

The concept of the application for humanitarian aid and its use with CAD/CAM technologies and virtual reality and its impact on the safety of the healthcare sector

Концепція програми з надання гуманітарної допомоги та використання її з технологіями CAD/CAM, віртуальною реальністю та її вплив на безпеку сектору охорони здоров'я

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Purpose: The article has presented the concept of a proprietary application for humanitarian aid and prosthetic needs for reconstruction submitted to the European Union Competition for Humanitarian Innovation (InnovAid) for innovative improvement solutions that increase humanitarian aid.

Method: analysis of statistical data and data from available literature and scientific articles, observation.

Findings: Improving the efficiency and effectiveness of humanitarian aid around the world, reusable and achieving the appropriate level of safety for the world's personnel, as well as providing access to innovative solutions for medical personnel anywhere in the world.

Paper type: practical, theoretical.

Мета роботи: представлено концепцію власної заявки на гуманітарну допомогу та потреби в протезах для реконструкції, поданої на Конкурс гуманітарних інновацій Європейського Союзу (InnovAid).

Метод дослідження: аналіз статистичних даних і даних з наявної літератури та наукових статей, спостереження.

Результати дослідження: Підвищення ефективності та дієвості гуманітарної допомоги в усьому світі, її багаторазового використання та досягнення відповідного рівня безпеки для персоналу в усьому світі, а також надання доступу до інноваційних рішень для медичного персоналу в будь-якій точці світу.

Тип статті: практична, теоретична.

Key words: humanitarian aid, CAD/CAM, virtual reality technology, 3D models, reconstruction prostheses, the safety of medical staff.

Ключові слова: гуманітарна допомога, CAD/CAM, технології віртуальної реальності, 3D моделі, реконструкція протезів, безпека медичного персоналу.

1. Introduction

The European Innovation Council has launched a competition for humanitarian innovation. The application "Humanitarian aid and prosthetic needs for reconstruction" was submitted for this competition. The European Humanitarian Innovation Award (InnovAid), supported by the European Innovation Council (EIC) under the Horizon Europe programme, recognizes European actors that have developed ground-breaking and life-saving technological solutions that have made humanitarian efforts more effective and cost-effective. The award aims to encourage change and inspire other humanitarian actors to step up their efforts and support innovation.

The criteria that will be considered in the grant competition are as follows:

- innovations: the use of modern technologies to meet the needs of the population in the most difficult situation;
- ensuring quality and durability and comparing them with existing solutions;
- affordability and cost-effectiveness – offering a better value for money and trying out existing solutions;

- engaging end users by ensuring their involvement in the design of tools that affect them (The European Humanitarian Innovation Award).

The competition is open to all humanitarian NGOs, international organizations or legal entities based in one of the EU Member States (including Overseas Countries and Territories) or in a country associated with the "Horizon Europe" program deadline for submitting competition entries is 3 October 2023 through the application system available to applicants.

Appearance of the application concept "Humanitarian aid and prosthetic needs for reconstruction".

Below I present the appearance of the conceptual application "Humanitarian aid and reporting prosthetic needs for reconstruction". The appearance of the application downloaded to the mobile phone.

