



POLYTECH

Peter the Great
St. Petersburg Polytechnic
University



Leibniz
Universität
Hannover

Leibniz Universität Hannover International Office

International Design Project

in Strategic Partnership with St. Petersburg Polytechnic University

Magic Surfer Game

by

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1 Project overview

The international Design Project is an international, collaborative project involving Engineering students from Leibniz University Hannover. The purpose is to realize a technical idea from scratch, experience work in an international team, visit one of the most beautiful cities in Europe, and work with students from Peter the Great St. Petersburg Polytechnic University.

During the project, students from both universities work in interdisciplinary teams to develop a concept for the design and manufacture of a new product. They get input and support from specialists in St. Petersburg and Hannover.

The first part of the project took place in Fab Lab in St. Petersburg from 4-11 April. During their stay in St. Petersburg, the participants from both Germany and Russia developed a product concept and planned a detailed design. In the following two months, the students then planned the remaining development, production and programming of the prototype through self-organized video conferences and e-mails. In June 2016, the Russian participants came to Hanover in order to assemble and test the prototype. The presentation of the project results took place in Hannover in June 2016.

2 Team and Concept

2.1 Our Team

Our team consisted of six students, three from Hanover and three from St.Petersburg. As seen in the picture (left to right), we are Christoph Kremsier (Mechatronics/Hanover), Tan Tan (Mechanical Engineering/Hanover), Alexander OPOCHANSKY (Mechatronics/St.Petersburg), Stefanie Lohse (Mechanical Engineering/Hanover), Dainis Dzenusko (Mechanical Engineering/St.Petersburg), and Garifulina Dinara Rifovna (Technical Design/St.Petersburg).



2.2 The Concept

The concept phase started right after our introductory meeting. Each group member was tasked with developing a sketch of an idea which would be possible to build in FabLab. In the first video conference on Skype, the group got a chance to meet each other and discuss the developed ideas. Owing to the short timeframe, we had to decide which idea would fit our group the best and plan any details we would need for FabLab within two weeks.

In order to coordinate the project and stay in touch we set up a Facebook group. That turned out to be the best communication base for the whole project.

2.2.1 The Technical Concept

Our idea of using magnetism to combine technical issues and having fun with our prototype lead us to the magic surfer game. Basically, it consists of two systems. A surfer figure with a metal ball in its base has to be moved on a plate by a hidden X/Y-plotter with a magnet underneath the plate. The surfer figure will follow the position of the magnet on the endeffector of the X/Y-plotter. The motors for moving the endeffector will be controlled by a joystick which is placed outside the box.

The magic game can be used in different ways. First of all, the obstacles can be placed and then a certain trajectory on the plate can be chosen, and someone can measure the time a player needs to finish the run without hitting an obstacle. As an add-on, the box should be able to recognize the surfer and obstacle positions and should move the surfer on a certain trajectory by itself.



