

Presentation of the Developed Mechatronic Devices for Exhibition Purposes

Case Study

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Abstract – Exhibiting at fairs is especially important for companies. Therefore, they need a well-organized and interesting exhibition booth. This paper presents the development of a mechatronic device that could be suitable for exhibition purposes. The device is developed based only on the defined general requirements by a specific company, which produces DC motors and corresponding components. The development process was organized as a competition project for students. In the paper, the development process is presented briefly, starting with the presentation of the project task and finishing with the presentation of some of the competition final results.

Keywords – exhibition device, mechatronics, product development.

1. INTRODUCTION

Exhibiting at fairs is a popular and useful form of presentation for companies in the field of industrial automation technology. Not only can they interact with potential customers, but it is also a great possibility of presenting their innovations and actual research results [1].

Companies need to arrange their stands creatively to be eye-catching since all their competitors are also present at the fairs. Clever and creative design of the stand draws attention of visitors. Companies should think of ways to facilitate conversation with visitors in relation to e.g. a theme or the promotion of the show. These solutions do not add much to their budget, but are a very effective way of marketing [2].

As mentioned above, creativity is of key importance. Stands do not have to be huge and contain too much text and visual effects, all these need to be chosen carefully to strengthen the image the company wants to create. In many cases, a smaller stand can be more effective and attractive than a huge one. Therefore, a huge budget is not necessary for arranging a successful stand [3].

One of the leading companies in the field of advanced motion solutions, Dunkermotoren GmbH, attends fairs on a regular basis. As they seek solutions for organizing a successful stand, they plan to develop a mechatronic device suitable for exhibition purposes. That means it should attract visitors at fairs and also promote the company's product portfolio. This device has been developed and is going to be produced by third-year students of Mechatronics and Mechanical Engineering at Subotica Tech – College of Applied Sciences under the supervision of professors from Subotica Tech and engineers from Dunkermotoren GmbH.

The device was developed based only on the defined general requirements specified by the company. The specific requirements had to be defined without active involvement of the company. The paper is structured as follows. The project is described in the second chapter. Chapter 3 presents briefly the development process, starting with results of initial brainstorming. Following that, some of the results of the competition are presented. Final comments are given in the Conclusion.

2. PROJECT DESCRIPTION

2.1. GENERAL REQUIREMENTS

During the design process students needed to use their creativity and innovation to build an attractive device. They worked in teams of 3-4 people. The most important requirement was to present and show the ability of the Dunkermotoren GmbH product portfolio. Furthermore, other special technical requirements, documentation requirements and requirements about the total cost were also defined.

2.2. SPECIFIC REQUIREMENTS

Apart from the above mentioned requirements, there are some special technical requirements:

- All motions had to be realized in high performance;
- Some of the motions had to be realized in parallel (at the same time);
- The most important technical requirement was to use rotational and linear drives from the latest technology based on the Dunkermotoren GmbH product portfolio [4-5];
- The gearboxes had to be used from the Dunkermotoren GmbH product portfolio;
- Control of the motions had to be based on the latest PLC technology [6-11] with support of the EtherCAT [12-14] communication technology;
- The maximum cost of the device should not exceed 7,000€;
- The motors and the PLC had to be placed to visible positions;
- All wires and other less important devices had to be hidden under a cover plate.

2.3. TIMELINE

The teams were given deadlines to follow for each level of their work. At the first level, a deadline was given for presentation of their preliminary ideas, then the CAD models, calculations, and schemes had to be presented as the second milestone of teamwork. Finally, in relation to the third milestone, the whole documentation was to be presented by the teams, and at this level the best works were selected.

After receiving the documentation of all projects, Subotica Tech professors and Dunkermotoren GmbH chief executives selected the project which was most attractive and most suitable for fair purposes. Furthermore, the documentation was analyzed again, and the realization of the winning project started.

3. DEVELOPMENT STAGES OF A MECHATRONIC DEVICE

Having in mind the definition of the project task, which was defined by giving only the general con-

straints, the process of developing a mechatronic device was divided into three subphases:

- Generation of multiple initial ideas;
- Development of 3D models by using computer aided design techniques;
- Finalizing the documentation.

All subphases are presented in the following subsections.