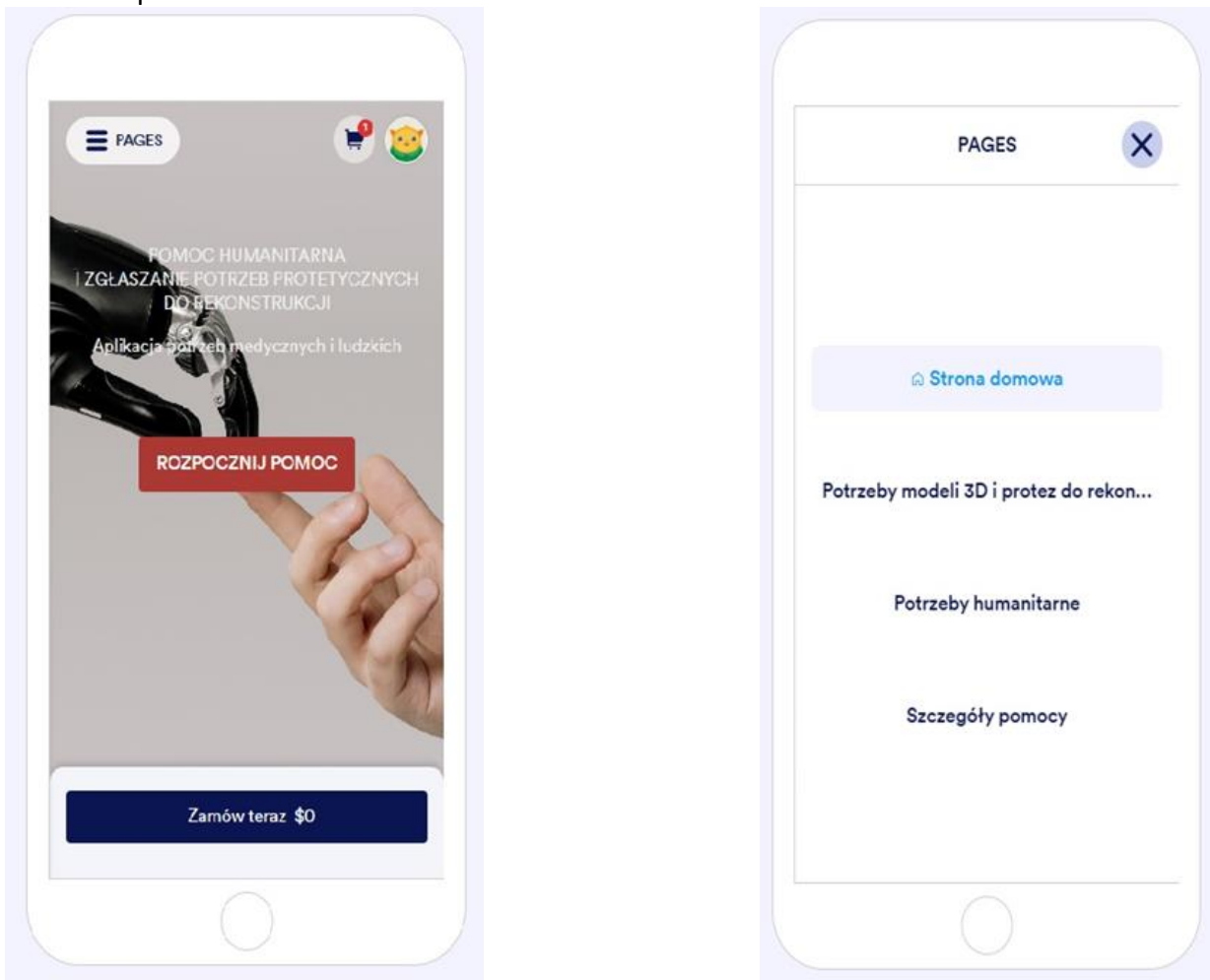


Photo 1 – Home page of the application and the main menu of the application "Humanitarian aid and reporting prosthetic needs for reconstruction". Application of medical and human needs. Polish version of the application.