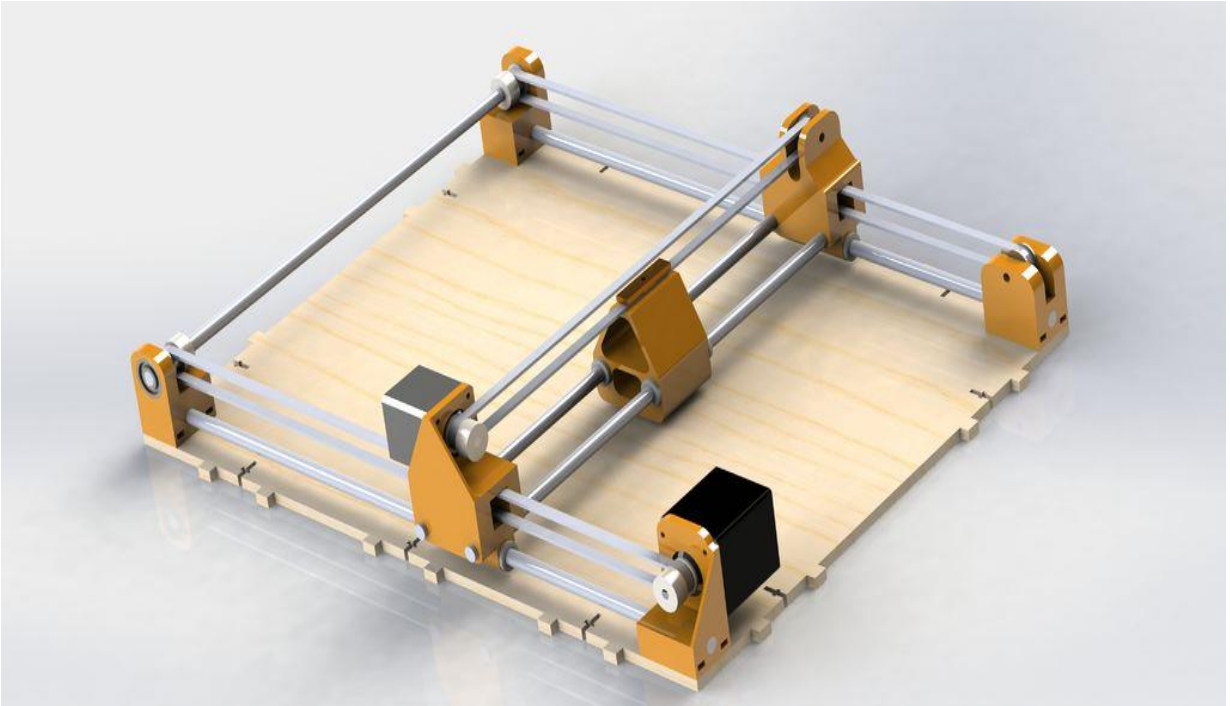
2.2.2 How to build the surfer in Fab Lab

Steps:

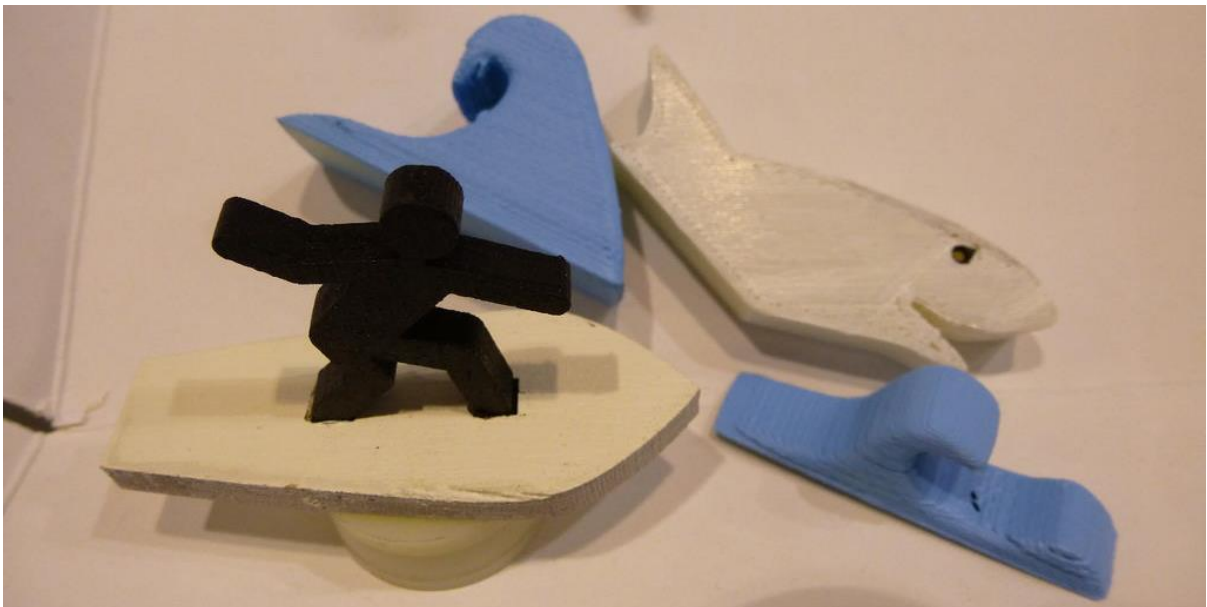
- develop the operating principles
- design a 3D-model to show the mechanics and schema of electronics
- write BOM
- manufacture body from plywood on CNC machines
- print other parts on 3D printer
- assemble
- make electric circuit
- program controller
- solve problems, optimize and debug

