 2003). There is no single ending. There are many probable and possible scenarios. This is how speculative design works that is becoming a tool in strategies of forecasting macro trends.

Visualising the future may affect the development of science and business, while concept cars are an example of such solutions. One of the latest popular examples also in the area of transhumanism is a project called Meet Graham that was developed upon request of the Australian Transport Accident Commission. The project involved cooperation of an artist, Particia Piccinini with Christian Kenfield, a trauma surgeon from the Royal Melbourne Hospital, as well as Doctor David Logan, an expert on accident research from Monash University. Together, they created a human model that would be able to survive a car accident. Applying a reverse treatment where you adjust the human body to modern cars, carried a more meaningful message than "be careful, buckle up". The Australian project, besides the social campaign message, shows a completely different side of science.

My project is based on research conducted by the University of Pennsylvania, regarding the change of the shape of nose depending on the conditions in which our ancestors lived and I combine the above with state of the art. I present NASA research, information regarding programmes on inhabiting Mars as well as technological and surgery possibilities, progress of 3D printing and on this basis, I propose a futuristic vision on how our noses could look if we lived on Mars.

Fig. 1. How our noses could change if we lived on Mars. Transhumanist speculations.

1. WHY NOSES?

The nose is mainly composed of soft tissue that may be subject to changes. Numerous plastic surgeries involving the nose are a proof of the above. Often such surgeries are not performed due to health reasons but primarily for aesthetic reasons. There are also situations where the first issue is connected to the second issue and this is an example of when an unnatural creation is better than the genetically specified "original". Is that a good thing?

The history of Oscar Pistorius is an interesting case, worth mentioning at this point. I do not want to refer to the private life of this athlete but I am only mentioning his name in the context of a transhumanistic discourse.

Oscar Pistorius participated in Paralympics. He wanted to take part in regular Olympics and he succeeded in 2012. However, there were some controversies and it was stated that his prosthetic legs may have given him an advantage over people without disabilities. The decision separated the world of sports. One of the counter-arguments regarding this decision that was also shared by a Polish long jumper, Maciej Lepiato, states that prosthetic legs constitute a technical performance enhancement because they give the athlete an advantage.

This case provokes a question regarding a bio-ethical aspect in relation to the limits of interfering with the human body. Nevertheless, it cannot be denied that prosthetic legs increased the human performance at that particular distance.

Since noses are already a part of the body that is subject to modification, it is worth thinking about their form. If technically and technologically we are able to print the human ear from material that can be used for implementing, does it have to look exactly like the "original" ear?

Nature shows a huge variety of noses. Let us focus on mammals because they have a highly-developed sense of smell. Examples of extreme forms of noses are presented by snub-nose monkeys, whitemargin unicornfish (which is actually a fish) as well as sword nosed bats. The nature has developed noses throughout many years of evolution, adjusting them to the climate and conditions. In my designs, I treat them as useful traces to new solutions for human noses. Using biomimical inspirations, also called biomimicry, is commonly known in engineering. One of the most notable examples of the mechanism of nature used by a man is a hook-and-loop fastener. It was transferred from the world of plants into a solution used by people. Thanks to its use by NASA in astronaut suits, it was popularised and became widely used. Despite the fact that it was invented in Switzerland and patented in 1955, only thanks to space cosmonautics did the solution become popular and used daily (Vanderbilt 2012).

1.1. Select physical and functional aspects of the nose

1.1.1. (Encyclopaedia Britannica 2018)

- The structure of the nose enables to warm up or cool down air adjusting it to the body temperature, before it reaches the lungs.
- The nose also acts as a filter so that it catches small particles preventing them from reaching the lungs.
- The nose moisturises air adding humidity to prevent the respiratory tract from drying.
- It strengthens and impacts one's voice.
- It supports the sense of smell.
- It can attract and impact the biology of attraction (Little, Jones, DeBruine 2011).

Changes of living conditions or atavistic needs relating to the sense of security, choosing stronger and more attractive units for extending the kind are key. Hence, the discussion regarding the change of the man's appearance and the model of attractiveness seems justified.

2. NOSE DESIGNS

I have prepared three nose designs and I focus on different functions in each case. I visualise the possible scenarios of the future in the form of unique nose designs, by means of the technological foresight method.

2.1. Nose designs — foresight database

a) Research from the University of Pennsylvania

Research conducted in 2017 by the University of Pennsylvania indicates that the human body has been evolving over the centuries in order to genetically adapt to existing climatic conditions. The record of this process can be physically observed based on the example of our noses. 3D face imaging was used in the research. 476 volunteers from West Africa, South Asia, East Asia and North Europe were measured. It has been ascertained that the width of our nostrils correlates with the temperatures and humidity of the local climate in which the ancestors of the volunteers lived. People whose parents and grandparents came from areas with warm and humid climate had wide nostrils. People originating in cold and dry regions — more narrow. The strongest correlation between the width of the nostrils and the climate can be observed in North Europe. This means that cold and dry climate is particularly favorable for people with narrow noses. (Zaidi, Matern, Claes, Huges, 2017)

The scientists have also discovered that the shape of nose is hereditary. They have found a correlation between genes and general similarity of noses in large groups of unrelated people. This means, that the shape of your nose is to large extent genetically conditioned.

