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MECART – A SPECIAL PROJECT

Abstract: *This paper presents a new project, called "MecArt", developed at the Faculty of Mechanical Engineering, University "POLITEHNICA" of Timişoara. MecArt started as a contest for students and pupils from Timişoara, passionate about graphics, painting, sculpture or poetry, but also being attracted to Mechanical Engineering.*
The authors have conducted the 3D Modeling section of the contest. This was a teaching challenge, because the participants were not required to have any prior knowledge of a 3D modeling software.
The paper highlights the multiple facets of the MecArt project and its results.

Key words: *MecArt, creativity, project, competition, 3D Modeling, high school students, teaching challenge.*

INTRODUCTION

The authors point out a special project, unique in Romanian technical universities.

This project started in 2010 at the initiative of the Faculty of Mechanical Engineering Students League of POLITEHNICA University of Timişoara. Now, the contest named MecART reached its sixth edition.

This project is particular in many aspects: by name, by topic, by the target audience, by the way it progresses, by the preparation mode, by the immediate visible results and the long term ones.

2. ETYMOLOGY

2.1 Etymology of the word MecArt

According to Larousse dictionary, the term MecART nominates the technique and artistic movement characterized by the use of photomechanical images [9].

In accordance with the Oxford Index "Mec art" is "A term (abbreviation for 'mechanical art') applied to works produced by transferring photographic images to canvas treated with photosensitive emulsion. Andy Warhol used photographic transfers unadapted in many of his screenprints, but the European artists associated with Mec art have usually modified or restructured the original image to create a new, synthetic one. The term was perhaps first used by the French painter Alain Jacquet (1939–2008) in 1964 (with a pun on the word 'mec', French slang meaning 'bloke'), and it was adapted soon afterwards by several other artists …" [10].

The expression "mec-art", short for "mechanical art", indicates the creative movement of a group of French and Italian artists. They, in the sixties came forward with radically new ideas about the social and communicative function of art, and spread an innovative practice of artistic production, with was opposed to the idealistic ambitions of traditional easel painting. In this direction, the group rejected not only the conception of genius, specially cultivated by the members of the informal painting, but also the vision of beauty and exclusivity of the extraordinary value of the unique painting. The artists who worked in the mec-art spirit, as faithful observers of the reality of contemporary life, accepted without reservations the consequences of civilization, media and technology [4].

Ian Chilvers and John Glaves-Smith, in [1] noted that "mec art" is a term (abbreviation for 'mechanical art') applied to works produced by transferring photographic images to canvas treated with photosensitive emulsion.

The French, Italian, Belgian, German, Swedish and American artists who adopted MecART, replaced the brush, palette and easel - the classical tools of the painter, with photos and new techniques of mechanical transfer of their various unconventional media: cloth treated photosensitive emulsion, cardboard, paper, ...

The artistic movement named "Mec art" or mec-art, arte povera, land-art, happening, body-art, have significantly influenced the '80s Romanian art also **[2]**.

2.2 The word MecArt nowadays

If the '60s artists brought the technology into painting, the students of the Faculty of Mechanical Engineering Students League of POLITEHNICA University of Timişoara tried to bring art into technology. Thus, they launched a new special project called "MecArt". So, the term "MecArt" gets a new meaning, it is the name of a cultural and artistic project that seeks to joint art with elements of mechanical engineering. For a special project, even the contest posters were special. Figure 1 present the poster for "MecArt 2012" and figure 2 shows one of the "MecArt 2014" posters, [7],[12].

Fig. 1 The "MecArt 2012" poster

Fig.2 One of the "MecArt 2014" posters.

3. MECART CONTEST HISTORY

In 2010, the Faculty of Mechanical Engineering Students League of POLITEHNICA University of Timisoara, launched the MecArt project.

The Faculty Board adopted this initiative, and, with a group of enthusiastic teachers, became a partner in organizing the competition.

MecArt started in March 2010, as a contest for students and pupils from Timişoara, with a passion for graphics, painting, sculpture or poetry, but also having mechanical inclinations. If the first edition (2010) was addressed only to the young people of Timisoara, the third edition 2012) was attended by over 120 high school students from throughout Timiş county, and the fifth edition (2014) was attended by high school students from 20 counties, [3], [5], [6], [7], [8].

The fifth edition of the MecArt contest took place along with two other competitions for high school students, in another major event organized by the POLITEHNICA University of Timisoara on 28, 29 and 30 March 2014.

