Chapter 6

Conclusions and future lines

Throughout the whole paper has tried to show, with a certain degree of depth, the main concepts that underpin it, handle as hardware and software performed. The design of the final tool involves making decisions that have sought to be justified in the best way possible.

The fundamental objective of the project consists in to design possible applications for a new multimodal interface, based on different Hardware and Software resources, to control and monitor UAVs in remote way; and programming a tool to prove the virtues and defects of this type of station. This multimodal interface is proposed due to the sensory lack presents in the telecontrol of UAVs, the goal is to compensate that sensory lack thanks to our different tools. For example, an UAV operator can not feel the turbulences in the UAV (maybe if he has a camera in the UAV can observe it), but if we would have inertial systems in the UAV we could emulate this turbulences using the vibrators.

I needed to know the station hardware which consists in many elements, four touchscreens (although the station currently only uses two), the headphones (with the integrated IMU and LED pattern), a fireware camera and the vibrators devices. Each one with a purpose and their combination can lead to more powerful tools. For example, we can use the headphones and vibrators at the same time, in this way when we receive a speech warning if after a while operator does not respond if possible to use the vibrators to attract the user attention. As we saw in previous section was needed to add the IMU and the LEDs pattern to the Headphones, this part is only related to hardware in the project. The electronic of the Headphones was studied and was done the necessary for the integration of the elements. I have to say that I thank the Hardware part because the project consisted only in to be with a computer looking for information and programming, and a new activity was rewarding.

In the same way, was necessary to familiar with different software tools like Head-Tracking and 3D Sound. The first tool has been tested with good

results, although prolonged use may be uncomfortable for the user. The second is ready to be integrated thanks to the station headphones but still not working.

Finally, it was necessary to learn about a 3D programming tool. Using OSG, I programmed a simulation tool to prove the system. I think that the result is good but with more time the tool can be even better. We could test the Head-Tracking thanks to the simulation tool with very good results. And the simulation tool can serve us in the future to test other things, new tools or new functionalities (as can be a collision detection system). Learn OSG was a very hard task because there is very little information and obviously everything is in English. Initially one must learn to use it to see the examples available on the website and changing them to see the results of such changes. But when you learn to use it is certainly very powerful and very intuitive tool.

Now we have a powerful simulation tool that not only allows us to prove the multimodal applications but also we can prove the effects of control multiple UAVs in the UAV operator giving us the ability to improve the human-machine interface.

But this is only the first step in the development of the simulation tool, the possibilities of the tool are almost limitless. And taking advantage of it, will be built the future lines. Now we are going to see some of these possible future lines:

- Integration of 3D sound in the system. It is necessary to add the functionality of 3D sound to the system, for that will take advantage of the inherent functionality of the station headphones to play stereo sound. Moreover, 3D sound can be added to the simulation tool allowing us to prove new configurations for the human-machine interface; for example we could detect audible warnings in the 3D space, which is an advantage having in account we have more than one monitor in our station, in that way we can know in which screen the warning has appeared.

- Improve the simulation tool is an unfinished task. The tool can be debugged much. For example is possible to improve the UAV movements, now we can only use helicopters in the scene (if we want to be realistic) because to rotate the UAV, it has to do that on itself. In future implementations could try to rotate the UAV in movement describing a path that includes the crossing point.

- Simulation tool can be used to prove different algorithms, as an algorithm to detect collision between UAVs. In that way we can simulate different situations and safely prove these algorithms.

- The search of new elements to our multimodal interface. Every day new technologies and applications appear. For this reason it is essential

keep up with them and think about which of them can serve to improve the station.

- Last but not least important is the ability of the simulation tool to improve the human-machine interface. We can make experiments to see like the system affect to the user of the station, assess the so-called human factors. Terms such as situation awareness (SA) and workload are very important at this point and they can serve us to evaluate the appropriateness of each item and application of the station. For example we can try to calculate, by an experiment, the called "workload" that is a psychological term to express how hard it can be a task.