In reality, our noses perform many more significant functions. They warm and moisturize the inhaled air, which helps to prevent illnesses and injuries in our airways and lungs. The scientists have long suspected that the shape of the nose had been evolving in a response to changing climate conditions. In a dry and cool climate natural selection favored noses which are better suited for warming and moisturizing the air.

b) 3D Printing

The possibilities of 3D printing keep developing. The race is in progress and it does not only relate to technology but also, or primarily to materials. The spectrum is so large that during a London-based conference regarding 3D printing in 2018, speakers talked about subjects regarding implants, aviation and jewellery within one discussion panel. The technology is not really that new because it was already known in the 1970s. The official date considered as the year of creating 3D printing is 1984 but concept works on the above technology started in the 1970s. In 1971, a French man, Pierre A. L. Ciraud, described the method of manufacturing items with any geometry by adding powder material, using the source of power for this purpose. It was published on 5 July 1973 and created a starting point for technology known today as SLS (selective laser sintering). Nevertheless, from that point on, 3D printing has been one of the fastest-developing technologies, both in terms of scientific experiments as well as hacker spaces supporting DIY movements. What is more, technology has become popular but a race is in progress regarding the variety of materials, improved prints and more precise parameters of print. One may also list materials and industries where we do not talk about print as a prototype or a method of obtaining a quick prototype but rather about a final product. For example: a bridge in the Netherlands entirely printed by a 3D printer at the University of Technology in Eindhoven, Chinese buildings printed in 3D, as well as items printed in 3D used in space. Works on printed habitats and also printed tools were a subject of a competition announced by NASA, entitled “3D Printed Habitat Challenge”. In biomedical engineering, works are performed regarding bio-printing of support structures that would later become the base for growing cells. One of such companies transferring those achievements to the stage of clinical tests is the Wake Forest Institute for Regenerative Medicine (WFIRM), which proved that it is possible to print tissue structures in order to replace damaged or diseased tissue in patients. Scientists from WFIRM have successfully printed ears, bones and muscles (Wook Kang, Sang Jin Lee, Kengla, Yoo, 2017).

c) Conditions on Mars

Mars is the planet closest to Earth, as recalls Elon Musk in his biography, “it is impossible that after conquering the Moon human ambitions for further exploration of the space should die”. [1] Mars is not a very hospitable planet, however compared to our neighboring Venus we may talk about harsh conditions that may become challenges for the scientists, engineers and other representatives of science. Let’s have a closer look on the physical conditions on the red planet:

Mars is a lot cooler than Earth, with average temperature of -63°C, which may drop to as low as -140°C. The lowest temperature on Earth was -89.2°C, recorded in Antarctica.

- Since Mars is further from the Sun, the amount of solar energy entering the upper atmosphere (the solar constant) is half of that entering Earth’s upper atmosphere. Since the sunlight is not reflected into the atmosphere, the surface of Mars gets a similar amount of energy as the surface of Earth. However, lack of atmosphere has other consequences.
- Mars’ orbit is more elliptical than that of Earth, which increases the amplitude of temperature fluctuation and the solar constant.
- Currently, the atmosphere on Mars is very thinned (approx. 0.7% of the atmosphere of Earth), which gives little protection against sunlight and solar wind. It is too thin for people to survive without pressure sets.
- The atmosphere on Mars consists predominantly of carbon dioxide. Therefore, even with a pressure correction atmosphere, local pressure of CO2 on the surface is 52 times larger than on Earth, which makes it possible for plants to grow on Mars.
- Mars has weak magnetosphere, so the protection from the solar wind is low.
- The radius of Mars is half of the radius of Earth, and its mass is 1/10 of the mass of Earth. This means that Mars has lower density than Earth.

