

DESIGNING PERSONALISED ANTI-SMOG MASKS

The study presents the effect of cooperation between the leading 3D scanner manufacturer, SMARTTECH and students from the Design Department at the Academy of Fine Arts in Warsaw, the so-called Massq group, in the project of designing personalised anti-smog masks. There were three people for whom anti-smog masks were designed. The SMARTTECH company joined the project by performing 3D scans of human faces.

Face spacial scanning was performed not only to shorten the time of designing, but also to reduce costs and create fully adjusted masks for individuals.



CASE STUDY



THE PROBLEM OF AIR POLLUTION IS GROWING.

Smog is one of the crucial problems that cities have to face. The air in Beijing is so dense that you cannot see buildings in the immediate area. New Delhi is the most polluted city in the world, while collectively, China has the group of most polluted cities. Unfortunately the problem of air pollution also applies to Poland. Especially during autumn and winter when coal-fired heating ramps up the amount of smoke produced. To the extent that some cities are forced to close down public buildings such as offices or schools. Air pollution can have serious consequences for the health of human beings. Smog causes lung diseases and increases the death rate. Smog severely affects not only big agglomerations such as Warsaw or Krakow but also smaller cities such as Radom or Toruń. Anti-smog alarms, which are especially common in winter, have become a disturbing feature of everyday life. Smog is a serious air pollution that can be compared to passive smoking. City dwellers worry about their health and the ecosystem damage costs of pollution.

In order to protect their health inhabitants of big cities decided to apply various forms of protection, such as air fans and recuperators installed at homes and anti-smog masks worn outdoors. The very poor quality of air in Poland forces people to wear masks for protection. Nowadays, the awareness of breathing polluted air and its harmfulness for human beings is rapidly rising, mostly through radio programs, TV news, Internet services, telephone applications, billboards, social campaigns. There are also organisations such as the Warsaw Smog Alert which inform city dwellers about the smog in the air using social media channels. In multiple places you can meet people wearing anti-smog masks more and more often. Anti-smog masks can stop over 99% of harmful substances with a diameter greater than 0.1 microns. Besides gaseous pollutants, the atmosphere can also be polluted by particles. They are often catalogued as 'floating dust' but they are best known as particulate matter (PM). PM2,5 is particulate matter up to 2.5 micrometres in diameter and PM10 is particulate matter 10 micrometres or less in diameter. Masks can protect against smog, including suspended dusts and carcinogenic benzo(a)pyrene, dust, allergens (pollen of plants), fumes, tobacco and coal smoke.

NEW TREND

You can also look at anti-smog masks in a different way. Currently, they can be an interesting and original element of everyday stylization. In addition, masks are a part of a health trend propagating in social media. People are sharing with friends how to keep our body in good condition and protect ourselves against various threats, such as smog. When you type "smog" into the web search engine, you can find pictures of people wearing anti-smog masks not only in far-flung corners of the world, but also in Poland. The Massq Group decided to treat anti-smog masks as a new element of our everyday clothing, which should not only protect us but also emphasize the individual style of the user. Because the anti-smog mask partially covers the face, it strongly affects the image of the user.



PROBLEM

The Massq Group aimed to design safe and attractive urban anti-smog masks. Unfortunately, most masks available on the market have an uninteresting and inelegant appearance. Thus the designers focused on creating attractive and comfortable masks that would match the shape of particular faces. Anti-smog masks, beside the visual qualities, have to efficiently protect the user. If the mask is not well-matched to the human face it will leak and the polluted air will get into lungs. To protect the person wearing it, the anti-smog mask should be individually matched to the user's face. Generally, the human body is a difficult object to measure by traditional methods. However a contactless 3D scanner enables precise measurement and thus, based on the virtual 3D model, we can precisely adjust the mask to specific and irregular shape of the human face. The Massq Group planned to create anti-smog masks based on 3D face scans. Eventually, designed masks would be printed on a 3D printer. Based on the 3D model, you can effectively design an airtight and individually tailored mask.

SCANNING PROCESS

OBTAINING THE GEOMETRY OF THE HUMAN FACE



The first step is to scan the faces of people for whom anti-smog masks were designed. Scanning is non-invasive, completely safe and does not cause any discomfort to the patient. In this case we used the 3D scanner MED 1.3 MPix from SMARTTECH with a 300 x 200 x 210 mm measurement volume, with 0.06 mm of accuracy and with 0.23 mm of resolution (18 points per mm2). We were able to accurately reproduce the structure and colour of the scanned face.