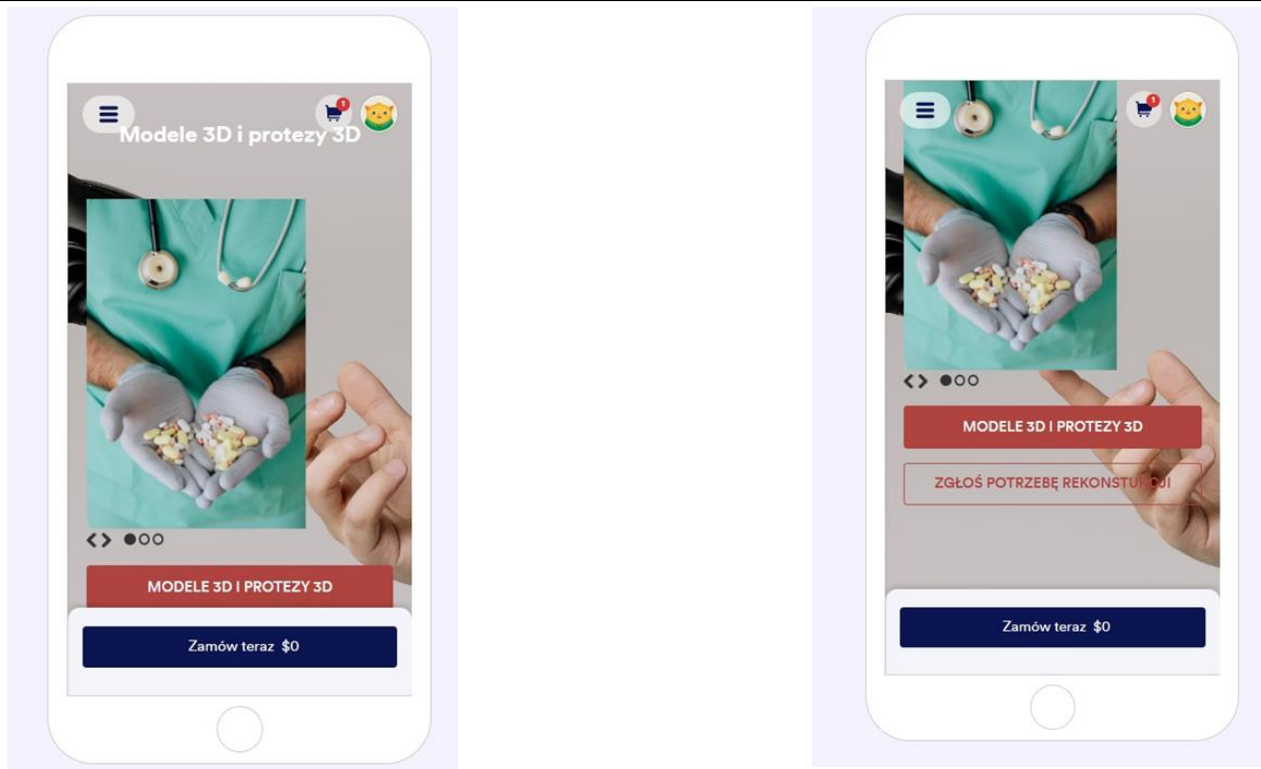


Photo 2 – Possibility to order a 3D model and a reconstruction prosthesis on the application “Humanitarian aid and reporting prosthetic needs for reconstruction”. Application of medical and human needs. Polish version of the application

