Chapter 1

Introduction

Is well known, the proliferation of robots in industry and the military the past century and what we have this. Much of the fierce technological development that we have suffered has been due to the occurrence of this robots and their ability to perform tasks more complicated or dangerous, and do well in record time. Among all these automata emerged in the last century are the UAVs (Unmanned Aerial Vehicle), which in the 90t's now beginning to have a prominent place in the military and more recently in civil.

But, what is an UAV? According to the ministry of the U.S. defense [14]:

An UAV is a powered, aerial vehicle that does not carry a human operator uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable and can carry a lethal or nonlethal payload. Ballistic or semiballistic vehicles, cruise missiles, and artillery projectiles are not considered unmanned aerial vehicles.

The first applications of such vehicles have been in the army, both for reconnaissance and espionage, to carry and launch missiles. The most characteristic example is the UAV called Predator (see Figure 1.1), owned by the army of the United States and brings in missions since the Gulf War. Its main mission is surveillance, the visual and radar reconnaissance, electronic eavesdropping and it has the ability to launch anti-tank Hellfire missiles.

But, UAVs have shown along them short story that not only have military applications, they can also be used for civilian goals, like fire detecting and fighting, surveillance labors, scientific research, agricultural applications, to transport... Especially for those tasks more dangerous and difficult. Without going further, UAVs had an important role, and with remarkable success, in search and rescue missions during the hurricanes that hit Lousiana and Texas recently.

Figure 1.1: Predator on flight

A representative example of such UAVs is the Mexican Ehécatl (see Figure 1.2), that is used for ecological monitoring, civil protection, surveillance tasks and in the called "War on drugs" (the new war powered by United States against drug smuggling)

Like we can see in its definition, we can distinguish two types of UAVs: those UAVs that can fly in automated way or those UAVs that are remotely piloted, even we can define a new type, a hybrid between the last two: sometimes the UAV can fly automatically and before or after the operator can fly the aircraft (for example in the maneuvers of landing or taking off). In all cases we need a control station to monitoring UAVs, in the full-automated systems is not mandatory but strongly recommended (likely system failures in automation must be detected), but in the other cases is essential have a control station that allows operator monitor and control the UAV. Moreover this station has the mission to improve the situation awareness (SA) of the operator because operator and UAV are not located in the same place and this situation produces a "sensory isolation". We believe in this project to implement a multimodal display to improve SA. Our objective is to design a multimodal display that allows the station operator to control and monitor everything related to one or more UAVs and confer the ability to act them in real time.

The main elements that constitute our station are: three touchscreens, a Firewire camera, vibrators devices and headphones (see Figure 1.3).

With the previous hardware elements and using software tools like Head

Figure 1.2: Ethecatl taking off

Tracking and 3D sound, will be likely development of the station to reach the best possible results.

Once the design is completed, i.e. when our teleoperation station will be ready to allow to its operator monitor and control UAVs with it, make easier the access to the info related to UAVs in real time and will give the operator tools to act on UAVs. The next step will be experiment with the station and its options with the aim to improve the Human-Machine interface. We will be looking for optimal configuration of our available tools taking into account concepts related to "human factors" and "theory of attention". This is very important in these types of systems, because not just the hardware and software are important, besides the physical limits we must take into account the psychological boundaries of the operator. Concepts such as prior commentary Situation Awareness and "workload" will be important in this point. We will see these and other important concepts at the last part of memory.

The main advantages of the proposed solution are:

1. Price. We have a cheap display. It goes without saying that with a bigger budget it would be possible improve certain aspects of the station. But I think that obtained results are very good.

2. Scalability. Simplicity of design for change and better facilities, this allows the use of new technologies or tools without prejudice to the original system.

3. Intuitive. The use of tools and access to information has been taken to make it transparent and the most comfortable and intuitive as possible for the operator of the station.

Figure 1.3: Estación multimodal

4. Versatility. It is possible to use the same system to control another type of autonomous vehicles with little changes in the software or in the way we use system tools.

Memory of the project consists of four different parts. The first part will speak about the physical elements present in the station, we will pay attention to existing devices and why the models chosen. In the second part, we can find a detailed description about Software tools that were studied during project implementation and which or why some were selected and others were discarded. The third part of the project will be about likely applications for our station and focus in UAV systems, using our software tools and hardware for that. Finally, the last part of the memory will deal about a 3D simulation tool design to experiments with our multimodal display with the aim to improve human-machine interface. After that, will be include conclusions and setting out the possible future lines, we will take into account in this part issues like human factors, situation awareness and workload to improve our system in this aspect that is as important as all previous.