This major event, entitled "POLITEHNICA Timişoara - a step towards your future" involved an impressive effort from the organizers, being one of the most complex and large projects for students.

The competition was addressed to high school students, especially those in the terminal year, who had the chance to see what it is like to be a student at the POLITEHNICA University from Timi□oara during a weekend. The competitors had the opportunity to check their knowledge by participating in competitions organized by the Faculty of Electronics and Telecommunications, [13] Faculty of Mechanical Engineering, [12], the Faculty of Chemistry, [14].

Over 800 high school students from 20 counties from the western part of the country attended this large event [3], [11]. The participants were accommodated in the student hostels in students complex and/or in the boarding schools hostels in Timi□oara. Housing, two meals a day and transport were provided free of charge to all participants.

The participants' interaction was a very important goal of this project. During the three days of the event, participants were accompanied and guided by POLITEHNICA student volunteers on a permanent basis. The program included social evenings, karaoke, sports activities, and a party.

High school participants at this "POLITEHNICA student for a weekend" had the opportunity to get acquainted with the POLITEHNICA University in Timişoara, as well as its educational offer. Also, they have been able to test their knowledge in their areas of interest and came in contact with students at the POLITEHNICA. At the same time, they saw what life for a student is like.

At the end of this great event, in a solemn festivity, participants have received awards and diplomas.

4. MECART CONTEST TOPICS

The first edition of the MecArt contest had six sections: Graphics/Design and Painting, Graphics/3D Design, Sculpture, Robotics, Creativity, Poetry, [5], [8].

The competitors received a subject with mechanical content that they will have to solve in an artistic manner.

In the Sculpture section, the participants received unconventional and organic materials and had to make a sculpture with a mechanical aspect.

Poetry section candidates were asked to write lyrics that contain the required mechanical terms.

All the next editions of the competition had five sections [6]. The Drawing/Painting, Graphics/3D Modeling, Robotics and Creativity sections have been included in all the editions. Due to the small number of competitors in Sculpture and in Poetry sections, the last three editions have included Photography as the fifth topic.

Sections from which participants can choose this year, on the sixth edition are [15]:

- Mobile Robots
- Creativity
- 3D Modeling
- Drawing/Painting
- Photography

For each section, participants are allotted the necessary materials for carrying out their new designs.

In Mobile Robots section, the competitors have to control their little mobile robots which they have entered in the competition. The Mobile Robots section, had two subsections: the speed test and the orientation test. The mini robots had to carry out movements along the path prepared by the organizers. Judging was done by academic teachers with expertise in this area.

The creativity competitors have received materials (screws, bearings, chains, pipes, etc. – usually used) and

plastics (sheets of paper, paperboard, etc.) from which they had to make handicrafts and other items that materialize what the competitors were imagining. All teams received the same number and the same type of pieces. A person specialized in this domain assisted the competitors to assemble/weld the necessary parts. Judging was done by a special commission and the best works were showcased. The most spectacular results were achieved in the Creativity contest. Figures 3, 4, 5 and 6 show some of them [5], [7], [8], [12].

The 3D Modeling section was devoted to modeling and 3D design enthusiasts. The participants had to create a virtual 3D model of a real mechanical part, using a 3D modeling software. Training and judging were held by teachers specialized in this area.

The Drawing/Painting section involved a drawing/painting with a theme of mechanics. Working materials (pencils, paper A3/A4, tempera, brushes) were provided by the organizers. At the end of the day, the best works have been showcased.

In the Photography section the participants were placed in locations where mechanical processes was and they had to make the most artistic photography in that area. Participants had to bring their own camera. Judging was done by a specialized commission and the best works were showcased.

5. MODELING PARTS AT MECART 2014

During the previous year, the authors of this paper were asked to organize and host the "MecArt 2014" contest's 3D Modeling section.

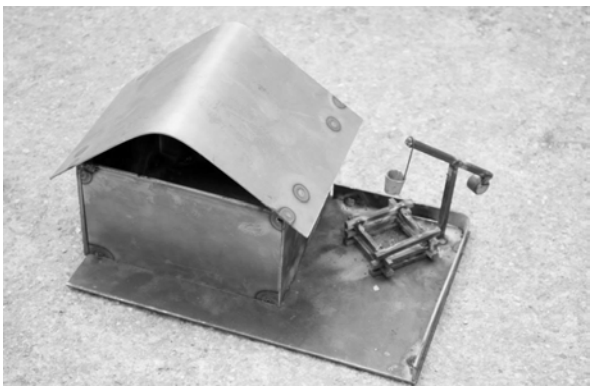

Fig. 3 "Granny's home"

Fig. 5 The "MecArt doggy"

This request was a true challenge, from preparing the contest to the final judging phase.

