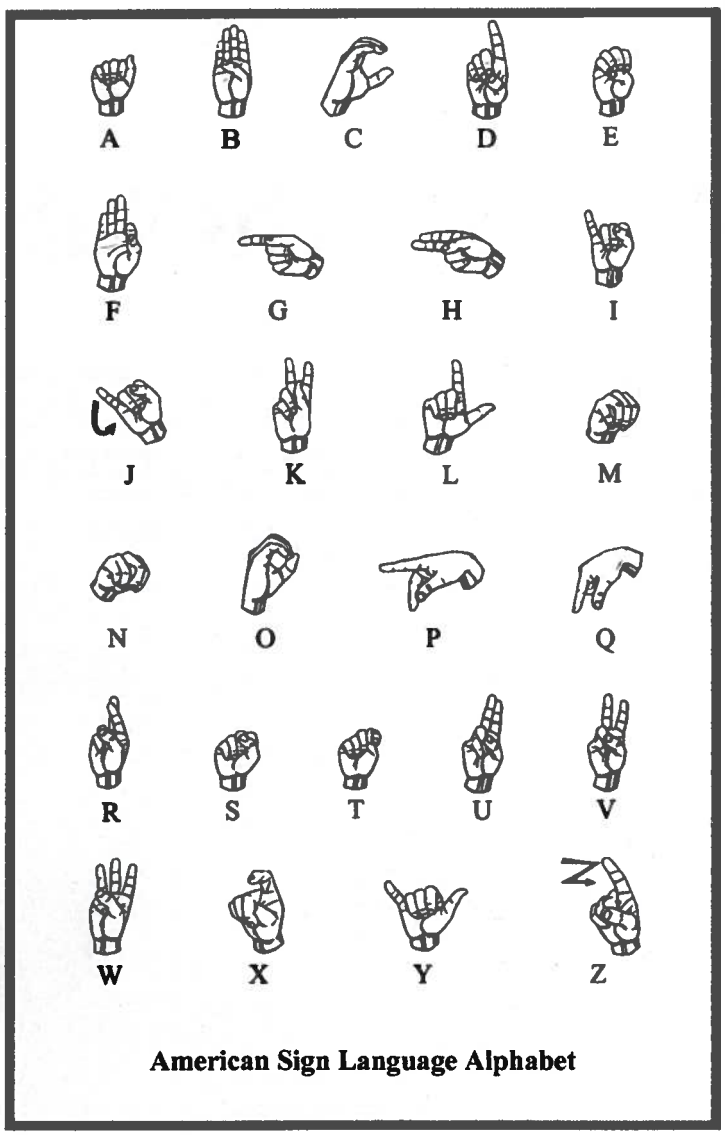
SLANG — Sign Language Assistance and Navigation Glove



American Sign Language Alphabet

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By Ionut-Gabriel Farcas and Radu-Florin Florea

The need for communication is always increasing. Although communication and socializing through spoken and written language are the most commonly used methods, the need for other means — such as signs or visual elements — has caught up and people are adapting and finding new ways of "talking" to each other.

So what could we students at the Faculty of Automation and Computer Science from the Technical University of Cluj-Napoca do to aid in this new trend? SLANG!

The idea for SLANG — Sign Language Assistance and Navigation Glove — came to us when we were handed the sign language alphabet while we were enjoying a cup of coffee with some friends at a local restaurant.

We took a look at it and thought "This is possible! We can make a glove that can translate these signs into letters that anyone can read and understand!" Before taking any action, we decided to complicate it and make it a universal controller.

We knew this would be a challenge for us; a test of our engineering skills. After clearly defining our idea, we presented our idea to Digilent Romania and entered their 2012 Design Contest.

Digilent provided us with the crucial items: a Cerebot MX4cK board (Microchip 32-bit PIC); Cerebot Nano board (Atmel eight-bit ATMega168 microcontroller); accelerometer Pmod; gyroscope Pmod; and two 2.4 GHz RF Pmods.

We used the Cerebot Nano as the control board on the glove, which transmitted all of the information obtained from the sensors on the glove to the Cerebot MX4cK board. This was connected to a computer and used for displaying the interpreted results.