This is just the tip of the iceberg of problems that we will have to deal with if we want to create a habitat on Mars and realistically think about its colonization or a regular life. How could this affect our bodies? Not in the perspective of the next few years, but in a more distant and long-term one? (McKay, 1991).

d) Preparations for living in space and Mars

In March 2015 Scott Kelly went to the International Space Station, where he spent 342 days. During that time, his twin brother stayed on Earth, however both of them took part in numerous studies. The aim was assess how a very long space travel, similar to that required for humans to get to Mars, will affect the human body, on the basis of comparison between two possibly similar organisms (Milstead, Charles, Paloski, 2018). Another program in the similar scope is Mars 500, a Russian experiment which commenced in March 2009 and was supposed to prepare people for a flight to Mars. It consisted in keeping 6 volunteers closed for 500 days, in order to examine their psyche. The project was carried out in the Moscow biological-medical institute (Shwirtz, 2009), Similar space camp was prepared for a trial start of extraterrestrial technologies and research strategies on the Devon island. The island serves as “home away from home” to the members of the Haughton-Mars Project run by NASA. EXO 17 Missionis a Polish contribution in the research concerning the subject in question. The surface of Mars was imitated by the Mars Desert Research Station in Utah, and it comprises tests of air filtering system and methods of stress management.

The examples of how humans are getting ready for Mars expedition and thus to conquer the space, and the recent attempt of the Falcon Heavy developed by SpaceX, bears witness that this moment is right around the corner. These events thus encourage us to view ourselves from a different perspective.

The human body will have to change if we are to adapt to new physical conditions. Are these the new challenges for the medicine or a direction of evolution? Undoubtedly, environmental conditions affect the body and in the course of time, by the law of evolution, adapting to changes is inevitable.

2.2. Nose designs — context

The project is of speculative nature; it is also worth noting its transhumanistic character. Implants, foreign bodies implanted in the body in order to recreate natural function or aesthetics of a damaged organ are a reality. Plastic surgery of the nose, in other words, rhinoplasty, is one of the most common and yet one of most complicated plastic surgery procedures. Surgery may correct the shape of the nose by reducing or increasing its size, modelling the septum and the tip of the nose, or regulate too little distance between the nasal holes. Plastic surgeon may lengthen or shorten the nose, however in most cases we are dealing with a complex surgery regulating nasal asymmetries. Changing the shape of the nose could also affect protection against frostbite or susceptibility to sunlight. There are a few statistics concerning frostbites in the world medical literature. Studies conducted by Finnish doctors of the Health Institute in Oulu show that the body parts most susceptible to frostbite are nose, ears, cheeks and chin as well as fingers and toes. Frostbites cause shrinking of blood vessels; strong narrowing of skin vessels may lead to skin ischemia and tissue necrosis. In many animals living in a cool climate the nose is covered with more rigid skin and is construed in a different manner, which makes it less prone to frostbites and sunburns. Aesthetic medicine is often associated with a whim of the wealthy, who seek to change their image not for health reasons, but merely to satisfy their vanity. However, aesthetic medicine stems from more obviously more significant situations, associated with reconstructing faces after accidents, burns or other, for instance, genetic defects directly affecting patient’s health. The meaning of nose outside medical context is proven by the aforementioned studies of scientists from Pennsylvania, which show that nose also has a complex evolutionary history, and the researchers suspect that additional factors, such as cultural preferences during mating, also played an important role in the formation of this organ. Research on the evolution of the shape of the nose and climate adaptation might have not only medical but also anthropological consequences.

2.3. Designs / scenarios

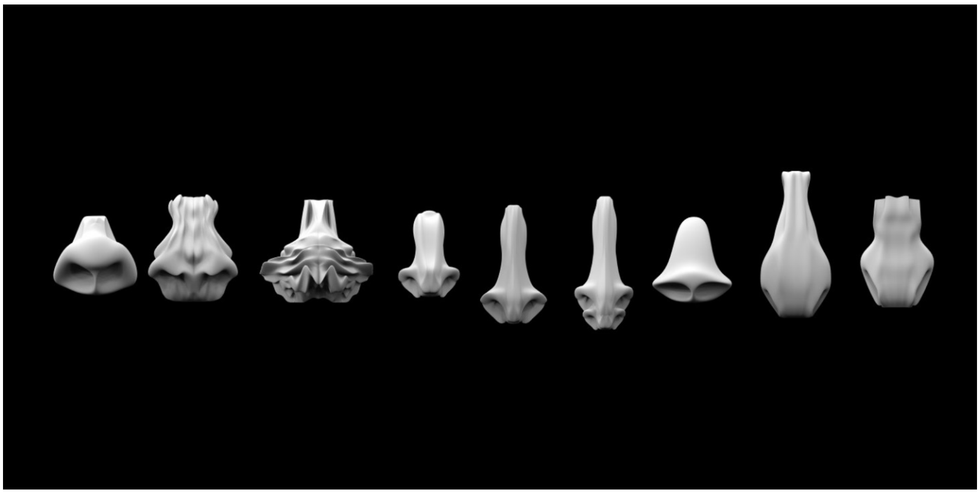


Fig. 2. Noses — different versions taken into account.