3.1. INITIAL IDEA GENERATION

The generation of initial ideas was performed as teamwork. Initially, 10 student teams were involved in this phase. Student teams had to present no less than three initial ideas. The ideas had to be presented as sketches. All sketches had to include a clear explanation of the basic functionality of the proposed device. Also, all required explanations, which could have been needed by the Assessment Committee, had to be included as well. Based on the presented initial ideas, the Assessment Committee had to decide which ideas met the necessary requirements defined in the project task and were suitable for each team to further work on. The sketches were mostly rough freehand drawings with textual explanations. An example of a freehand sketch, which shows an initial idea of an automated DJ - table is presented in Fig. 1 [15].

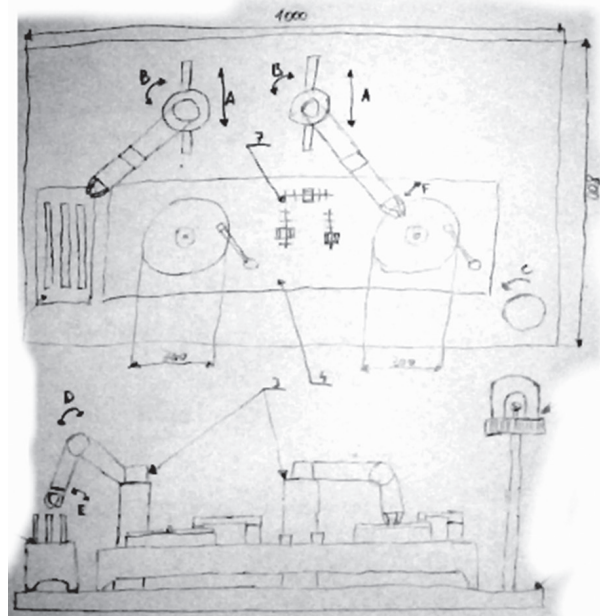


Fig. 1. A rough sketch

3.2. DEVELOPMENT OF 3D MODELS

Evaluation of initial ideas resulted in a decision that nine teams were allowed to work further on the development project. One of the teams was excluded from the project by the Assessment Committee due to their poor performance during the first subphase.

During this subphase, 3D models were developed. The development of 3D models included all required calculations, analysis, etc. One of the 3D models, the 3D representation of the idea of a three-dimensional labyrinth is presented in Fig. 2 [16-17].

3.3. DOCUMENTATION

The developed 3D models, together with the required calculations and supporting documents, were again discussed by the Assessment Committee. The result of that assessment was that all student teams, which were allowed to enter the previous subphase, should have taken part in the next subphase.

This subphase included the finalization of the detailed technical documentation. In addition, as a supporting document, a multimedia presentation had to be prepared to make it easier for the Assessment Committee to select the three winners and the overall winner of the contest.

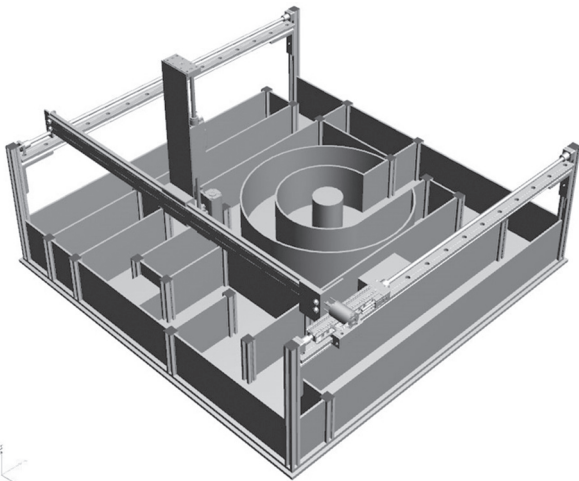


Fig. 2. Second phase - CAD model

Each team had to present their development in front of the Committee (Fig. 3). Based on the final presentation, the Assessment Committee decided on the three winning projects and declared the overall winner. In addition to these winning projects, three other projects were selected as successful. The best student teams received gift packs from company representatives.



Fig. 3. Third phase - presentation

4. PRESENTATION OF THE RESULTS

In this chapter, first we present the winners of the contest. Following that, all other projects, which were selected as successful, are presented as well. The presentation includes a rendered image of the developed mechatronic device. The description is completed by a short explanation of the functionality of the device.

4.1. WINNING PROJECT No. 1

The first winner is presented in Fig. 4 and Fig. 5 [18]. The student team named it the "Cube mover". The developed device is an automated one. It can operate autonomously and continuously. To the visitor who visits the exhibition booth, it feels like the machine is working randomly, due to the complexity of the motions. The motions are pre-programmed. The machine is capable of moving several cubes from one stand to the other, one by one, in an impressive way. All cubes have printed letters on each side. The proper combination of the cubes prints out the name of the company. The device first moves the cubes into the flat area. During this phase, the device combines linear and rotational movements. In the second phase, it positions the cube to the empty stand by combining a set of linear movements. The positioning phase is finished when all cubes are positioned correctly on the other stand. After that, the whole process is repeated over again.