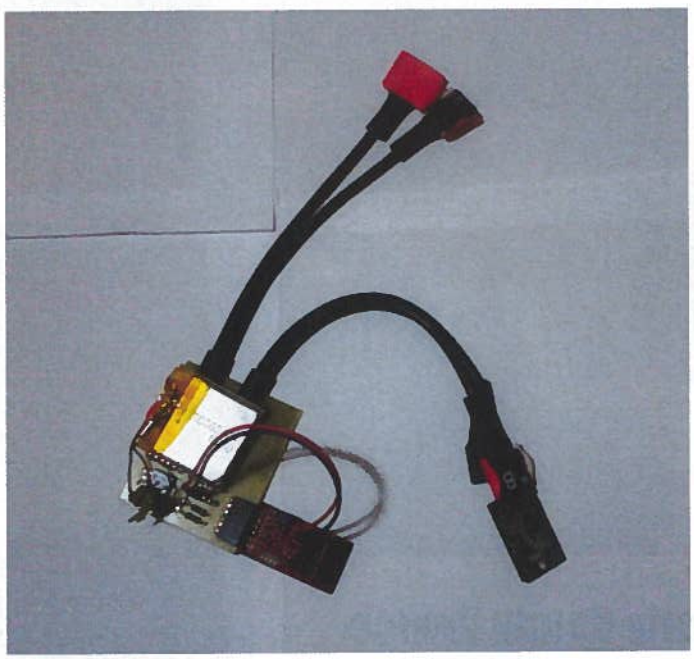
We needed some sort of board to distribute power and to connect all of the sensors to the Cerebot Nano, so we designed a small board in EagleCAD containing a 3.3V voltage regulator, several capacitors and resistors, and — of course — a battery. The gloves were bought at a bike shop (no knitting required).

So, how could we translate hand gestures into readable letters? The idea was to mount the accelerometer and gyroscope — better known as an IMU (Inertia Measuring Unit) — on the back of the glove to obtain the hand's position, and then read the position of each finger. Sounds simple enough, right?

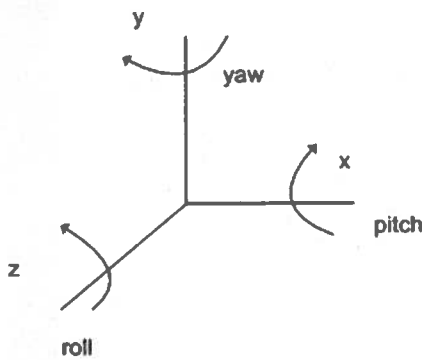
Obtaining the finger positioning was easy enough. Initially, we wanted to use resistive flex sensors that changed their resistance according to the degree of the bending of the sensors. However, the time to complete the project was limited, so waiting two or three weeks for the flex sensors was too long (taking into account that the contest was going to take place in one week).

In our search for a solution, we found that by just placing contactors (simple buttons, in our case) on the tip of the fingers, we could get pretty accurate results. So, we decided to use these as a temporary solution. Simple, right?

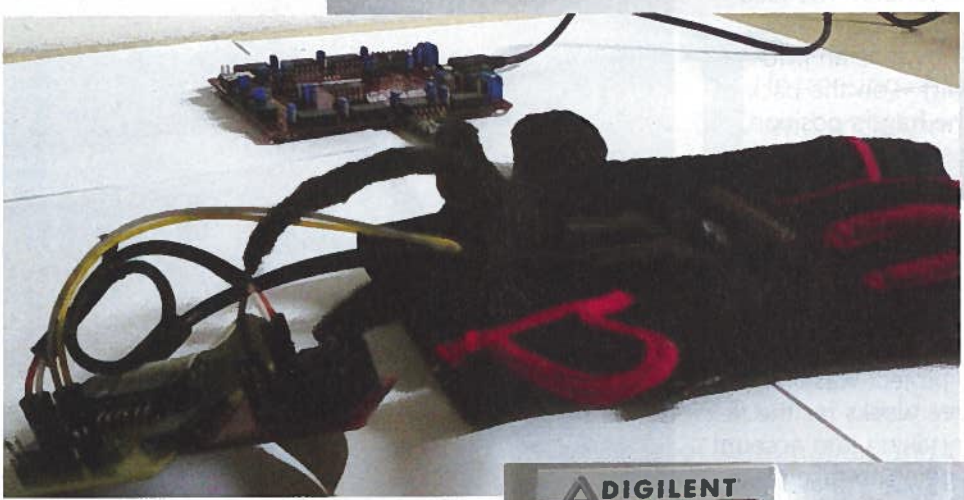
Well, when it got down to obtaining angles (pitch and roll) from the IMU, it got a whole lot trickier. Even though a gyroscope is very precise, it tends to drift. On the other hand, (no pun intended), the accelerometer is a bit unstable, but it doesn't drift. By using these two combined and with the help of a Kalman filter (which basically predicts with very high accuracy the needed pitch and roll angles), we obtained the hand's position. Having all this worked out, it was easy to interpret the results obtained from the sensors and use them for whatever purpose.