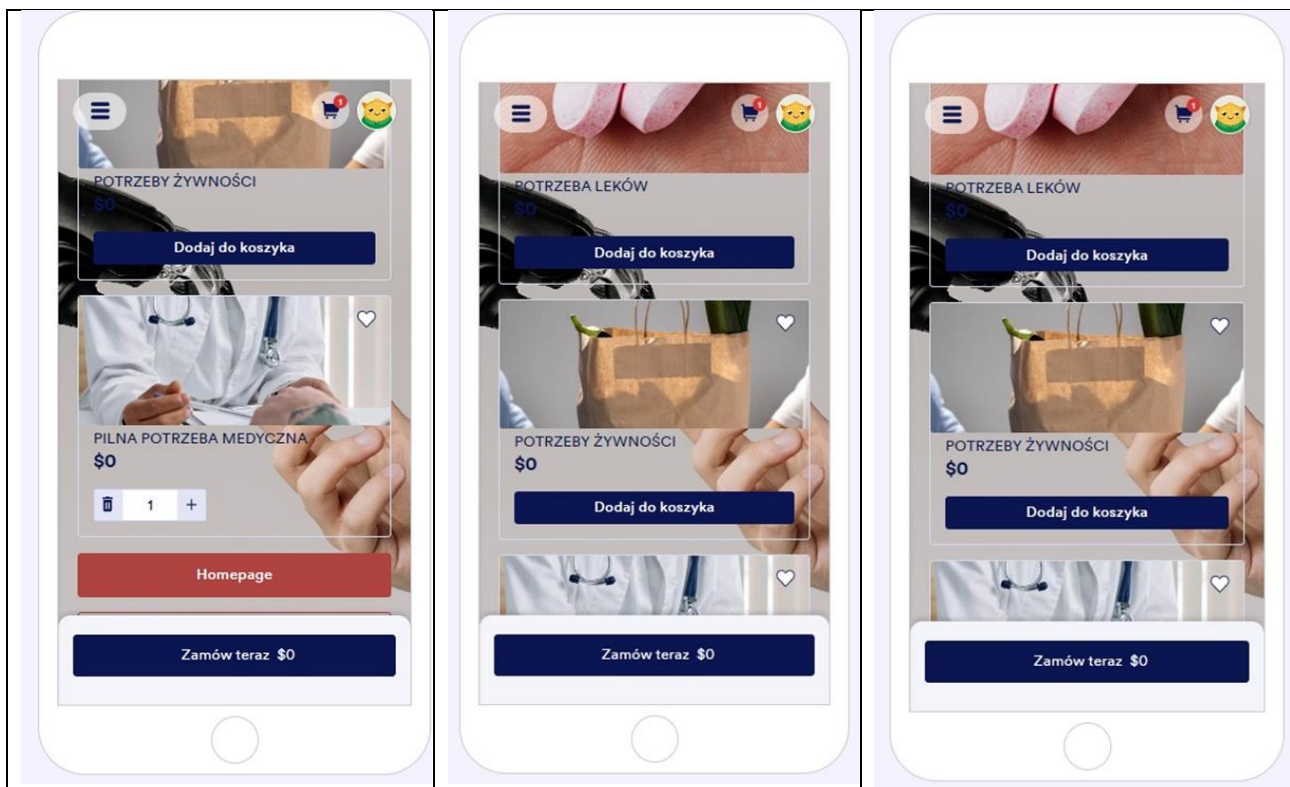


Photo 3 – Possibility to report urgent humanitarian needs for medicines, food, medical tests on the application “Humanitarian aid and reporting prosthetic needs for reconstruction”. Application of medical and human needs. Polish version of the application

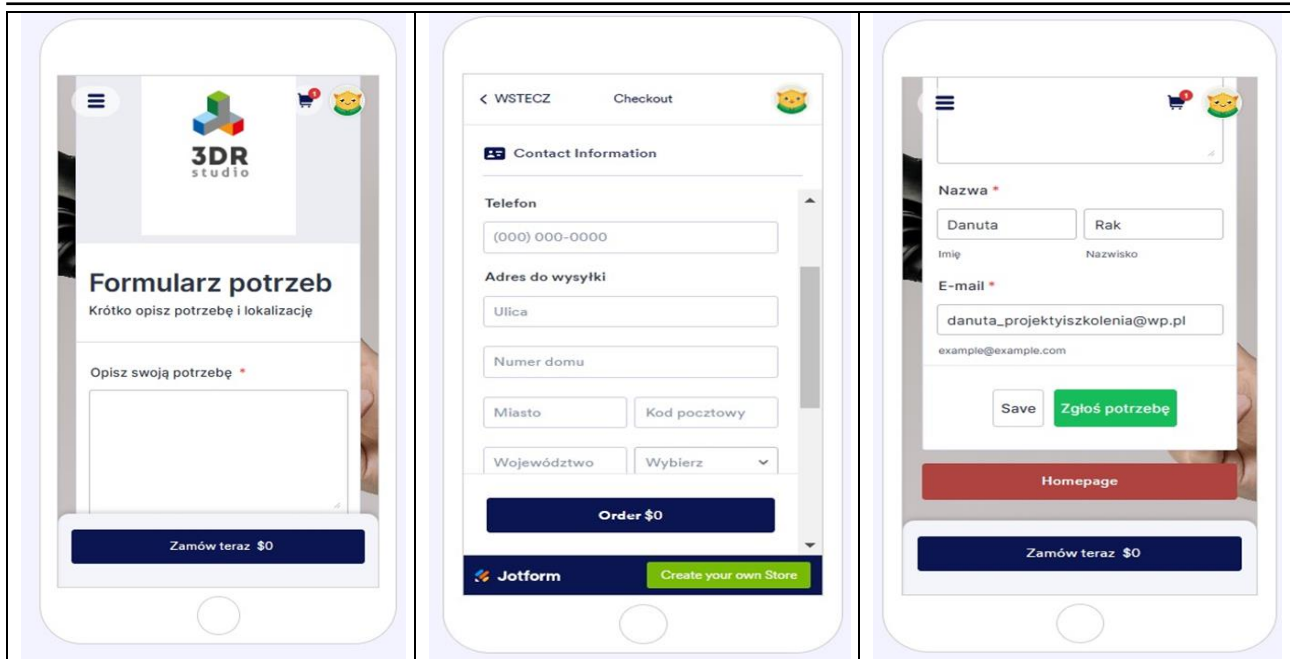


Photo 4 – Contact form for reporting needs along with determining the location of the person in need on the application “Humanitarian aid and reporting prosthetic needs for reconstruction”. Application of medical and human needs. Polish version of the application

Advantages and disadvantages of the application “Humanitarian aid and prosthetic needs for reconstruction. Application of medical and human needs.

