

# Interactive parkourelement for “Robots Unite”

David Kroginski  
Nuernberg Institute of Technology -  
Georg Simon Ohm  
Nuremberg, Germany  
kroginskida87346@th-nuernberg.de

**Abstract**—*This technical paper shows the work, which has been done by two students of electrical engineering during a student project, supervised by one professor. This will be about the process from planning to construction, the problems faced during the project and how an enrichment for “Robots Unite” is build.*

**Keywords**—*robots, tournament*

## I. INTRODUCTION

It exists a mayor number of tournaments, where teams are building complex robots and then competing against each other. For a student it is often very difficult to get started, even if they are very interested in robotics. The problems are that often the robots get very expensive, even by building and programming it by themselves. Also, it is hard to start, if they are new and do not get help, especially during the beginning phase. For that reason, our professor started the tournament “Robots Unite”. In this tournament students from schools are making a team and building their own robots. Because of the regulations, the robots are smaller and cheaper, this is why this tournament is more affordable. Also, our University, the TH Nuremberg, is in contact with the participating school in the region. That is a big advantage for the students, because there are in contact with a university and the professors, what can be helpful for developing their own robots. With that everything the hurdle to start robotic is much smaller and the students have a great opportunity to enhance their skills. At the moment, the robots are fighting, by getting through a static parkour as fast as possible. The wish of the organizer is, that the robots have to work together, so even during the development of the robots communication between the team is needed. For that we want to develop an interactive parkour element, that one robot alone cannot get through alone. With some interactive parkour elements, the tournament can get more exciting and versatile. For the parkour elements, it must be built in a way, that the students can easily rebuilt it by themselves, improve it and add more features.

## II. PROJECT DESCRIPTION

The project is an addition for the tournament “Robots Unite”. Therefor we wanted, that our parkour element is fitting to the rest of the parkour and tournament. We visited the finals in Nuremberg to get a feeling for the spirit of the tournament. The students are working in their teams together to be sure that everything is working. They are making adjustments to the robots, so it fits better the parkour, which is set up for the day. Testing the software, so they can control the robot wirelessly and make sure it is dependable. Every team has their supervisor helping them with his knowledge and experience. The communication between the different teams was hold at a minimum because they are competing against each other. The organizer wants to change it. Changing the tournament, a bit, so at least two teams have to work together, to be able to finish the whole parkour in the given time limit. We watch the finals and get some ideas for our interactive parkour element, which we started planning for afterwards. Everything will be well documented, so it is easy to rebuild, and very easy to operate, so at the tournament everyone can set it up. For our project we

had four main phases. Getting ideas and planning everything, building the construction, programming, and documentation.



Figure 1 Finished parkour element

### A. Idea and planing

At the beginning of the project, we were collecting ideas. The base idea of the tournament is to build a rescue robot, which can get to hard to reach places and make something. So, the main function of our parkour element will be a box with two sliding doors on the opposite sides, which are electrically powered by an electric dc motor. The robots will have to do something to be able to open it. Next to the doors will be push button, which has to be used by the robots in order to open the door. We wanted to make it more versatile, consequently we thought of more than one mode. The box is getting a single and a team mode, but also three puzzles. For the difficulty we planned multiple stages. The First stage is, what we are building, with the push buttons for the robots to operate. A possible next stage could be a circuit braker or a ball valve to operate, to make the situation a bit more realistic. This can be done by the next group working on this project, but before this, the first stage has to be tested on the next event. Afterwards we planned the whole construction of the parkour element. The next planning phase was about the electrical hardware and what are we using to control everything. There were two possibilities, a microcontroller, or a plc. We decided for the plc because it is more robust and is more reliable. This was for us particularly important, so that the parkour won't cause any trouble during the tournament. Also plans for the wiring were made, with details like relays and fuses. The last step in the planning phase was, how are we making the hardware stuff safe, that if the plc is programmed wrong, or an error occurs, nothing gets destroyed. For that we designed a relay logic, which prevents a short circuit by wrong operation of the electric motors. Not only we thought about the hardware safety, but also about the safety for the builder and operator.

We tried to make it as safe as possible, especially about what happens if something or someone is in the door movement.

### B. Construction

We had a maximum space given, in which we had to realize everything, the mechanic and the hardware. We thought about, how to build it in a way that it will be easy to rebuild. In this phase we learned how quickly the plans can change, because what we thought was not possible to realize. We build it with 15mm OSB wood to make it strong enough, so nothing happens if the robot is driving against it. This material is also rather simple to process. For greater stability and easier assembly, we made a plug system. We have a two-layer design. A lower layer for the robot to operate and a second layer on top of the first layer for the human to operate and where the electrical hardware is placed.

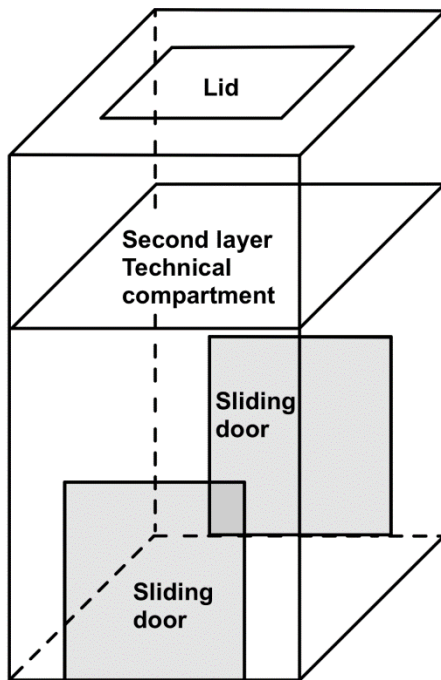


Figure 2 Sketch of the layout for construction

### C. Programming

All functions need to be programmed. Because we use a plc, we must use their software. We use a Siemens LOGO as our plc, so we used “Siemens LOGO! Soft Comfort”. In this program the functions are programmed in a graphical way with logic gates. In this way no prior programming knowledge is needed. Simple functions are very easy to implement. If a

function is complex, it needs a bit of logical understanding to realize it. An advantage of the program is, that the functions can be simulated and tested. In our stage the program covers five different functions, which can be used for training or in the tournament. By our program, which will be well documented we want to give a good base for future improvements by the students or the next team.

### D. Documentation

For us it is not only important that our parkour element is working, but also that it can be used by everyone in the community. For that, a very good documentation is important. We want to make an article on GitHub, where everything can be found. There will be the plans for the wooden construction for the box, the hardware used and how to wire everything up, and the program. An advantage of the plc is, that if the program is available, it can be loaded on a micro-SD card and the plc flashes from it. With that everything the first startup can be done by everyone. With all the documentation the next group can adapt their ideas for a stage two. By making it public, everyone of the community can help and share their ideas for new functions. Also, we will give advises how to plan everything when it will be rebuilt. The documentation will be hold at the most current state. In the elements itself, the technical compartment will be labeled in a way, so for putting it in operation no extra directions will be needed.

## III. CONCLUSION

The project is not one of the demanding from the technical site, but it still was challenging to complete. We learned how to start a project and plan everything, even when the plans have to be revised during the process of construction and programming. We will be happy when we will see it in use in the next event of “Robots Unite”. We gave our best, but we found details that can be done better at the next version, which will be updated in the documentation. Hopefully, our work will be valued by the community and maybe we will see our parkour element be used somewhere over the world.

## IV. ACKNOWLEDGMENT

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