5.1 The competitors

The 3D Modelling competitors that registered were highschooll pupils in their final years, from different types and highschool profiles, regardless of their level of knowledge of any graphics software or 3D Modeling.

Most of them have never seen such software.

Some of them came out of curiosity, to get acquainted with the faculty of Mechanical Engineering, with its study offer, with its facilities, with student life in Timisoara.

5.2 The competition

The competition was carried out in two stages:

- First, during 1-1.5 hours, at the start of the contest, the competitors were invited to a short training on using the 3D software.
- Then, during maximum 1.5 hours, the participants were asked to realize a virtual 3D model for a real mechanical part, using the presented software.

In this manner, any student, even those who had no knowledge in this area, could participate.

6. PREPARING THE 3D MODELING COMPETITION

Preparing the contest required four large stages, each a challenge in its own way, even for the two teachers with over 24 years teaching experience and over two decades of using graphics/modeling software.

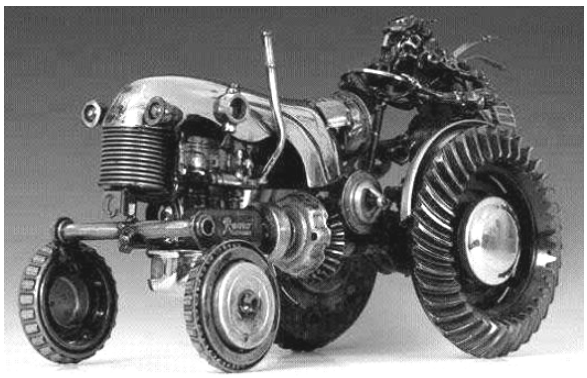

Fig. 4 "My tractor"

Fig. 6 "My motorbike"

These steps were:

- Preparing the contest subjects,
- Preparing the presentation of 3D software and of the 3D modelling techniques that were used;
- Finding the procedures to ensure the contest transparency and the evaluations objectivity;
- Establishing the assessment grid for the models made during the contest.

6.1 Preparing the contest subjects

Preparing the contest subjects was the first challenge, the authors had to decide if the presented subjects:

- Should there be real physical objects or printed virtual models?
- Should there be mechanical parts or simple teaching models?
- Should they be imagined by the competitors or pre-set by the judges?
- If the subjects are virtual, set by the judges, should they be presented as graphics or textually described?

Based on their teaching educational experience, the authors opted for real mechanical parts:

- simple enough to be modeled in AutoCAD by beginners, but
- elaborate enough to require a set of drawing and modelling commands, and
- picked in such a way that they could be modeled in at least two different ways in the 3D virtual space.

Figure 7 presents 3D models of a class of mechanical parts used in the contest. The 3D models in figure 8 illustrate another category of mechanical parts used as contest subjects.

A new issue came up: should the subject be unique or should there be individualized subjects? The authors opted for the second choice. Furthermore, each part was numbered and the competitors drew lots, without seeing the pieces at that time.