The “Humanitarian Aid and Prosthetic Reconstruction Need Reporting” application is an application for reporting medical and human needs. The application consists of a start page where the “report help” button will open a menu consisting of the following tabs:

- the needs of 3D models and prostheses for reconstruction,
- humanitarian needs, i.e. reporting basic humanitarian needs, i.e. medicines (including cleaning products), food and medical assistance, understood here as the need for examination, providing medical advice – it should not be confused with first aid,
- help details – people reporting help will be able to briefly describe what help they need in what amounts and then use the contact form to leave their contact details and address.

Who will be able to use the application? How will this information reach governmental and non-governmental organizations providing humanitarian assistance? Why are 3D models appearing here and the need for prostheses for reconstruction?

How will humanitarian aid reach the victims?

These questions certainly indicate the need to improve the application, the concept deliberately assumed in its name that it is an application for medical and human needs, the tab for submitting 3D models and prostheses for reconstruction will be used by medical staff who will first prepare for implant surgery prosthesis and then he will perform this operation. The concept of this application assumes the creation of a communicator between medics around the world and engineers. In this way, support centers operating at governmental and non-governmental organizations should be created, covering people who have been injured as a result of crisis situations and need such prostheses to partially or completely return to fitness. The task of support centers in the field of 3D models and prostheses for reconstruction will also be to collect 3D models of these prostheses, which will serve as an educational tool for medical staff, as a form of preparation for treatments / operations, but also as a huge scientific base, various case studies. This

database could be made available to medical universities around the world, but also to technical universities in the field of medical engineering. The next tab concerns urgent needs such as medicines, food, medical assistance and these needs in crisis situations are the most urgent, answering the question of how this aid would reach individual people who report a humanitarian need. The concept assumes that also connected with governmental and non-governmental and non-governmental organizations providing humanitarian aid, collection points for humanitarian needs, such points may be the nearest hospitals, churches, schools or other characteristic institutions. Therefore, a person who sends a humanitarian aid application will be able to collect as much as he needs medicines, food, water or report to a specific point where a doctor will come. In response, the person will receive the address of the PH (Point Help), i.e. the help collection point.

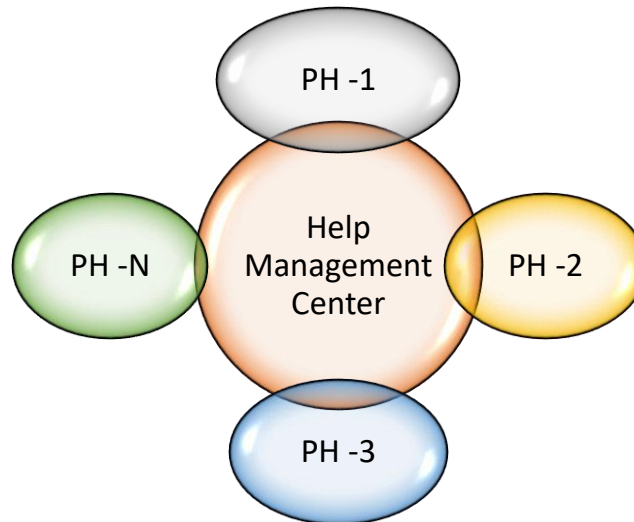


Figure 1 – Scheme of providing support to people who reported an urgent humanitarian need. Relationship between the Aid Management Center and Point Help

Defects. Yes, the application of medical and human needs also has disadvantages. The concept does not assume who should pay for the maintenance of the application, there is a need to create government aid management centers, create a map of help points, a great need for volunteering, people involved in humanitarian aid and another disadvantage is that state healthcare may be abused, some will be closer to come to a Help Point than to a medical clinic or the nearest hospital, and thus there will be an even greater need to hire medical personnel who will be on duty at help points. Abuse may also occur when reporting basic humanitarian needs, medicines, food, cleaning products – it will be difficult to assess whether this person actually needs them. The application has no influence on abuses related to this.

The use of applications with CAD/CAM and VR technologies and its impact on the safety of medical staff.