The acquisition board with the Cerebot Nano and the RF Pmod connected.



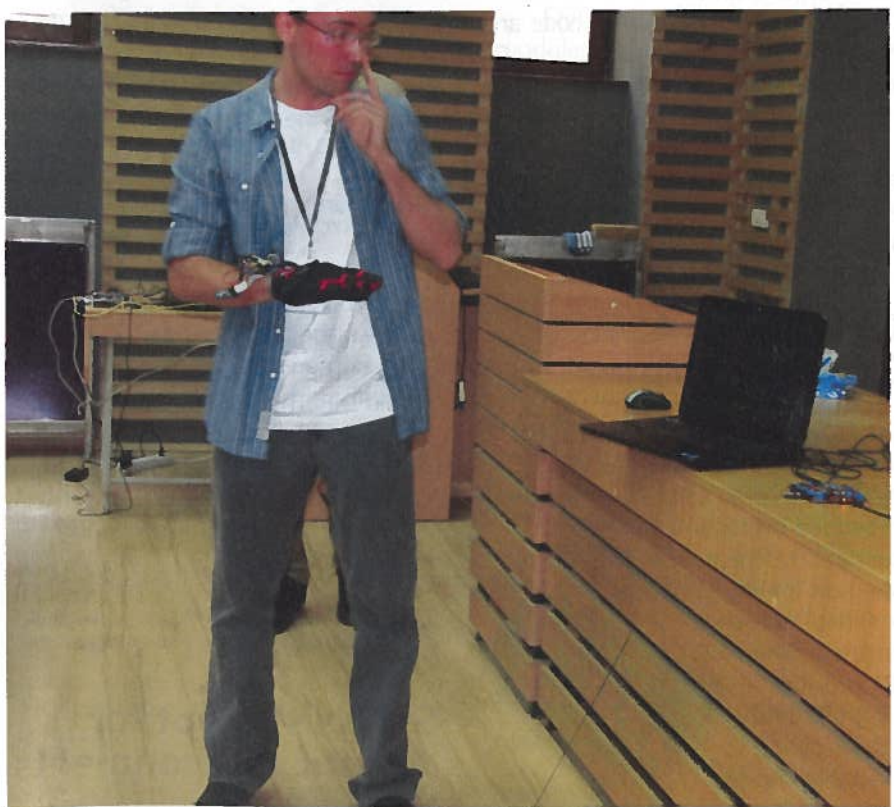
SLANG with everything connected, the night before the contest.



A Truly Handy Device

SLANG is not just a translating glove for sign language. It can also be used as a wireless controller for all sorts of applications. A small size hovercraft has been wirelessly controlled with SLANG by using a simple protocol that converted data received from the glove into motor speed and direction.

Also, SLANG has been used as an aerial combat simulator game controller. This was achieved through the implementation of a USB-HID mouse controller which controls the in-game plane by using the finger combinations and the roll and pitch angles — all of them received from the glove.



SLANG in action at the Digilent Design Contest in Cluj-Napoca.

In Closing

SLANG was a challenging project for us and we are proud that we were able to bring it to a final state. It can be used for many different applications, from which others can benefit. Of course, SLANG can be improved but that's the idea of a prototype: to show that an idea can be brought to life. This project was a test for us, and we like to think that we passed it with flying colors. SV