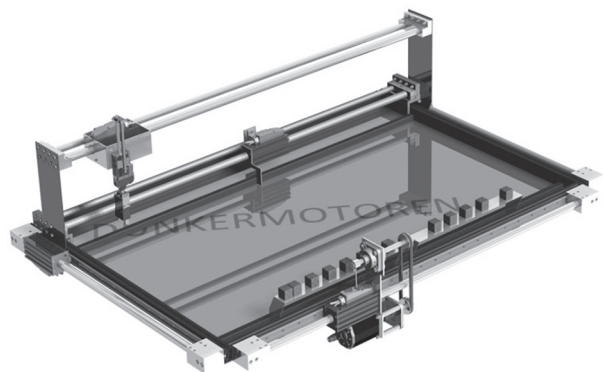


Fig. 4. Winning project No. 1

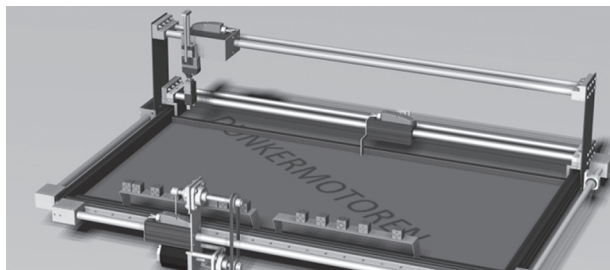


Fig. 5. Winning project No. 1

4.2. WINNING PROJECT No 2

The second winner is presented in Fig. 6 and Fig. 7 [15]. The student team named it the "Mosaic". The developed device can work in fully automated mode without interruptions. To the visitor who visits the

exhibition booth, it feels like the machine is working randomly, due to the complexity of the motions. The movements are pre-programmed. The cycle of the device ends when the desired image, which is divided into 16 quadrilateral surfaces, is set properly. The device is capable of moving the quadrilateral surfaces along three axes. The surfaces can also be rotated around the vertical axis. After the cycle ends, the surfaces are mixed up, and the whole process is repeated.

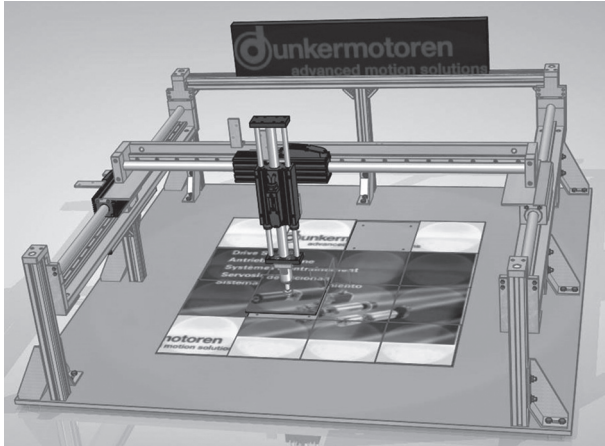


Fig. 6. Winning project No. 2

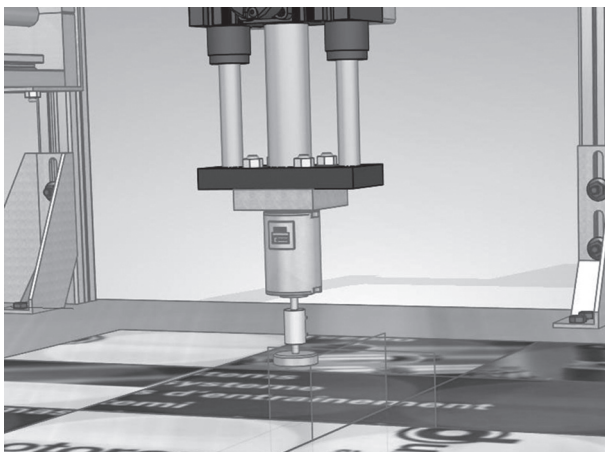


Fig. 7. Winning project No. 2

4.3. WINNING PROJECT No. 3 – THE OVERALL WINNER

The overall winner is presented in Fig. 8 and Fig. 9 [19]. The student team named it “Ball shootout”. The developed device can work in a fully automated mode without interruptions or in a semi-automated mode allowing the visitor to interact with it. To the visitor who visits the exhibition booth, it presents a possibility to interact with the device and to win a ball, which is a souvenir with the company logo.