2.3.1. Double nostrils

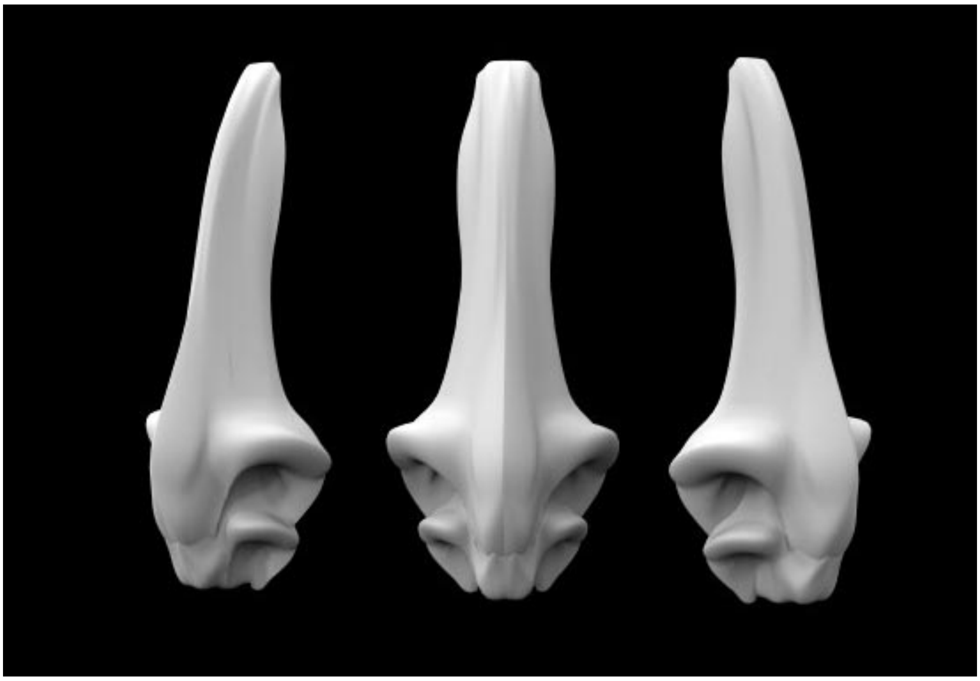


Fig. 3. Nose project *Double nostrils* — rendered nose in different views.

A. Long narrow noses are genetically associated with Nordic facial features.(Zaidi, Mattern, Claes, McEcoy, Hughes, Shriver 2017). This is associated with the fact that with a narrower nose, it is easier to warm up air, as compared to wide nostrils, due to low temperatures, both during travel and after landing.

B. On Mars, people will live in habitats. They will wear space suits and helmets while walking on Mars surface and they will be forced to live in air-conditioned spaces. Also the trip itself there will involve staying in air-conditioned rooms.
Already today, we spend plenty of time in air-conditioned rooms and this has its consequences (allergies, colds, dryness). Analogue astronauts practice such a preparation on Earth.

C. We cannot forget about mental factors. Long travel and time spent in closed space may impact anxiety or less severe symptoms such as discomfort. Relaxation techniques inspired by Pranayama breathing exercises show a huge impact of breathing through the nose on staying calm and providing oxygen to the brain. Double nostrils make i possible to strengthen the sense of a deeper breath.

Fig. 4. Nose project *Double nostrils* — photo of 3D printed object in Flexible material Tango Plus 9740 . Technology polyjet, solidified liquid photopolymer by using UV light.

