Requirements Toolbox Report

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Chapter 1: Requirement Set: software requirements

Description

Implementation Status

Total: 10, Implemented: 0, Justified: 0, None: 10

Verification Status

Total: 10, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 10

Change Information No change issue detected.

1 The source code shall be traceable

Requirement Type Functional

ID SO-001

Description

The source code shall be located in a repository so that changes can be tracked and previous versions are accessible.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

2 The software shall be able to communicate the drone and the GCS

Requirement Type Functional

ID SO-002

Description

A communications software shall be designed so that the drone can communicate with the GCS wirelessly in order to transfer the collected data by the sensors in the drone and receive instructions from the computer.

Change Information No change issue detected.

Implementation Status

Total: 5, Implemented: 0, Justified: 0, None: 5

Verification Status

Total: 5, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 5

2.1 The control system shall have a fail-safe mechanism in case of connection loss

Requirement Type Functional

ID SO-002.1

Description

The control system shall have a fail-safe mechanism that triggers when the connection between the drone and the GCS is lost or disrupted. This mechanism shall perform the last assigned task and remain in its current position.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

2.2 The control system shall have an automatic landing mechanism in case of connection loss

Requirement Type Functional

ID SO-002.2

Description

If the connection between the drone and the GCS is lost for a period of 30 seconds or longer, the drone shall initiate a controlled landing procedure. This procedure shall involve the drone descending slowly and vertically until it reaches the ground.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

2.3 The control system shall cooperate to estimate the position of the drone

Requirement Type Functional

ID SO-002.3

Description

Both the drone and the GCS estimate the position of the drone using sensor information, odometry and a mathematical model. The GCS compares the current drone estimate with its own to obtain deviations from the target.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

2.4 The drone shall send images to the drone

Requirement Type Functional

ID SO-002.4

Description

The onboard computer shall not perform any image processing, sending captured images directly to the GCS for processing.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

3 The software shall be able to process images

Requirement Type Functional

ID SO-003

Description

A processing pipeline shall be created which takes images as inputs and produce obstacle detections as outputs. The detections shall then be processed into instructions for the drone to execute.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

4 The remote control system shall have access to battery status

Requirement Type Functional

ID SO-004

Description

The drone shall be equipped with a battery monitoring system that continuously measures the battery's remaining charge level. This information shall be transmitted to theGCS, which shall provide real-time battery status updates to the user. The remote control system shall use this information to warn the user when the battery level is low, allowing the user to take appropriate actions to ensure a safe landing and battery replacement if necessary.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

5 The software shall complete a control loop fast enough to ensure the reactivity of the drone

Requirement Type Functional

ID SO-005

Description

In order to ensure the reactivity of the drone, the processing pipeline shall be as lightweight as possible by making use of optimizations and efficient technologies.

Change Information No change issue detected.

Implementation Status

Total: 2, Implemented: 0, Justified: 0, None: 2

Verification Status

Total: 2, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 2

5.1 The software shall use a compiled programming language

Requirement Type Functional

ID SO-005.1

Description

The programming language shall be compiled in order to minimize the latency between detection and the consequent instruction.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

Chapter 2: Requirement Set: stakeholder requirements

Description

Implementation Status

Total: 6, Implemented: 0, Justified: 0, None: 6

Verification Status

Total: 6, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 6

Change Information No change issue detected.

1 The system shall be functional before may 2023

Requirement Type Informational

ID ST-001

Description

According to the project management, the drone shall be able to perform both race phases by May 2023. This will be the end of the INGENIA SE Project and the competition will take place.

Change Information No change issue detected.

2 The drone shall fly in an enclosed space inside the university

Requirement Type Informational

ID ST-002

Description

In order to meet the legal constraints, the drone shall fly inside the university area and below a specific height. Also, the space shall be enclosed to ensure the drone's stability and avoid severe atmospheric disturbances that could damage the drone because of its lightweight.

Change Information No change issue detected.

2.1 The system shall comply to current regulations on drone flights

Requirement Type Informational

ID ST-002.1

Description

The drone shall comply with the following regulations:

* Reglamento de Ejecución 2020/746
* Real Decreto 1036/2017
* Reglamento Delegado 2019/945
* Reglamento de Ejecución 2019/947

Change Information No change issue detected.