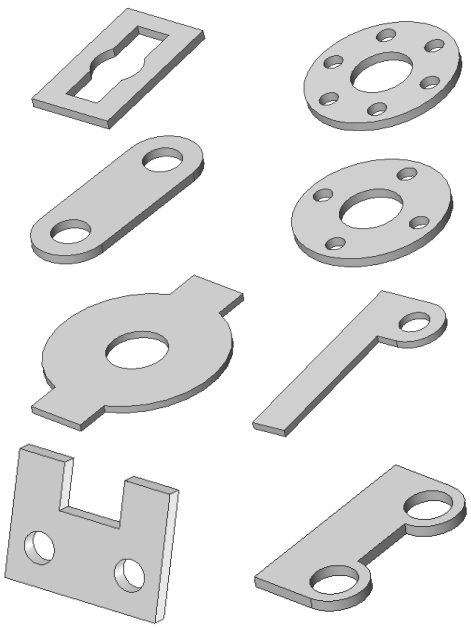

Fig. 7 3D models of some contest subjects

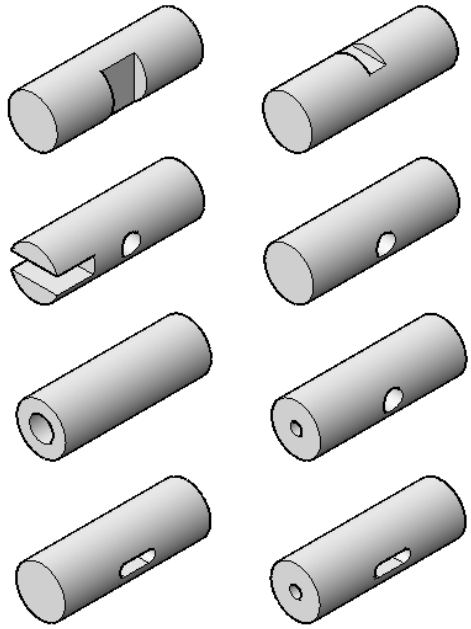

Fig. 8 3D models of some contest subjects

Necessary measuring instruments (callipers) were provided by the organizers.

6.2 Preparing the training

Considering those outlined in previous paragraphs, the authors were faced with a real challenge: preparing training for modeling software and 3D modeling techniques, for some students who have never had contact with AutoCAD, who have no basic knowledge of 2D technical drawing.

The participants' training had to meet clear stringent requirements, as:

- to be short (limited to maxim 1.5 hours),
- to be clear,
- to be accessible, even for those who have never seen any graphics software or 3D Modeling software,
- to be concise,
- to provide enough concepts, commands and working techniques, so that the participants could meet the competition's demands,
- to be interactive.

Specifically, the training had to answer two questions: what and how to present.

The answer to the second question was simple and immediate: the presentation must be done directly from AutoCAD, using a video projector.

The answer to the first question was harder to find. The major difficulty was to put together a portfolio of concepts, commands and working methods, taking into consideration the participants' knowledge and especially the allotted time. Also, the contest's subjects needed to be strictly related to the presentation: to be accessible to competitors and to be solved using the above concepts and commands.

Consequently, the authors proceeded quite opposite than usual: they first determined the subjects' complexity level, from this inferring the portfolio of notions, commands and working techiques needed to model them.

In a very short time, compared to the amount of information required to be submitted and assimilated, the authors had to present enough elements so that the participants could meet the competition's demands. For this, it was necessary to thoroughly establish the above, but especially to prepare in advance the graphic material needed for the presentation.

The authors decided that the training should be divided into two parts. The first part consisted of a presentation of a portfolio of notions, commands and working techiques.

For example, in order to solve the type of subjects in Figure 7 and Figure 8, the list of items briefly described were:

- A brief presentation of the AutoCAD 3D workspace;
- Presentation of the coordinate systems and coordinate types used;
- How to enter commands and options;
- The "Object Snap" modes, the "Osnap" function;
- A few 2D commands like SNAP, GRID, PLINE, CIRCLE, ZOOM, MOVE, COPY, ERASE.

It was then insisted on work commands in 3D virtual space, like:

- Primitive solids' modeling commands (SPHERE, BOX, WEDGE, CYLINDER, CONE, PYRAMID);
- Modeling commands (EXTRUDE, REVOLVE);
- Commands needed to implement Boolean operations on solids (UNION, SUBTRACT, INTERSECT);
- UCS command;
- VIEW and VISUALSTYLES commands.

Gradually presented examples, carefully chosen in shape, size and vizualisation style, influenced the understanding and assimilation of the listed items considerably.

For example, the "EXTRUDE" command presentation was performed on previously prepared files, having 2D contours and necessary trajectories already drawn, copied multiple times. Thus, the original elements were preserved in the drawing, along with the extruded result, for a better understanding of the command's syntax (figure 9, figure 10 and figure 11).

Applying the command was made in front of the students, talking to them and detailing the command's syntax step by step, until the extruded objects were

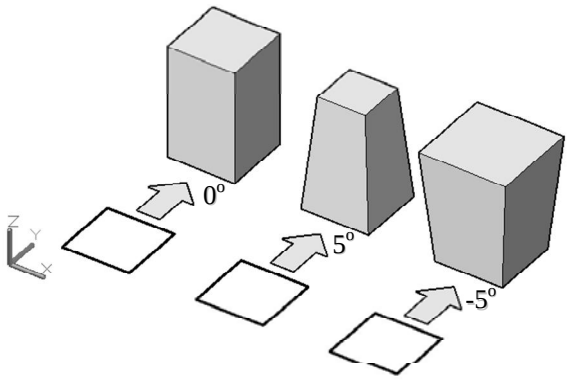

Fig. 9 Extruding the same 2D contour, with the same heigt but with different angles.

different classes of 2D objects (Figure 11).