CAD programs – Computer Aided Design mean computer-aided design, in which you can create two-dimensional (2D) and three-dimensional (3D) objects. They are used in engineering and technical fields by architects, constructors, electricians and mechanics. Because CAD programs enable the creation of three-dimensional objects, they are also very popular in various fields of medicine. After the 3D modeling process is completed, the designed object can be exported to files with the extension stl, i.e. files that work with 3D printers. Thanks to these possibilities, the field of CAD/CAM is developing with great success, especially in the field of prosthetics. The CAM system stands for Computer Aided Manufacturing – computer-aided manufacturing. With CAD software, you can model:

- dentures;
- skin patches;
- pills;
- anatomical models;
- stiffening of broken limbs as a substitute for plaster;
- organs or bones;
- skull implants, implants of single teeth or entire dental arches.

Virtual reality is an image of artificial reality thanks to information technology, currently there is a huge development of technologies such as VR or artificial intelligence (AI). Virtual Reality allows users to create, edit projects in virtual space. Thanks to VR technology combined with CAD software, it is possible to walk around objects, test and modify a 3D model, which saves time and money, as well as detects many errors and, as it turns out, invaluable in various fields of medicine, because it can save a patient's life, increase the safety of medical staff during the operation, who will be carefully prepared for this.

The application "Humanitarian aid and reporting prosthetic needs for reconstruction" is an application for reporting medical and human needs, but also in conceptual assumptions it is to be a huge database of 3D models, thanks to which it will be possible to make low-cost prostheses, stiffening limbs instead of gypsum, produce implants using CAM manufacturing methods. Engineers from around the world will be able to create 3D models thanks to the answers to medical needs and save them on a special platform designed for this purpose. The medical staff, observing the 3D model thanks to virtual reality, will be able to better prepare for the operation, explain to the patient what the medical operation will consist of and what its course will look like. Such a base will affect the level of safety of medical staff during medical operations, the level of education and the opportunity to discuss case studies from around the world will increase and, above all, it will affect the standard of living of patients who are waiting for reconstruction and their families. 3D models collected in one database will also affect the safety of resources – ready prostheses, implants, which should shorten the patient's waiting time for reconstruction surgery and speed up the recovery rate after an injury.

2. Materials and Methods

Materials about the application "Humanitarian aid and reporting prosthetic needs for reconstruction" is an application for reporting medical and human needs, collected for the competition entry of the European Union Commission for innovative solutions in the field of humanitarian aid, available CAD programs, CAD / CAM technology, 3D printing materials as well as available articles available on PubMed, Scopus, libra.ibuk.pl as well as own materials, 3D models created for medicine.

3. Results

The "Humanitarian Aid and Reconstruction Prosthetic Needs Reporting" application is a medical and human need reporting application is a concept application before being implemented in real life emergency situations. The new technological solution is to help provide humanitarian aid in various places in the world affected by social crises, armed conflicts, natural disasters, epidemics, etc. In order to implement the application in real conditions, it is necessary to support governmental and non-governmental organizations providing humanitarian aid, Ministries of Health, the World Health Organization and especially people involved in volunteering.

4. Discussion

Forecasts of new applications

It is projected that the "Humanitarian Aid and Reporting Prosthetic Needs for Reconstruction" application for reporting medical and human needs will improve and increase humanitarian aid in crisis situations, will cover people who are waiting for post-traumatic reconstruction and will increase access to the use of prosthetic technologies. Other applications of the application include the permanent introduction to the medical education system in Poland and in the world of the possibility of using modern CAD / CAM technologies, VR, AI, which may be permanently introduced to the governmental and non-governmental system of carrying assistance in crisis situations.

Comparison with other possibilities on the market

The available applications can only be partially compared with other assistance options on the market. All over the world, there are applications primarily used to monitor health, a good example are applications for people suffering from diabetes, hypertension, or applications for determining the disease based on its symptoms. There are many applications also related to financial management in healthcare units, clinical and financial documentation management, offering rehabilitation programs. The application "Humanitarian aid and prosthetic needs for reconstruction" is an application for reporting medical and human needs, it may be the first application in the world that combines the technical and medical worlds. It will cover people which in crisis situations will require reconstruction, and on its basis, a database of 3D models will be created that can be easily printed thanks to the possibility of 3D printing, which will be a powerful didactic base for medical staff. Over time, the application will be able to be extended with new functions, namely informing about real threats to people providing humanitarian aid, including medical personnel.