The developed device is a flat surface, which is tilted from the horizontal position like a pinball table. It has a launching mechanism, which can swing left and right and is able to shoot out the ball when the visitor presses the “Fire” button. The visitor wins the ball if the ball reaches the opposite end of the device. Two moving

subassemblies, which are moving from left to right (the movements are both linear and rotational), represent the obstacles, which try to stop the ball reaching the opposite end of the device. The balls are fed automatically into the launching mechanism.

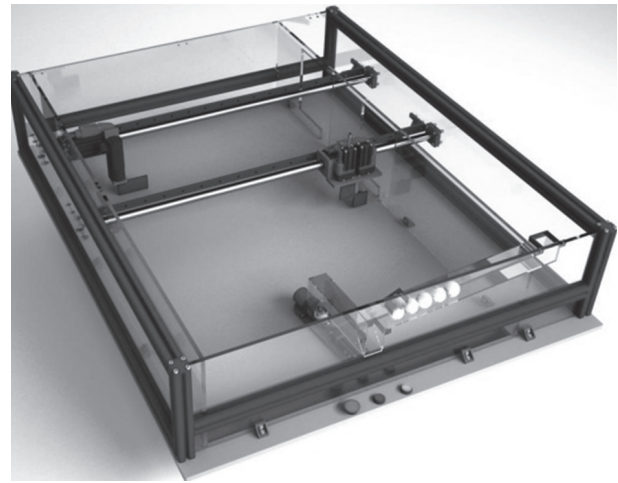


Fig. 8. The overall winner

4.4. SUCCESSFUL PROJECT No. 4

This project is the first that was rated as successful. It is presented in Fig. 10 and Fig. 11 [20]. The student team named it “Hit it”. The visitor who visits the exhibition booth is able to interact with the device and test his/her reflexes against the device.

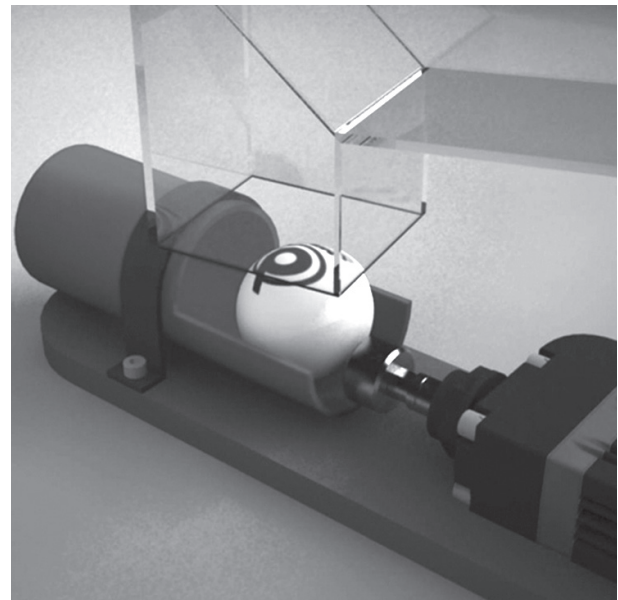


Fig. 9. The overall winner

The developed device has a paired matrix of dummies. Pairing is done by connecting the two dummies by levers. If a visitor hits a dummy by his/her hand, the device reacts immediately by hitting the dummy back to its initial position using a hammer-like mechanism. When the dummy is in its original position, the device waits for the visitor to hit another one. The visitor has the possibility of hitting more dummies at the same time.

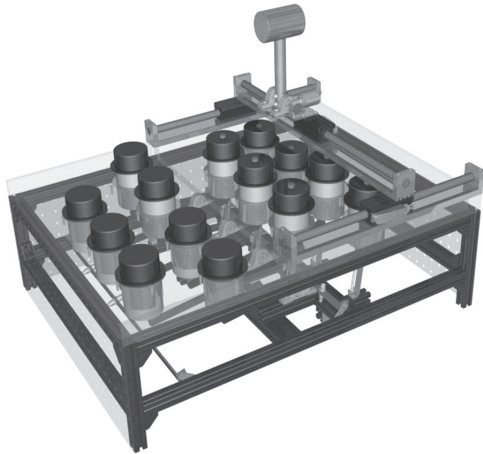


Fig. 10. Successful project No. 4

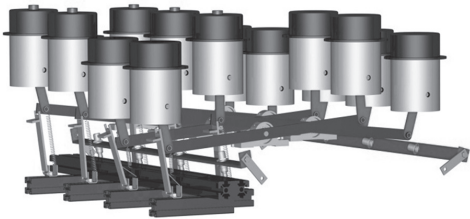


Fig. 11. Successful project No. 4

4.5. SUCCESSFUL PROJECT No. 5

This project is the second one that was rated as successful. It is presented in Fig. 12 and Fig. 13 [21]. The student team named it "Win me a gift". The visitor who visits the exhibition booth is able to interact with the device and test his/her skills by possibly winning a gift.