The "REVOLVE" command presentation was performed by applying it to the same contour (copied several times). The rotation axes used were previously drawn in different positions and at different distances in relation to the contours. Different rotation angles were applied to the same contours, to understand their measurement direction in 3D virtual space and the outcome of their application, in record time. Original objects, contours and axes were kept in the drawing (copied before applying the "REVOLVE" command) to facilitate understanding of the command (figure 12).

Presentation of Boolean operations applicable to solids ("UNION", "SUBTRACT" and "INTERSECT" commands) was performed on the same solids four times copied previously, to highlight different spectacular results not only in terms of command, but depending on the objects' selection modes (figure 13).

To increase the appeal of training and check its immediate results, during the final stage of the presentation, competitors, along with the trainer, have completed two 3D models, step by step. With each new modeling step, the previous step's result was copied in order to follow and better understand the previous command's effect.

For each model at least two types of modeling methods were discussed and tried.

Beginning with drawing the 2D objects needed for the 3D models, participants were constantly supervised

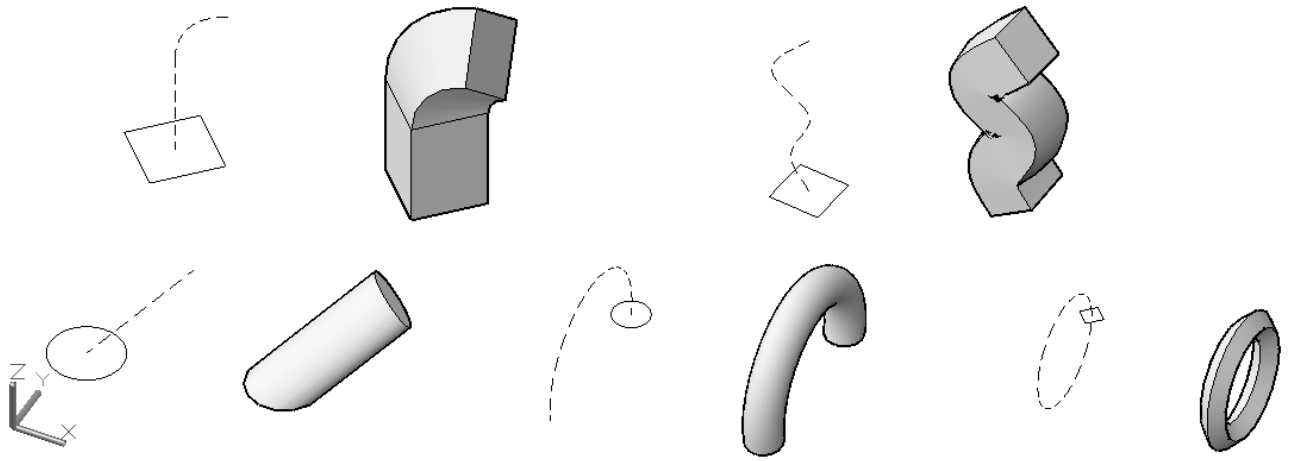

Fig.10 Extruding different contours along different paths.

obtained. It was insisted upon the extruding result of and assisted by the two teachers, coordinators of the

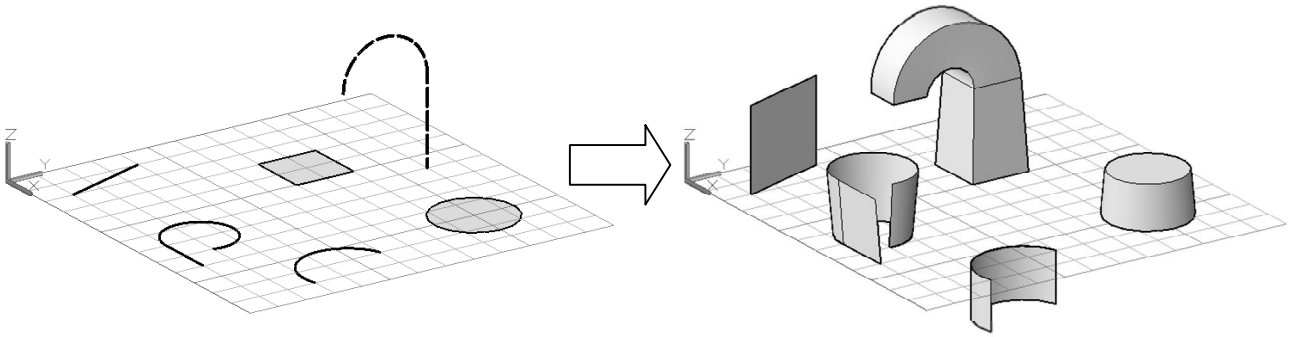

Fig. 11 Outlining the results of different 2D object categories extrusion

modeling contest.