2.3.2. Boxer

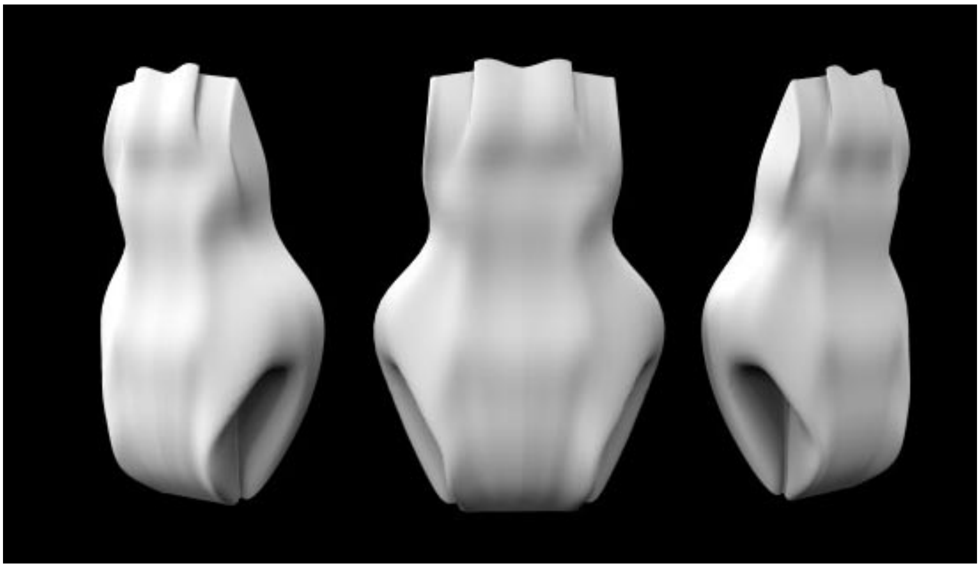


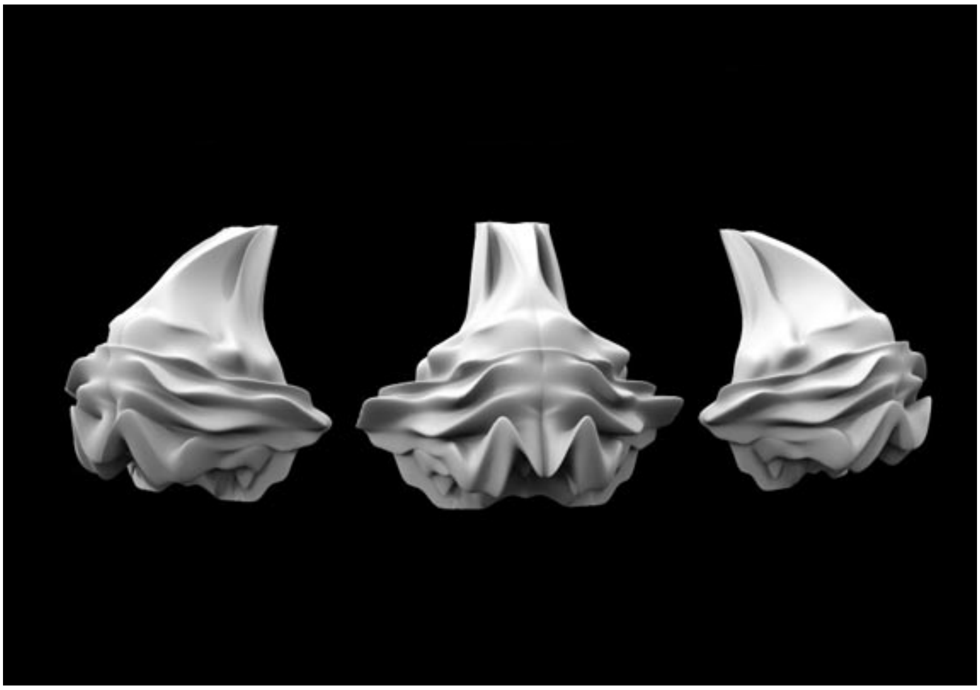
Fig. 5. Nose project *Boxer* — rendered nose in different views.

A. Utilising the experience of mountaineers, we know that the nose being an extensive part of the body, is the most prone to frostbite. Additionally, it is also subject to sunburns due to sun rays being reflected from snow. Burns also occur at the bottom of the chin or neck, according to Adam Bielecki, a Polish mountaineer.
   Mountaineers use special bands and tapes for covering noses and cheeks that protect against temperature and sun. For this purpose, the model of this nose is made more flat and it sticks out less,
B. The width and size of nostrils in this case is also related to the sense of better ventilation and deeper breath. In the world of animals, such a reference can be observed in the African Buffalo.
C. Wide biomimical nostrils and flattened nose may also affect one's self-confidence. The above-mentioned African Buffalo is one of the most dangerous animals in the World, which is enhanced by the specific nose appearance. An additional stylistic reference regarding a flat nose and wide nostrils is the structure of boxers' noses, which due to numerous injuries resulting from fights, modify the nose appearance. In the context of new attractiveness, it could create another subject of discussions.
D. From the point of view of functionality, such a nose would also be less prone to injuries relating to long use of helmets, that would break the nose in the case of a fall or trip, without securing it.

Fig. 6. Nose project *Boxer* – photo of 3D printed object in Flexible material Tango Plus 9740 . Technology polyjet, solidified liquid photopolymer by using UV light.

2.3.3. Radiator / resonator

Fig. 7. Nose project *Radiator / resonator* – rendered nose in different views.



A. Similarly to the design of radiators, the wavy surface of the nose may impact heat transfer.
B. The wavy surface reaching deeper may also have a clear impact on one's voice. The nose is a resonator and has an influence on acoustic effects. Since communication is mainly conducted with the use of microphones, its effect will be the same as in an aircraft cockpit, which means that some frequency will be interrupted by noises, and this will make communication more difficult. In basstraps used in recording studios, you may have noticed wavy structures which contribute to changing the acoustic effect.
C. Additionally, an example of nose structure of one of the sword nosed bats also shows that the nose is very fleshy. Scientists are of the opinion that this may be associated with echolocation. Due to the disrupted day (Earth) rhythm and the sense of day and night caused by artificial lighting, the trace in research regarding to transfer of waves and vibrations with reference to echolocation, also seems interesting.