The human body is difficult to measure by traditional methods. The contactless 3D scanning enables precise measurement and perfect adjustment of the mask based on the 3D scans. A single measurement lasts only 0.2 second, thus live objects can be successfully scanned. We also managed to automate the measurement thanks to the SMARTTECH3Dmeasure software.

As a result of a single scan a point cloud was obtained in which each point is described by the X, Y, Z coordinates and RGB colour component (Red, Green, Blue) The cloud was further transformed into a triangle mesh which was created using SMARTTECH software and then the file was used for 3D printing. The entire process of scanning took about 30 minutes. Based on a series of single scans, SMARTTECH specialists created a 3D model of a human face using specialized software SMARTTECH3Dmeasure v2018.







The software **SMARTTECH3Dmeasure** is used to control the 3D scanner. The measurement results are displayed as point clouds on the computer screen. Individual single scans were fitted to each other, and then a triangle mesh was created. The option of an automated measurement which performs the entire process including the creation of a triangle mesh in OBJ format minimizes the user involvement and accelerates the post-processing. The editing functionality of **SMARTTECH3Dmeasure v2018** made it possible to create a complete 3D model of a human face. Moreover, the control module of the software made it possible to measure the whole face. The final result of this stage is a file in an OBJ format, which is fully compatible with all 3D printers available on the market. Based on the created 3D model of the face students had the opportunity to design anti-smog masks that were well-fitted to individual users. Finally, several different models were printed on the 3D printer.

SUMMARY



The main advantage of wearing anti-smog masks is their effectiveness. Masks are adapted for the urban use and fit well in this space. An interestingly designed mask is a strong distinctive element of clothing giving safety and intriguing appearance. In order to provide pollution-free air the masks have carbon filters, which are exchangeable.

Masks are made in various colours and can be decorated with multiple patterns. A wide range of stylistic features allows you to adapt it to your unique style. Thus the mask becomes a very personal object. Because it covers a part of face, it is important to design it properly and precisely match its shape to the user's face. Such possibilities of mask matching to the particular user are possible by using the SMARTTECH 3D scanner MED for body scanning. The face of a person can be captured as a virtual model and precisely measured. It is possible to calculate volume, surface area and create cross-sections. Thanks to this the mask matches perfectly to the face of its user, which provides both full protection and comfort. The 3D scanning allows for a precise mapping of the geometry of the object in contrast to traditional methods which are based on making masks manually.

The cooperation between the Massq Group and SMARTTECH improved the design process of anti-smog masks. 3D scans are characterised by metrological accuracy and high resolution, which in combination with the editing and analysis functions available in the SMARTTECH3Dmeasure give many possibilities. The 3D scanning technology is an appealing alternative to traditional, cost- and time-consuming methods of creating new tools.



PROJECT PARTNERS

Using contactless 3D scanners from SMARTTECH in order to scan parts of the human body or entire figures is becoming more and more popular in various industries. Scanners are used most often for creating personalised and functional products that improve the comfort of our life. During the scanning of a human body there is a possibility to use an integrated system of two or more MED 3D scanners. Thanks to this capability the overall measurement cycle will take less than a second. Such an automated measurement method saves time and reduces project implementation costs. The entire process (from scanning to the measurement of the volume) takes around 15 minutes. The time can be reduced when the operator gains experience.

What is really useful is that the SMARTTECH 3D scanners do not require recalibration before they are used for measurements thanks to the permanent calibration performed during the manufacturing process. The scanners also have an enclosed casing and a special ISA (Internal Shock Absorber) system. Scanners from SMARTTECH can be certified by independent measurement laboratories. This advantage makes them perfect for companies and institutions that require this certification. It also assures us that the 3D scanners have the appropriate accuracy.



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SMARTTECH is a leading global manufacturer of professional grade 3D scanning solutions. The company announced the launch of the new 3D scanner MED series dedicated to digitize living organisms. Due to growing interest from health and security sectors SMARTTECH decided to upgrade its product offering, improving the scanners' 3D scanning speed and the quality of obtained colour of scanned surfaces. From now on researchers and doctors can use dedicated measurement equipment designed to digitize complex shapes of human body. The SMARTTECH 3D scanning technology has been used since the year 2000 in different industries. Established as a spin-off company from Warsaw University of Technology under the leadership of Prof Malgorzata Kujawinska SMARTTECH has been constantly developing its 3D scanning technologies based on structured LED light.







MASSQ GROUP was created by students of the Faculty of Design at the Academy of Fine Arts in Warsaw. The main goal of the Group is to create customised tools dedicated to individuals.

The result of the "Anti-smog masks" project is the final exhibition organized by the Academy of Fine Art from 8 to 17 June 2018 in Warsaw.