The subject for one of the models made step by step, is shown in Figure 14. Figure 15 shows the modeling steps of the stand in Figure 14, made by using the primitive solids exclusively and the needed Boolean commands. The second modeling method made step by step together with the competitors, was to apply the "EXTRUDE" command on the 2D contours drawn during the first stage. Applying the "SUBSTRACT" and "UNION" commands followed.

6.3 Procedures taken to ensure the contest transparency and the evaluations objectivity

To ensure the contest transparency and the evaluations objectivity, the workstations were numbered and the competitors drew lots, regardless of contest subjects numbers.

At the beginning of the contest, competitors picked a password in duplicate by drawing lots. It has been used mandatory as the contest file name. The participants have preserved a copy of the password, and the other copy was put into an envelope, sealed in front of the competitors.

At the end of the contest, after assessing the solutions and preparing the final ranking of the files, the sealed envelope with the passwords was opened in front of the competitors. Passwords' classification was then filled with the competitors' names, thereby determining the winners.

For total transparency of the evaluation, correctors showed the evalution grid and opened the winning files for reviewing. If there were requests, correctors and competitors discussed the required files, justifying the score.

6.4 Establishing the evaluation grid for the contest's 3D models

Establishing an assessment grid for the 3D models made during the contest generated a lot of turmoil. Major set requirements were:

- The model had to match the drawn part in shape and size;
- The position in which the 3D model was saved had to meet the requirements specified at the beginning of the competition;
- There had to be one solid model, regardless of how many parts were used to build it;

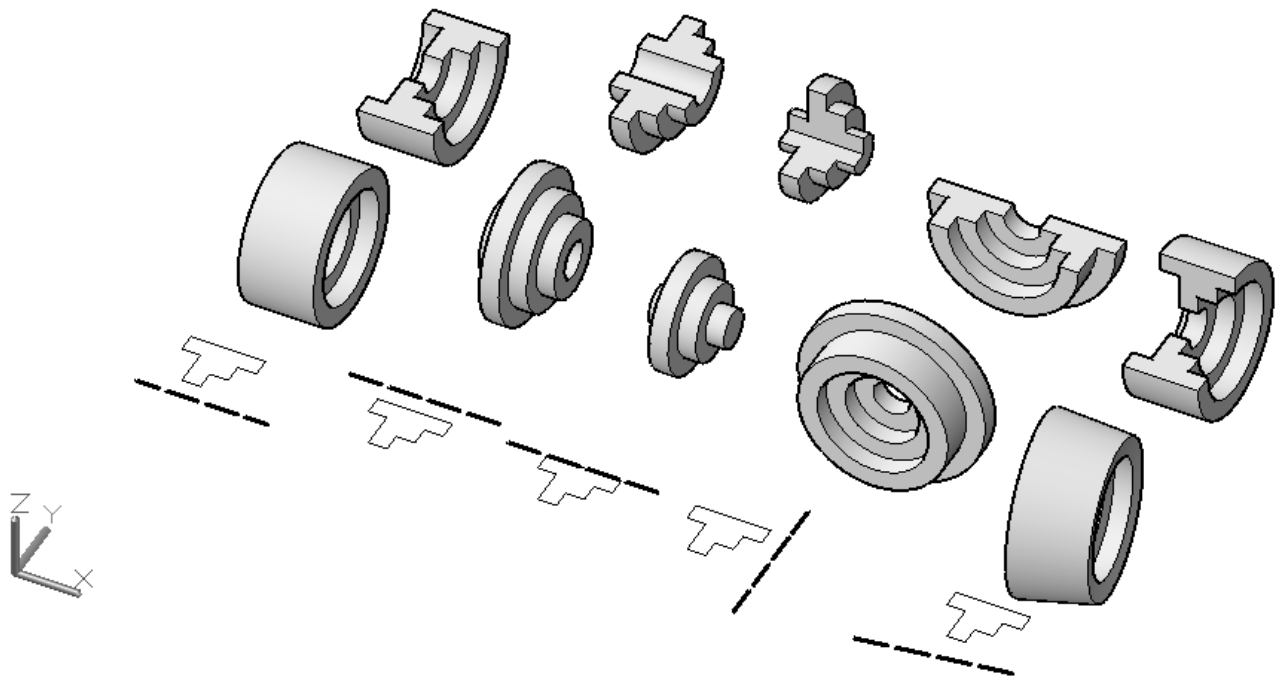

Fig. 12 Revolving the same 2D contour around different axes, with different angles .