Fig. 8. Nose project *Radiator / resonator* – photo of 3D printed object in Flexible material Tango Plus 9740. Technology polyjet, solidified liquid photopolymer by using UV light (front view).

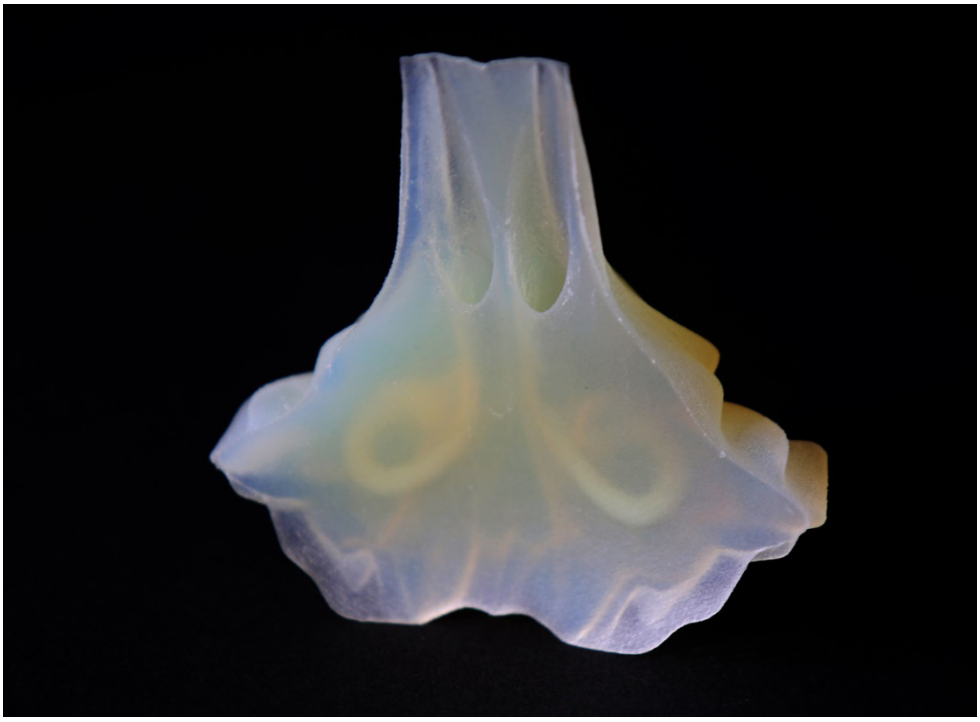


Fig. 9. Nose project *Radiator / resonator* – photo of 3D printed object in Flexible material Tango Plus 9740. Technology polyjet, solidified liquid photopolymer by using UV light (back view).

3. CONCLUSIONS

The "Who nose" project refers to the possibilities of 3D printing and plastic surgery in the context of challenges that we will all face. It has a speculative character. It does not mean that people will grow such noses in an evolutionary way on Mars. Already at this stage of medical development, we introduce many changes into our body: artificial eyes, mechanical prostheses, bypasses. Perhaps this apparently stylistic or aesthetic change could have a bigger impact on the comfort of our lives on Earth.

I have considered different stylistic options based on the above assumptions and decided to present three options that in my opinion will be a best representation of the issues and their options discussed herein. Since this is a speculative project, the answers will not be definite and they may be a proposal of interpretation.

Fig. 10. Noses – different versions and their scale on human head.

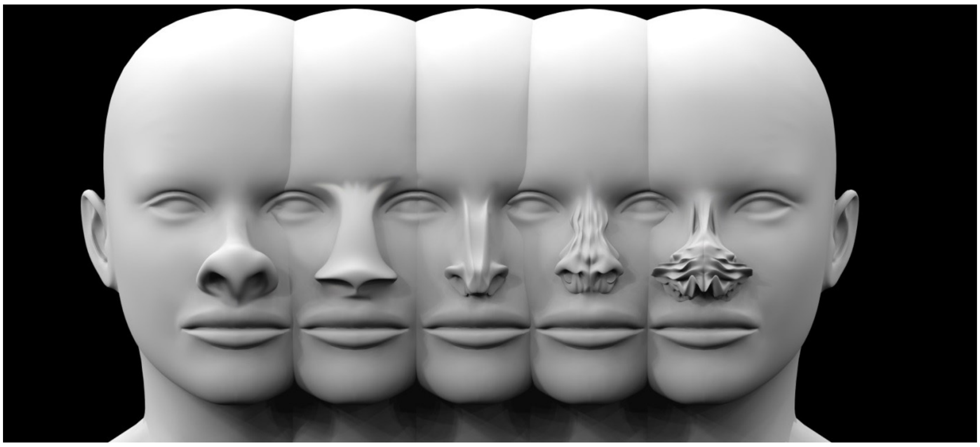


Fig. 11. Noses – different versions.