3 The team shall design a competition in coordination with the other team

Requirement Type Functional

ID ST-003

Description

The team shall negotiate with the other team the trials and rules of the competition, as well as the winning conditions.

Change Information No change issue detected.

Implementation Status

Total: 6, Implemented: 0, Justified: 0, None: 6

Verification Status

Total: 6, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 6

3.1 The competition should have a speed test

Requirement Type Functional

ID ST-003.1

Description

The test should accurately measure the flying speed of the drone

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

3.2 The competition should have a precision test

Requirement Type Functional

ID ST-003.2

Description

The test should measure the ability for the drone to detect a mark and position itself relative to that position precisely

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

3.3 The competition should have an obstacle avoidance test

Requirement Type Functional

ID ST-003.3

Description

The test should comprise obstacles to test the ability of the drone to detect and avoid those obstacles.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

3.4 The competition should have a point system

Requirement Type Functional

ID ST-003.4

Description

To determine the champion of the competition, a scoring system should be designed with defined scoring criteria for each test. The scoring mechanism should evaluate the performance of each team and assign a numerical value to their results. The team with the highest cumulative score at the end of the competition will be declared the winner.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

3.5 The competition should value style

Requirement Type Functional

ID ST-003.5

Description

A jury shall be responsible for determining the drone with the most stylish design and/or impressive control tricks, based on visual aesthetics and performance during the competition. The jury shall be composed of experts in the field of drone design and operation (Ricardo Sanz), with knowledge and experience in evaluating the technical and aesthetic aspects of drone performance.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

Chapter 3: Requirement Set: system requirements

Description

Implementation Status

Total: 16, Implemented: 0, Justified: 0, None: 16

Verification Status

Total: 16, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 16

Change Information No change issue detected.

1 The drone shall be able to fly in a controlled manner

Requirement Type Functional

ID SY-001

Description

Controlled manner is defined as the ability of the drone to maintain stable flight conditions, maintain a specific altitude, and follow a predefined flight path with minimal deviation from the planned trajectory.

Controlled manner is further specified with the following numerical constraints:

* Altitude: The drone shall be able to maintain a specific altitude within a tolerance range of +/- 10cm.
* Stability: The drone shall maintain a stable flight pattern with minimal pitch, roll, and yaw deviations from the intended flight path, with a tolerance range of +/- 5 degrees.
* Trajectory: The drone shall be able to follow a predefined flight path with minimal deviation, within a tolerance range of +/- 20cm from the intended trajectory.

Change Information No change issue detected.

Implementation Status

Total: 7, Implemented: 0, Justified: 0, None: 7

Verification Status

Total: 7, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 7

1.1 The drone shall be able to lift its own weight plus the components mounted

Requirement Type Functional

ID SY-001.1

Description

To participate in the different races the drone shall fly on its own. In order to achieve this, it has to self-propel, so the motors shall provide the necessary power to lift its own weight and the components mounted.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

1.2 The GCS shall be able to manipulate the drone manually in case of security threats or unexpected events

Requirement Type Functional

ID SY-001.2

Description

In case of any security threats or unexpected events, the manual control system shall be used to ensure the safety of the drone and the surrounding environment. The manual control system should be able to control the drone's movement in various directions, including forward, backwards, left, right, up, and down. It should also be able to adjust the speed and altitude of the drone in response to the remote control signals.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

1.3 The GCS shall be able to control the movement of the drone automatically

Requirement Type Functional

ID SY-001.3

Description

In order to ensure the reliable and safe operation of the drone, it is necessary for the drone to have a control system that is capable of controlling the movement of the drone automatically. This means the drone shall be equipped with an automatic control system that can be remotely accessed and controlled through a remote control device.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

1.4 The GCS should relay information about the status of the drone

Requirement Type Functional

ID SY-001.4

Description

The GCS should be able to provide real-time feedback on the drone's status, including its location, altitude, battery life, and any potential errors or malfunctions. This feedback should be easily accessible and clearly displayed on the remote control device to ensure the user has complete awareness of the drone's status.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

