**Chapter 2: Introduction**

In this capstone project an unmanned aerial vehicle (UAV), also known as drone, was designed from scratch. A UAV or drone can be defined as an aircraft that does not carry a human pilot or passenger and is fully or partially autonomous. The term unmanned aerial system (UAS) is used when the selection of the GCS and communications unit is included in the design. The term UAS includes the whole system involved when operating a UAV. Thus, in truth, for this project, a UAS was developed since the vehicle must be designed along with an interface to interact with it and a communication scheme to facilitate this interaction.

The design competed with that of other universities as part of Honeywell’s first annual navigation challenge competition. Initially, the UAV design had to integrate the HGuideN580 navigator that was going to be provided by Honeywell. Then, using Honeywell’s navigator the UAV had to be capable of flying autonomously along a predetermined flightpath established through waypoints. According to Clough, this is considered as level 1 autonomy for the UAV since it will only have the capability of executing preplanned missions [1].

Apart from the type of autonomy, there is also a set of basic factors that must be taken into consideration for the UAV design which are weight, lift, drag, and thrust. According to these parameters, elements such as frame, motors, propellers, and batteries are identified, as well as some electrical components such as the flight controller and the electronic speed controllers (ESCs). Flight controllers are designed to assist UAV flight. However, they must be fed information from the user specifying the desired state or position to execute their function. The drone may interpret the desired position in two different ways depending on the mode in which it is operating. If it is in manual mode, then it will interpret the desired position by receiving values for throttle, roll, pitch, and yaw. If it is in autonomous mode, then it will interpret the desired position by receiving values for coordinates x, y, z. The drone must be able to interpret the desired position for every instance of time. According to this information, the flight controller will receive information from its navigator or sensing devices and send separate digital signals to each of the UAV’s ESCs. Then, the function of the ESCs is to receive these digital signals known as pulse width modulations (PWMs) and control the revolutions per minute of the UAV’s motors and power them at the same time. Since the UAV was designed from scratch, all these elements had to be individually selected. As a result, comparisons between products of the same type were executed and the compatibility between each of the selected components for the design was verified. This selection process is described in more detail through the project solution section in this report.

From another point of view, as it may be observed, this is a multidisciplinary project. As a result, the tasks necessary to complete the UAV design were divided into three main disciplinary teams: ME, COE, and EE. This report has been written by the EE team members whose main task was to design the UAV’s control system to ensure proper maneuver for unforeseen disturbances. Knowledge of MATLAB/Simulink was particularly important for this project since the control system was designed through this software by taking into consideration the four basic elements that make up a control system: the sensor, the transmitter, the controller, and the final control element.

It is important to mention that halfway through the competition, the design requirements were changed by Honeywell since they would not be able to provide the HGuideN580 navigation units to the competing teams. Due to this occurrence, Honeywell decided to host the navigation challenge for remotely controlled drones instead of autonomous ones. Thus, all requirements relating to autonomous flight were dissolved from the competition. However, the UAV team continued to pursue the design of an autonomous UAV as shown in the following sections.