Project: Remote Control System
for E-skateboard

Stuttgart University
Institute Of Electrical Energy Conversion (iew)

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I was really excited when I was chosen to be one of the five students who could participate the SUPER program in Stuttgart University. While I had never been to Germany before, I always heard that Germany was a country with high level of industrial technology. So I always want to visit Germany and have a look. And SUPER program gave me the chance to make my dream true. In Stuttgart University, I was assigned to the Institute of electrical energy conversion (iew), which focus on high torque electrical machine and conductive charge system. My job there was to develop a control system for an electrical skateboard. So my project was more inclined to product development. And iew, which was my host institute, was my customer.

In this project, the goal is to design a remote control system for the electrical-drive skateboard for institute of electrical energy conversion. Rather than a research program, this project is about product development. The remote control system was required to be able to control the movement of the electrical-drive skateboard, and be easy for user to operate. The main body of the remote control system was designed to be a joy stick controller, which was easy for the user to interact with the skateboard. To create the connection between the controller and the skateboard, two HC-05 Bluetooth modules were attached two Arduino board. By programing the Arduino boards using the IDE software, signals could transfer from the controller to the skateboard. There were two main problems. The first one was to figure out how to send multiple data at single time through serial communication. The Bluetooth modules used serial communication to transfer data, which means only single data can be transferred each time. However the joystick controller generated two data each time which were X axis and Y axis. To solve this problem, the two data were combined into one single data so that they can be transferred at the same time. The second problem was to find a way to make the system easier and more fun for the user to interact with. To achieve this goal, a little OLED screen was added to the controller which can give the user clear feedback by its display. The final result met all the requirements and performed better than the customer expected. However due to the short period of develop time, some features which could improve the system were not added, such as the battery percentage indicator, the security identification to the system, and the connection check between the skateboard and the controller. As conclusion, the remote control system was successfully developed and fully functional.

The most interesting part of my project was to improve the system to let the user have a better experience. To achieve this goal, the idea was generated which was to add a screen to the remote control. By adding a user interface display, the interaction between user and the system would not only complete by manual aspect, but also by visual aspect, which was the most effective way to improve the using experience of a product. Then it came to the VI design phase. The library used to programing the VI was ‘U8glib’, which has functions to set the font of the string, draw the shapes to make the interactive interface. The main code could be found in the appendix with
There were designed to be 2 part of the VI. The first part was the star interface, which would only display once after power on. The first thing to display was the name of the institute which was owner of the electrical-drive skateboard. This could emphasize that it is iew which possess the technic from this skateboard.

Figure 1. Interface displays the name of the institute

The next content to show to the user was designed to be the name of the product, which could gave user the first impression of the product and make user remember the name of the product in mind.

Figure 2. Interface displays the name of the product

Then last content to display in the starting phase was simply a “Welcome”, which could make the user feel more excited and comfortable to continue to the product experiencing phase.

Figure 3. Interface displays a simple “Welcome”

In Beta 1.0 the user interface was designed as a circle indicator following the position change of the joystick. Although the circle follow the position of the joystick quite precise, it kept shaking when the joystick at the origin due to the error. Besides this, the interface appeared to be meaningless since it just shown the position of the joystick, which can directly observed just by looking or feeling the joystick itself. So
the interface needed an improvement.

![Image of User Interface Beta 1.0]

**Figure 4. User interface Beta 1.0**

In Beta 2.0, significant changes were made to the user interface. For the Y axis of the joystick which controlled the input of the power, a power percent bar indicator was put in the middle, which could send the feedback of the power input. Also a numerical indicator was put under the power bar, which could show exactly the numeric percent of the power input. For the X axis which controlled the direction input, two arrow indicators were put on each side of the power bar. The arrow indicator would change length by the change of the X axis input. And the shanking bug was also fixed by around the number near the origin to the origin value.

![Image of User Interface Beta 2.0]

**Figure 5. User interface Bate 2.0**

When it came to final version, the objective was to improve the user experience in a way with more fun. So the concept of mode change was generated. By adding another operation mode, the user would acquire a new experience with more excitement and fun. So the new mode was named “Sport Mode”, which would make the skateboard more sensitive and faster. And the origin mode was name as “Entry Mode”, which was for new users to get familiar with the controls. The design of the Sport Mode interface was more dynamic, the power input indicator was changed to a huge circle which indicated more power. And the direction indicator was changed to
sharp triangle which looked more aggressive. The original design of the logic to switch between modes was to call out a menu and then to choose mode, which was tedious for the user to switch especially during the skateboard moving. This might cause safety problem. So the mode switch mechanism was then designed by simply hit the button of the joystick, which was easy and convenient.

![Figure 6. Sport Mode interface](image)

The 3-month life in Germany was really fantastic. Stuttgart was indeed a really wonderful city in my mind. It was tidy everywhere; its transportation was so convenient (the U Bahn and the S Bahn); and the people in Germany were very friendly. I visited many places in Germany, which were all fabulous, such as the Munich, the Nueschwanstein, and the Hohenschwanstein...... Although those places were really beautiful and definitely worth a visiting, the most impressing place to me were still the industrial museums. I was totally lost myself in the Mercedes Museum and factory tour, there were so many histories about engineering, and there were so many masterpieces of vehicle. If I could, I would go there as many times as possible. Here are some photos I took in Germany.

![The first car’s patent.](image)
The fancy cars in Mercedes Museum.

I saw him in a Zoo in Stuttgart.
The Neuschwanstein, if you want to visit inside, you need to reserve the ticket before or else you will wait in an infinite line to get the ticket.

The beautiful churches in Germany.
A cool small alley~

Us and our welcome Buddy~
Best steak I ever had in restaurant [m]eatery

My favorite local food—Schweinshaxe, which is roasted pork ankle with sour vegetable.

So according to all these wonderful experiences, I definitely recommend this great program which offers a chance to visit Germany. There you will have a good chance to do a research; you will have wonderful time visit the whole Europe; you will be able to meet good friends. I really love this program! Join SUPER, become super!