The developed device is similar to devices that can usually be found at amusement parks. Basically, it is a box filled with different gifts. The visitor has the possibility of lifting one of the gifts. The visitor is allowed to control the movement of the hook. The aggravating factor is the continuously rotating bottom of the container, which consists of three concentrically positioned rings. The rings rotate at different angular velocities around the vertical axis.

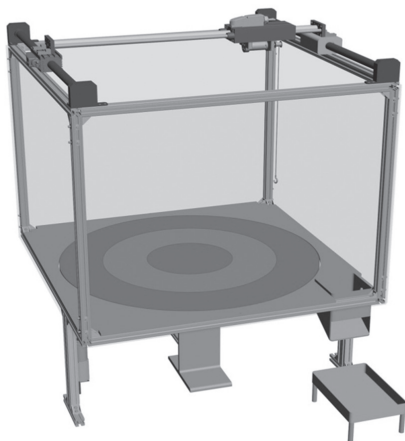


Fig. 12. Successful project No. 5

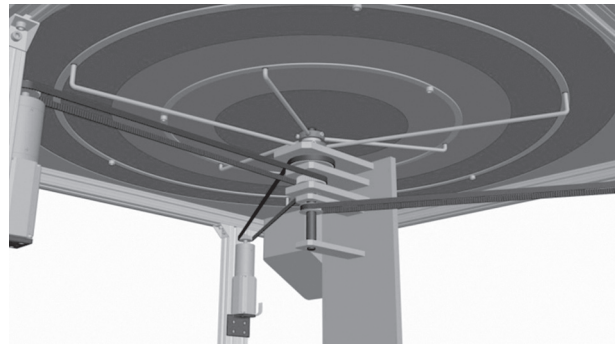


Fig. 13. Successful project No. 5

4.6. SUCCESSFUL PROJECT No. 6

This project is the last one that was rated as successful. It is presented in Fig. 14 [16]. The student team named it "Find a way out". The visitor who visits the exhibition booth is not able to interact with the device, but the device works continuously. By watching the movements of the device, the visitor has an insight into the possibilities of the drives. The device is pre-programmed to drive the pointing head next to pre-defined barriers built in 3D. The drive is made of linear and rotational components.

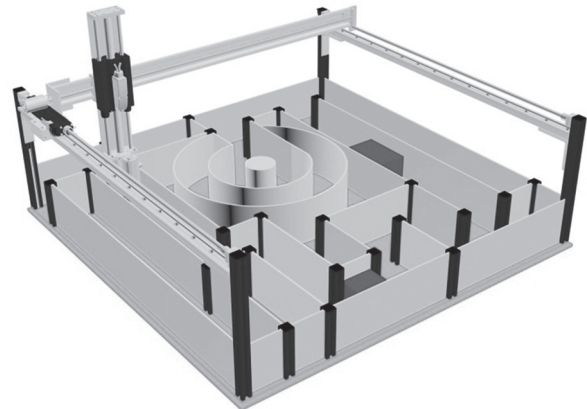


Fig. 14. Successful project No. 6

5. CONCLUSION

Fairs attract a lot of visitors, who are potential customers. Therefore, companies are forced to exhibit at fairs. For companies, the main purpose of exhibiting lies in the possibility of reaching as many customers as possible, not just to be at a fair. To be able to reach potential customers, companies have to stand out from the crowd to be able to grab the attention of visitors walking past their stands.

For successful realization of the set objective, companies try to arrange their stands cleverly by putting up a theme, show promotion or some kind of competition or other way of interaction that will help open conversation and entice people to the stand.

By taking into account the above mentioned facts, Dunkermotoren GmbH decided on the development

and production of a mechatronic device, which will attract possible customers by promoting the characteristics and possibilities of the company's product portfolio. The mechatronic device was designed and a working prototype was going to be manufactured at Subotica Tech.

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