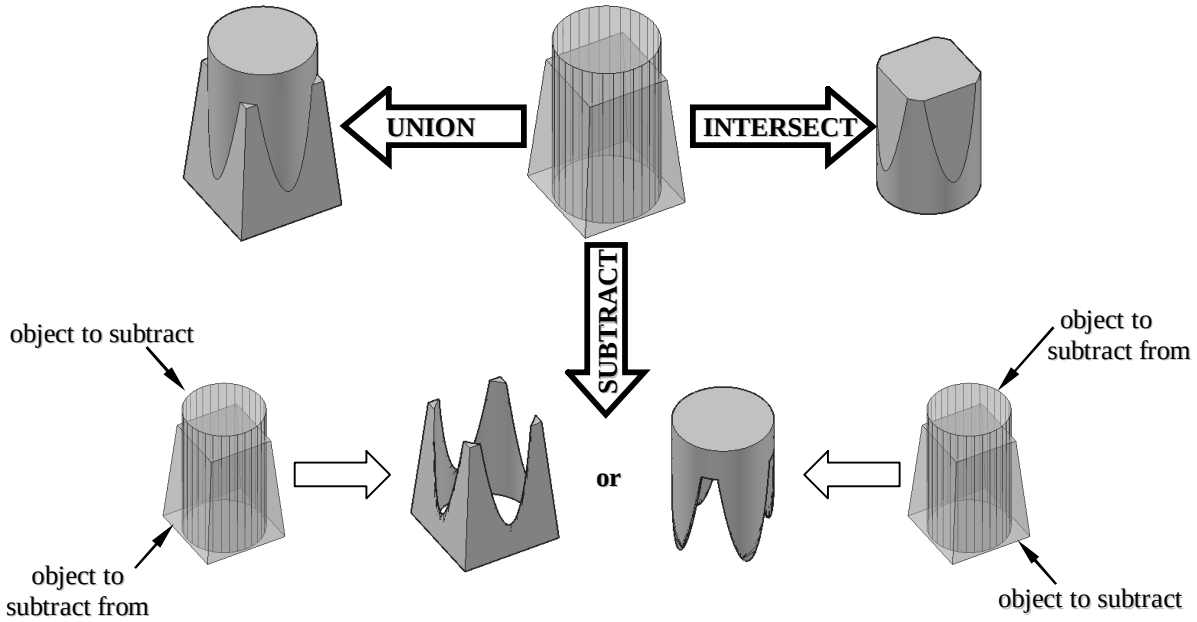

Fig. 13 Explaining Boolean operations on solids.

- Viewing style had to be the same as the one stated at the beginning of the competition;
- Model development time was recorded for each contestant, ensuring a way to break the tie for files with the same score.

7. CONCLUSION

The MecArt contest, now in its sixth year, is a special competition also through its multiple meanings.

As the name indicates, MecArt is a combination of mechanics and art. This ambitious project, by theme, organization and even the name chosen, is something entirely new.

Students from the Faculty of Mechanical Engineering League, the Faculty Board and a group of dedicated teachers contributed to its progress. Its unique theme, organization and development, the number and knowledge of competitors entered in the competition were as many challenges for the organizers.

The contest itself is a competition that allows the participants to verify their level of knowledge in the field of their choice, while proving their creativity.

The Mobile Robots and Creativity sections, being carried out in teams, helps prepare young people for teamwork.

Participants' interaction is another important objective of this project. The contest's development and the socio-cultural program provided to the competitors led to strong friendships among the pupils from the 20 counties, but also with student volunteers from the Politehnica University of Timisoara student organizations.

The competitors had the chance to get to know the life of the Politehnica student, to know Timişoara

The authors, responsible for carrying out the full 3D Modelling section, were compelled to find techniques and working methods suitable for the competitors' level and the duration of the contest.