After we came up with the idea and main concept we had to think about its realization. The model of every part in mechanism was done with a CAD program (Solid Works). We used a CNC milling machine to manufacture the surfer's body out of plywood. Other parts were printed on a 3D-printer with ABS plastic. To assemble the XY coordinate system we used steel rods. In order to move the end effector we placed two stepper motors which are controlled by L6474 driver. We decided to use the magnetic force to connect our surfer figure with the end effector. That's why we used a metal ball inside the surfer and put magnet on end effector. For low friction we choose caprolon as the main material to make sure that the ball is rolling inside.

The whole system will be controlled by stm32 microcontroller (MCU). It gets an analog signal from the joystick and sets signals to move the stepper motors. Also MCU can be tuned to accept signals from a computer. As a Computer, we used a Raspberry Pi 3, which can observe and detect the surfer figure and the obstacles by a webcam and openCV software. The MCU and drivers were kindly provided by STmicroelectronics Company.



It took about 8 days of work in FabLab in Saint-Petersburg and 2 days in Hanover to finish the project.



Result:

We made a good working project, which was successfully presented. It was introduced on technical exhibition Geek Picnic in Saint-Petersburg. We took a very valuable experience in working with an international team, improved our language skills, acquainted with the culture of Russia and Germany and of course had a good time.

3 Organization and Preparing

The trip to St. Petersburg has to be planned some weeks before departure from Germany. There are several things we had to focus on. First of all, the communication platform between German and Russian students should be available for both sides anytime, e.g. we used Skype for explaining difficult problems and making fast decisions. Furthermore we needed an online storage program like Dropbox to share data files. In order to finish our project on time, we started to discuss about materials that will be needed in St. Petersburg early and asked the Russian students which materials will be available in the FabLab. It would have been helpful to see their facility, machine workshop and materials to be prepared for special tasks.

Technical preparation and planning is a huge topic. However, we had to organize our trip to St. Petersburg. Due to the fact that we needed a visa for entering Russia, we got information by the International Office how to apply for a Russian visa. To receive a Russian visa there are several official documents required. We needed an international passport, an invitation by an official constitution as the university and a fixed start and end date of our visit in Russia. Therefore, we started searching for flights and applying for an international passport as early as possible. Most of us have chosen a direct and cheap flight from Hamburg to St. Petersburg with Aeroflot. Furthermore, one of us booked a flight to Moskau to visit a second city and arrived with us on the same day in St. Petersburg.

After collecting all required documents, there are two important steps on the way to get a Russian visa. First of all, we had to sign in the official Russian embassy website which is written down in the presentation by Natalia Butych. During the registration process, we had to decide if we are going to apply for the visa at the embassy or at the visa centrum in Hamburg. We tried both opportunities with different results. At the embassy we paid more for the visa than at the visa centrum which we did not expect because it is a private organization. Additionally, the embassy won't send any documents, so that we had to drive to Hamburg twice.

4 St. Petersburg

4.1 Housing

When we arrived at the Pulkovo Airport in St. Petersburg, our Russian adviser organized a shuttle that brought us right to the place where we were supposed to live for our stay. It was a student hostel but the occupants only spoke Russian so without a translator we could only guess what they wanted to tell us by reading their gestures. The language barrier was a big problem from that on because the owners almost came to us almost every morning and tried to tell us something we could not understand. Our group of students got separated into males and females and they also separated our three Asian students from us.