5. Conclusions

The application "Humanitarian aid and reporting prosthetic needs for reconstruction" is an application for reporting medical and human needs, in addition to meeting the conceptual assumptions, i.e. providing humanitarian aid and providing humanitarian assistance to people who are waiting for reconstruction, e.g. limbs, it will be a base for building a safety culture of medical staff thanks to increasing access to modern technologies such as CAD/CAM, VR and the use of artificial intelligence (AI), as well as increasing the educational base for medical staff. The application is also intended to improve the preparation of medical personnel for reconstruction surgery by providing a 3D model of the limb in order to prepare for surgery and thus increase safety during the planned operation, the safety of providing the necessary prosthesis. Conclusions for further research will be the creation of a permanent database of 3D models for reconstruction, which will contribute to increasing the level of education of medical personnel in the world.

6. Financing

This study received no specific financial support.

7. Competing interests

The authors declare that they have no competing interests.

References

- A generic risk assessment and planning tool for all hazards to mass gatherings. World Health Organization Publishing, Geneva 2023.
- Chen, J., Li, N., He, D., Wu, M., Long, H., Yang, K., Qi, S., Zhang, W., Wang J. 3-D printing for constructing the burr hole ring of lead fixation device in deep brain stimulation. *Tools and Techniques*, Volume 58, pp 229-233 (2018).
<https://doi.org/10.1016/j.jocn.2018.10.086>
- Dodziuk, H. 3D printing/AM. Uses and social and economic effects. Publisher: Scientific PWN SA (2019).
- Dodziuk, H. 3D printing/AM. Uses and social and economic effects. Publisher: Scientific PWN SA (2019).
- Fay, CD. Computer-Aided Design and Manufacturing (CAD/CAM) for Bioprinting. Year 2020. 3D Bioprinting pp 27–41. Protocol First Online: 24 March 2020. Accesses 3 Citations Part of the *Methods in Molecular Biology* book series (MIMB, volume 2140). Available from :
https://experiments.springernature.com/articles/10.1007/978-1-0716-0520-2_3#:~:text=10.1007/978%2D1%2D0716%2D0520%2D2_3
- Occupational hygiene in nursing and medical rescue. Edited by Bartosz Bilski. Medical University of Karol Marcinkowski in Poznań. Poznan 2016.
- Safety of patients and medical staff. Ergonomic conditions. Medical University of Silesian Paists in Wrocław, Wrocław 2020.
- The European Humanitarian Innovation Award: the first edition is launched (europa.eu) Available from :
https://eic.ec.europa.eu/news/european-prize-humanitarian-innovation-first-edition-kicks-2023-03-22_en
- Wallach, Kloski L., Clouds, N. 3D printing. A practical guide to hardware, software and services. 2nd edition. Year 2022. Publisher: Helion.

Список використаних джерел

- A generic risk assessment and planning tool for all hazards to mass gatherings. World Health Organization Publishing, Geneva 2023.
- Chen, J., Li, N., He, D., Wu, M., Long, H., Yang, K., Qi, S., Zhang, W., Wang J. 3-D printing for constructing the burr hole ring of lead fixation device in deep brain stimulation. *Tools and Techniques*, Volume 58, pp 229-233 (2018).
<https://doi.org/10.1016/j.jocn.2018.10.086>
- Dodziuk, H. 3D printing/AM. Uses and social and economic effects. Publisher: Scientific PWN SA (2019).
- Dodziuk, H. 3D printing/AM. Uses and social and economic effects. Publisher: Scientific PWN SA (2019).
- Fay, CD. Computer-Aided Design and Manufacturing (CAD/CAM) for Bioprinting. Year 2020. 3D Bioprinting pp 27–41. Protocol First Online: 24 March 2020. Accesses 3 Citations Part of the *Methods in Molecular Biology* book series (MIMB, volume 2140). Available from :
https://experiments.springernature.com/articles/10.1007/978-1-0716-0520-2_3#:~:text=10.1007/978%2D1%2D0716%2D0520%2D2_3
- Occupational hygiene in nursing and medical rescue. Edited by Bartosz Bilski. Medical University of Karol Marcinkowski in Poznań. Poznan 2016.
- Safety of patients and medical staff. Ergonomic conditions. Medical University of Silesian Paists in Wrocław, Wrocław 2020.
- The European Humanitarian Innovation Award: the first edition is launched (europa.eu) Available from :
https://eic.ec.europa.eu/news/european-prize-humanitarian-innovation-first-edition-kicks-2023-03-22_en
- Wallach, Kloski L., Clouds, N. 3D printing. A practical guide to hardware, software and services. 2nd edition. Year 2022. Publisher: Helion.