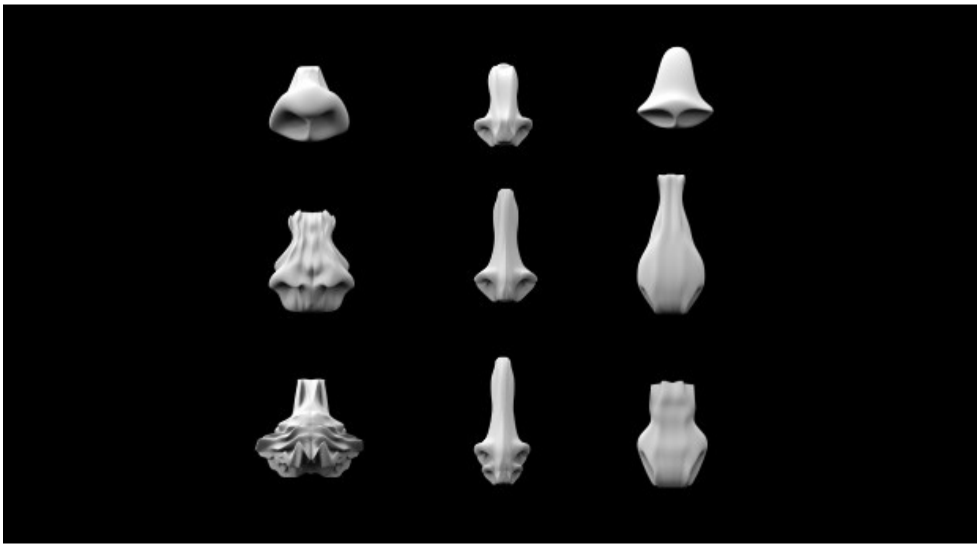


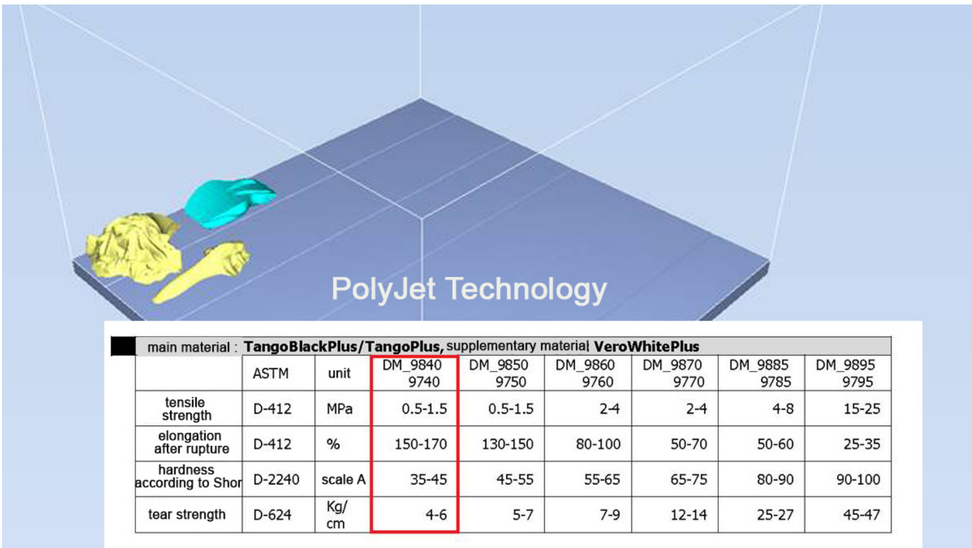
Fig. 12. Noses – different versions.

4. TECHNICAL INFORMATION:

Noses were printed at Bibusmenos, in Polyjet technology.

It uses liquid polymer resins hardened with UV light. They are applied in layers with piezoelectric heads, similarly to large 2D format prints. This is one of the most accurate technologies, namely Rapid Prototyping (RP) due to the development of parts made of ultra-thin layers, with thickness from 16 to 32 micrometers. The support material in this technology is constituted by resin sprayed by a separate group of heads that can be removed with water under pressure or dissolved in alkaline water, after solidifying.

As opposed to SLA and DLP technologies, PolyJet does not require re-exposure after printing. Each layer is fully networked and exposed so that the models are ready for tests and presentations immediately after cleaning the support structures. This material is often used in the medical industry for developing models and reconstructing the anatomic shape of a patient.



main material : TangoBlackPlus/TangoPlus, supplementary material VeroWhitePlus								
	ASTM	unit	DM_9840 9740	DM_9850 9750	DM_9860 9760	DM_9870 9770	DM_9885 9785	DM_9895 9795
tensile strength	D-412	MPa	0.5-1.5	0.5-1.5	2-4	2-4	4-8	15-25
elongation after rupture	D-412	%	150-170	130-150	80-100	50-70	50-60	25-35
hardness according to Shor	D-2240	scale A	35-45	45-55	55-65	65-75	80-90	90-100
tear strength	D-624	Kg/ cm	4-6	5-7	7-9	12-14	25-27	45-47

Fig. 13. 3D printing preparation and material technical details.