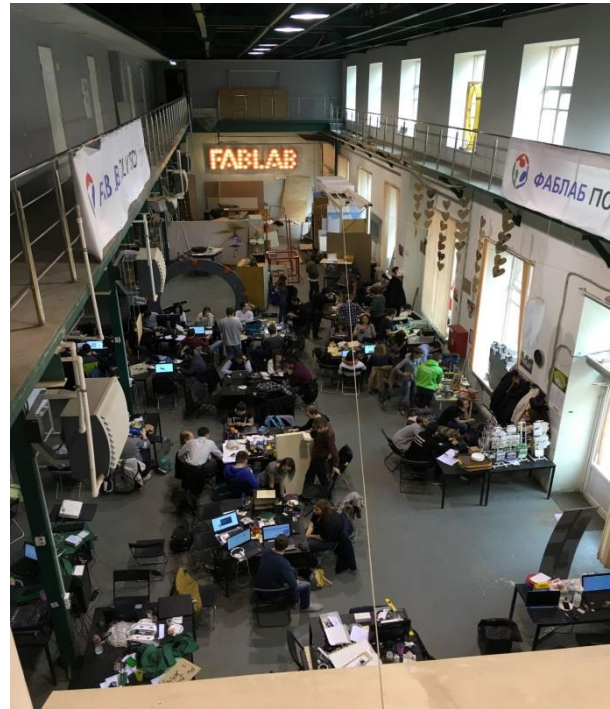
The housing itself was fair. The rooms were very dusty but we could adjust to it for the week we stayed there. We shared a bathroom with maximum six people and also had the opportunity to use a kitchen. At the end we had to pay a fee which was around 4000 rubles. We could not pay by credit card and we had to bring the exact amount of money in cash. The reason was a vending machine which was responsible for the payment and only accepted cash. Again we had problems using it because you could not select a different language than Russian.

But an advantage of the hostel was its location. We were able to reach the university, the subway station and supermarkets/restaurants/pharmacy/bank etc. within a maximum 10 min. walk.

4.2 University (FabLab)

Every morning we started our day with a walk to the FabLab and started working at around 9:30am. The Russians were very hospitable and offered us coffee, tea and some biscuits every day. Right from the beginning a clear schedule was set and we were able to take part in tutorials and workshops every day. It was well organized so we did not work for our project the whole time. For Lunch break we walked over to the university cafeteria where we had an extra room and they served a warm meal for us. The meal always consisted of a typical Russian soup, a salad and a schnitzel with pasta which we got tired of after eating it for the third time.

The working atmosphere was a little hectic. The FabLab is a very loud place when all the machines are running and it is full of people. It was hard to find the things you needed to work with if you did not know the laboratory. But it was still fun to learn new technical vocabulary and to get the possibility to use the machines and built all by yourself. It is sad that we could only work on mechanics in St. Petersburg and not in Hanover, when the Russians came to visit.



Although it got a little stressful in the last days when everyone was trying to get their project running for the final presentation, the Russian students always spread out a good will and tried to keep a happy atmosphere by for example playing good music etc. The whole time they were very helpful and hospitable.

Some bad ideas were the dancing workshop and the videos we very supposed to film. No one of our group was interested or motivated to do it but some other groups had fun doing it instead of finishing their project. Another problem was the hygiene in the bathroom. The toilet was terribly dirty so we decided to use the ones in the university building.

In the evening we finished our work at around 6pm and usually walked over to the subway station directly to drive into the city.

After the week of working in the FabLab we were supposed to present our project in the new built conference hall of the university. It was nice to see what every group came up with in only one week of work. Again we experienced the great hospitality when they gave us some self-made lasercut pins with the logo of FabLab as a present and a precious certificate that proofs our work in St. Petersburg.

4.3 After work – free time

We were overwhelmed by the Russian motivation to show us their city and im-molate their whole free time to just spend time with us. After working in the FabLab we often went to a restaurant or bar, had dinner together and played some Russian games they taught us. We were surprised that you get very good food for a small amount of money which is very different to Germany. That is the reason why we test-ed a Steak House one night (called “Stroganoff Steak House”) and were just stunned by the meat they served and the price we paid in the end. Another Restaurant we can recommend is the “market place” where the cook prepared exquisite dishes right in front of us and we were able to find a table for the whole group. Of course the drinks were also very cheap.