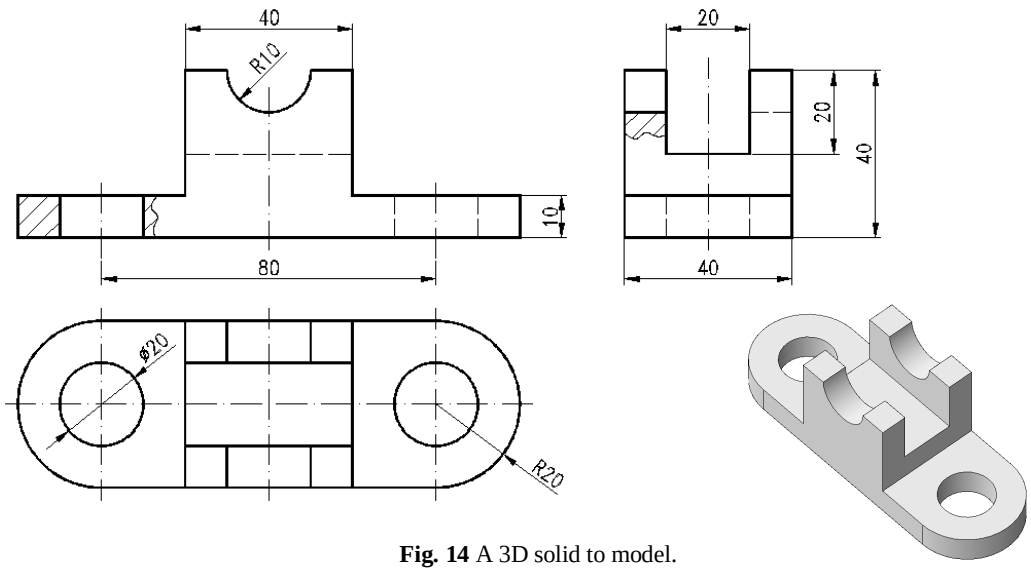

Fig. 14 A 3D solid to model.

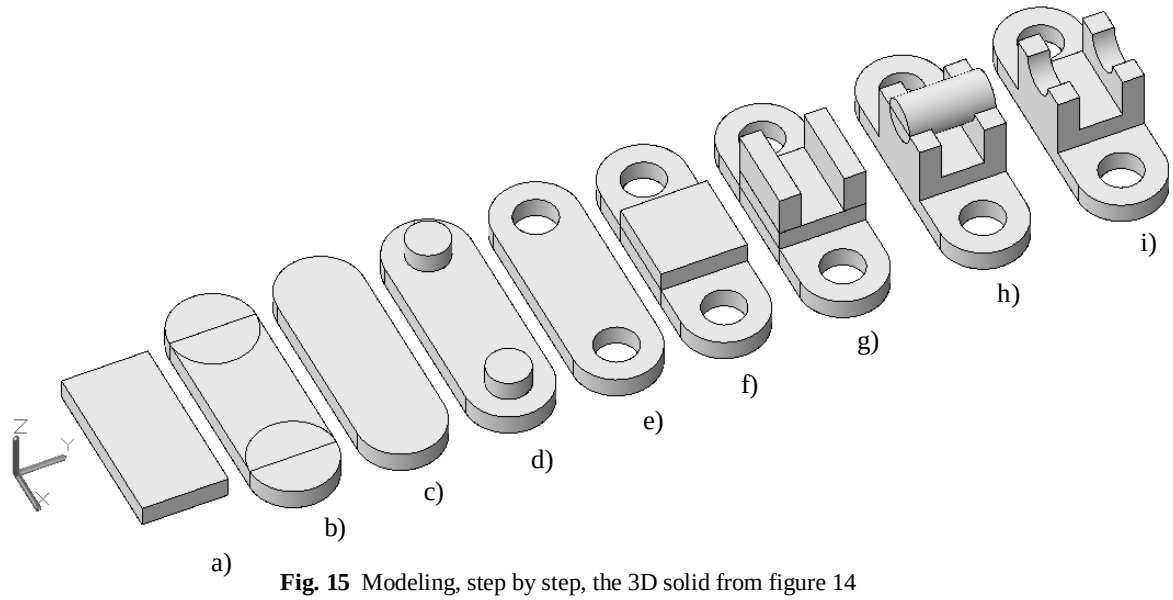

Fig. 15 Modeling, step by step, the 3D solid from figure 14

The results of the contest, participants' impressions and the fact that many of them are now students at the Faculty of Mechanical Engineering, gives us reasons to consider the MecArt project a success.

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