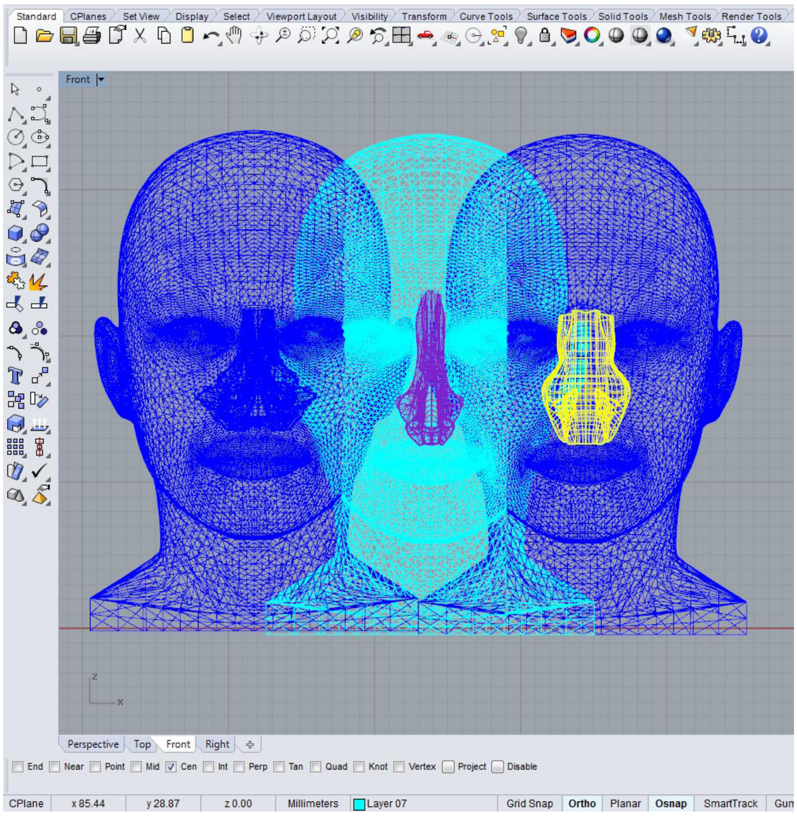


Fig. 14. 3D models preparations in Rhinoceros 5.

Fig. 15. All three selected models — photo of 3d printed object in Flexible material Tango Plus 9740. Technology polyjet, solidified liquid photopolymer by using UV light.

A video asset can be found at https://youtu.be/7cnn1f6tynk

References:

Birch, Paul. *Terraforming Mars Quickly,* British Interplanetary Society, vol. 45, no. 8, Aug. 1992, p. 331-340.

Encyclopaedia Britannica. *Nose Anatomy,* 2018.

International Astronautical Federation. 65th International Astronautical Congress, Toronto, Canada, 2014.

Kang, Hyun-Wook, Sang Jin Lee, Carlos Kengla, and James Yoo. *Printing Replacement Tissue,* Science & Technology Research News, 2016.

Kurzweil, Raymond. *The Singularity Is Near: When Humans Transcend Biology*, Viking, USA, C. 2005.

Liberman, Daniel. *The Story of the Human Body: Evolution, Health, and Disease,* 2013.

Little, Anthony C., Benedict C. Jones, and Lisa M. DeBruine. *Facial attractiveness: evolutionary based research,* US National Library of Medicine, National Institutes of Health, 2011.

McKay, P. Christopher, and Davis L. Wanda. *Duration of Liquid Water Habitats on Early Mars*, Icarus, 90:214-221, 1991.

Schiwrtz Michael. *Staying Put On Earth, Taking a Step to Mars,* Page D1 of the New York.

Vance, Ashlee. *Tesla, SpaceX, and the Quest for a Fantastic Future,* 2017.

Vanderbilt, Tom. *How Biomimicry is Inspiring Human Innovation* Smithsonian.com, 2012.

Voros, Joseph. *A Generic Foresight* Process Framework, 2003.

Zaidi, Arslan A., Brooke C. Mattern, Peter Claes, Brian McEcoy, Cris Hughes, and Mark D. Shriver. *Investigating the case of human nose shape and climate adaptation* PLoS Genetics, 2017 .

Paloski, William H., John B. Charles, and Lisa Milstead. *Human Research Program Integrated Research Plan*, NASA, 2018.