In addition to that the Russian students offered us to show us the city of St. Peters-burg. One afternoon they organized a tour and one of them did the tour guide to ex-plain us the main details. We also liked that we had the Thursday off to visit the Her-mitage Museum which is very popular and it was a great experience to have a look inside the enormous “winter palace”. Afterwards we climbed up on a high church spire which gave us a great panoramic view of the city. The whole time we were lucky with the weather that gave us the opportunity to do all the sight-seeing. Another day the Russian students took us to a miniature museum called “Grand Market” where we saw the whole Russian country built up in separated sections in a small dimension. We can also recommend driving into the city at night and walking by the Newa or across those beautiful bridges. You get an incredible and different impres-sion of the city which just convinced us with its beauty and versatility.



Last but not least we were impressed by the Russian subway. First of all the stations are built very deep into the ground. It is hard to imagine but it needs you about 3-4 minutes to go down with the escalator and sometimes another 2-3 minutes to get to

the platform where your train is leaving from. We took this picture from the top of the escalator to prove that you cannot see the end or where you are going. Secondly the Russian subways are very punctual so you just have to wait up to 4 minutes until the next train is coming. We also experienced what people had said before: Rus-



sians use everything as long as possible – so they use the subways until they break we guessed because some of them have been very old and loud already.

5 Hannover

5.1 Accommodation and organization

To get to Hannover we used two: one group used a route Saint Petersburg to Moscow – plane to Düsseldorf – train to Hannover, others flew to Munich, then to Hannover. The driver, provided from LUH, met us in the airport and drove us to a hotel. The hotel was really nice, every room has its own shower room. There was free internet access, but it was not working at some time, however it was the only problem. Housekeeper gave us keys from main door, and we were able to come or leave hotel at any time.

On first day, we came to an organization meeting. There we met our teammates again, listened a very interesting lecture from Nataliya about difference in mentality in German and Russian peoples. They gave us some money for subsistence.

We started on weekends, that's why student canteen didn't work. Germans were very friendly and suggested us a self-made lunch. Also we ate in the canteen, and found meal very delicious.

5.2 Working process and presentations

We worked in other building, which was in 10 minutes of walking. There was spacious classroom with computers. German students and professors were kind to give us a short tour on university labs and told about actual projects. We took projects and most of necessary equipment from Russia, but some machines, for example 3D-printer, were available for us in LUH's labs. We have done larger half of our project in Russia, so it left only to assemble and program it.

Third day was for presentation. It took place in a nice conference hall, equipped with a projector and audio system. The process of presentation was filmed. It took about two hours to show result of each group. Everyone in our team told about his own part. Everyone in project did his best and results was great.

5.3 Free time

Our friends showed us other university buildings, including the large tower in city center. It was very nice view. After presentation we wen to café, we discussed results and talk about everything. At the evening we walked in park, played some active games like “Ali-Baba”, the goal of this



game is to break a chain of opponents, rules like in “Red Rover” game.

We had a lot of fun, done interesting work and left only good memories about this program.

6 Resume

The most important point to note is that the project experience is very positive and beneficial to participating students. Any changes should avoid interfering with those aspects of the scheme which already function well.

The weakness we have noted need to be considered in the context of a relatively new scheme that is still evolving and we hope that our suggested improvements are considered in that context.

We think it would be helpful to have a clearer application procedure and timeframe. This would likely speed up the process and allow more time for logistical matters to be organised and coordinated.

We would also like to clarify that when we suggest improving organisation and coordination, we are referring to the overall scheme, not the individual student projects. The fact that we had to think about the most convenient and effective way to communicate with each other (i.e. Skype and a Facebook group), is actually part of the essential skills we learned. Therefore, we believe it is important that if greater assistance is provided to the students, it should focus on the logistics of travel to/from Russia etc, and not upon the coordination and execution of the team's project, which should remain the student's problem to solve.