1.5 The drone shall have automatic lift-off and landing procedures

Requirement Type Functional

ID SY-001.5

Description

The drone shall be designed with automatic lift-off and landing procedures to facilitate safe and efficient operation. The automatic lift-off procedure shall enable the drone to take off from a stationary position without requiring manual input from the operator. The automatic landing procedure shall enable the drone to land in a safe and controlled manner, without requiring manual input from the operator.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

1.6 A control algorithm shall run onboard the drone

Requirement Type Functional

ID SY-001.6

Description

To enable autonomous operation, the drone shall be equipped with a control algorithm that runs onboard. This algorithm shall be responsible for processing sensory inputs and controlling the drone's movements based on programmed objectives.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

2 The drone should have visual indications of its current status

Requirement Type Functional

ID SY-002

Description

The drone should be designed with clear and easily visible visual indications of its current status. These indications should include information such as battery level, altitude, speed, and any active modes or commands. The visual indications should have high contrast and brightness and should be easily distinguishable from a distance. They should also be positioned in a way that is visible to the operator during operation, without obstructing the view of the drone or causing distractions.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

3 The battery installed in the drone shall be large enough to ensure the competition is completed

Requirement Type Functional

ID SY-003

Description

The battery system equipped on the drone shall be sufficient to complete all tasks with no need for a recharge. Therefore, the battery capacity shall be sufficiently large.

Change Information No change issue detected.

Implementation Status

Total: 2, Implemented: 0, Justified: 0, None: 2

Verification Status

Total: 2, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 2

3.1 At any moment during the competition, there should be at least two battery replacements for the drone

Requirement Type Functional

ID SY-003.1

Description

During the competition, it should be required that the drone is equipped with a minimum of two replacement batteries, available at any moment. These batteries should be charged and ready for use, to ensure the uninterrupted operation of the drone throughout the competition.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

4 The drone shall be able to navigate autonomously

Requirement Type Functional

ID SY-004

Description

The drone shall be designed and programmed with the ability to navigate autonomously, following a predefined path and avoiding possible obstacles.

Change Information No change issue detected.

Implementation Status

Total: 6, Implemented: 0, Justified: 0, None: 6

Verification Status

Total: 6, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 6

4.1 The drone shall detect and avoid obstacles in its path

Requirement Type Functional

ID SY-004.1

Description

In the second stage of the competition, the drone should be able to avoid obstacles of the following categories:

* Hoops
* Poles
* Doors
* Split Rectangles

Therefore, the drone should be able to distinguish between obstacle types and decide its trajectory based on this information.

Change Information No change issue detected.

Implementation Status

Total: 3, Implemented: 0, Justified: 0, None: 3

Verification Status

Total: 3, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 3

4.1.1 The system shall detect obstacles using a camera mounted on the drone

Requirement Type Functional

ID SY-004.1.1

Description

A camera shall be used to collect information about the surroundings of the drone. Specifically, information about object types, distance, angles, etc. shall be collected.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

4.1.2 The drone must react in time to obstacles in its path

Requirement Type Functional

ID SY-004.1.2

Description

The complete process of capturing, sending, processing, receiving and reacting shall be performed sufficiently fast so that the drone shall not collide with obstacles in its path.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

4.2 The drone shall be able to follow a target position

Requirement Type Functional

ID SY-004.2

Description

The drone shall be equipped with a control system and sensors that enable it to track and follow a specified target position accurately and reliably. The control system shall be capable of interpreting and executing commands from the GCS, and shall be designed to ensure the safety of the drone and surrounding environment.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1

4.3 The GCS shall generate trajectories for the drone using Bezier curves

Requirement Type Functional

ID SY-004.3

Description

The Ground Control System (GCS) shall have direct responsibility for controlling the movement of the drone. It shall generate a trajectory consisting of a set of target positions defined by Bezier curves, which shall be transmitted to the drone's control system for execution.

Change Information No change issue detected.

Implementation Status

Total: 1, Implemented: 0, Justified: 0, None: 1

Verification Status

Total: 1, Passed: 0, Justified: 0, Failed: 0, Unexecuted: 0, None: 1