GROUP NUMBER: 4.13

MEMBERS:

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ROLES TAKEN ON IN LAB ACTIVITIES (*with example in first row*):

Member	**Lab 5**	**Lab 6**	**Lab 7**	**Lab 8**
1	Manager	Questioner	Scribe	Questioner
2	Questioner	Manager	Scribe	Scribe
3	Scribe	Questioner	Questioner	Manager
4	Questioner	Scribe	Manager	Questioner
5	Scribe	Scribe	Questioner	Questioner

6	Questioner	Questioner	Scribe	Scribe

TEAM CONTRIBUTION STATEMENT

For each person, indicate the extent to which you agree with the statement on the left, using a scale of 1 to 4 (1=strongly disagree; 2=disagree; 3=agree; 4=strongly agree). Total the numbers in each column.

Evaluation criteria	**1**	**2**	**3**	**4**	**5**	**6**
Attends group meetings regularly and arrives on time.	4	4	4	4	4	4
Contributes meaningfully to group discussions.	4	4	4	4	4	4
Completes group assignments on time.	4	4	4	4	4	4
Prepares work in a quality manner.	4	4	4	4	4	4
Demonstrates a cooperative and supportive attitude.	4	4	4	4	4	4
Contributes significantly to the success of the project.	4	4	4	4	4	4
TOTAL	24	24	24	24	24	24

Feedback on team dynamics:

How effectively did your group work? Our group worked effectively, with someone taking charge, ensuring everyone was involved, getting the best out of everyone. No one was afraid to critique each other's ideas, meaning that we were able to see different viewpoints on the same topic. On top of this, each task was split up into smaller sections that we completed individually and then came together and put all our ideas together. Therefore, everyone played a part every step of the way; ensuring this was a team effort. We met outside of labs in our own time to further continue working on the task in order to make sure we were all on the same page.
Were the behaviors of any of the team members particularly valuable or detrimental to the team? Please explain. All of the team members were equally valuable, playing pivotal roles in the completion of this project in their own way. Everyone brought different skills to the table which were utilised for the benefit of the team and each person was heavily involved throughout the duration of the project. We all worked together outside of labs which showed that everyone in the team was dedicated to ensuring that the outcome of the project was to the highest standard. When assigned with a task, no one complained or tried to pass it off, the task was always completed to the best of their ability.

What did you learn about working in a group from this project that you will carry into your next group experience?

From this project, we learnt that working as a group means that you can split the work up so everyone plays a role in the completion of a task. We can also see how much easier a task is to complete when the entire group comes together and is forthcoming, everyone shares their ideas and is not afraid to tell others when they have a conflicting idea or if they do not agree with their idea. This also highlights the importance of the involvement of every group member as no contribution is too little and everyone's opinion is valuable.

PART A: PROBLEM DEFINITION

A1. Problem Statement & Project Aims

Based on the project brief and as an outcome of Lab 1 'Defining the Problem', please state the main project aims and objectives as captured by the group. Aims are the overall purpose of the project. Objectives are individual tasks that would need to be done to solve the problem. Be clear and precise. Avoid ambiguities. Reference your sources.

AIM: A drone to be developed to be used in accidents to search for survivors where rescue teams may not be able to - due to poor visibility/weather/terrain making the crash site inaccessible to humans. The drone can fly above the debris to capture a bird eye's view of everything.

OBJECTIVES:

A1.1 To identify sensors most suitable to reducing search times for the rescue teams by finding the survivors and making known their location

A1.2 To evaluate suitable materials that can be used in the drone to make it withstand collisions and at the same time light enough to fly.

A1.3 To use the suitable speaker to speak with the survivors who know current situations.

A1.4 To identify a microcontroller that can handle input from the controller and camera, then control propellers and output to video feed.

A2. User Requirements

These are derived from the project brief, constraints, and scope, and your interpretation and elaboration of the problem. The user requirements form the basis of understanding between the user(s) of the system and the engineering design team, and they reflect the user view of the system. The key question to answer here is "WHAT?" – "What does the User need or want?"

A2.1 The drone is to search and rescue after disasters terrain which is inaccessible to humans.

A2.2 The drone must be considerably light but be able to withstand different weather conditions

A2.3 The drone must be able to return a pinpoint location of where the survivors are found

A2.4 The drone will have a storage compartment to send out relief supplies to survivors in situations where it takes time for rescue teams to arrive at the scene

A2.5 The drone must have a feed showing the controller what the cameras see, giving the options to switch between the infrared and normal camera

A2.6 When falling, or knocked off balance, the gyroscope will stabilise it's orientation within a second, ensuring the drone doesn't crash

A2.7 The drone must utilize cheap materials and tools such that it can be mass-produced

A3. Constraints

Constraints could include scalability, functionality, user's interaction limitation, ethics, and design for sustainability. This will allow you to draft a more realistic system requirements and limits the options in the design choices, thus helping direct the design and development process.

A3 Constraints:

A3.1: Battery life for the drone can be a huge issue if the drone is needed for longer periods and perform tasks that drain its battery

A3.2 The weather cannot be controlled so in high winds the drone may struggle to fly

A3.3 The drone will not be able to physically help people - for example by moving debris. It is utilised for locating survivors and providing resources

A3.4 The landscape may limit the visuals of the drone making it hard to find people.

A3.5 The drone must not pose a danger to survivors when the drone is damaged to avoid accidents.

A3.6 The drone may be limited to range especially the signal distance, which can limit communication between the drone and the rescue team.

A3.7 The storage compartment must be large enough to maximise the resources sent but can't be too big or the drone may not be able to fly properly

REFERENCES

You need to adequately support PART A (AIMS, OBJECTIVES, USER REQUIREMENTS, CONSTRAINTS) by at least 4 credible scientific resources: academic journals, conference proceedings, and scientific periodicals. Sources like The Guardian and Forbes are not considered scientific and must be avoided for this assignment. Sources like Wikipedia and Buzzfeed can be biased and aren't considered as credible information sources. You must use the Harvard Referencing Style for in-text citation and your References list

Grifths, A. (2015). *Drones in the emergency services*. [online] Available at:

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Drone USA. (n.d.). *The 5 Best Drone Features for Search & Rescue Missions*. [online] Available at: https://www.droneusainc.com/articles/the-5-best-drone-features-for-search-rescue-missions

Gianluca Casagrande, András Sik and Gergely Szabó (2018) Small Flying Drones : Applications for Geographic Observation. Cham, Switzerland: Springer. Available at: http://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=1632613&site=ehost-live (Accessed: 3 December 2020).

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Hayat, S., Yanmaz, E., Bettstetter, C. al. Multi-objective drone path planning for search and rescue with quality -of-service requirements. 1183–1198 (July). Available at: https://doi.org/10.1007/s10514-020-09926-9

PART B: SYSTEM REQUIREMENTS

System requirements are derived from the user requirements and technical constraints. The key question again is "What", but this time from the system perspective: "What are the system inputs, outputs, indicators, operational modes and key functions that will help fulfill user requirements?". It is the first step towards the "HOW?": "How will we design and implement this system?"

B1. Input/Output Requirements

State all requirements related to system inputs and outputs. These include inputs and outputs from the "environment" as part of the normal system operation (e.g. data and information from users of the system or or signals from the sensors that interact with the physical environment; data that the system returns or presents to the user, or signals that the system uses to control actuators that interact with the physical environment), and the inputs and outputs that used as part of maintenance, i.e. testing and troubleshooting processes.

B1.1 Infrared camera to detect radiation and measuring the temperature of the surroundings

B1.2 GPS output system returning the latitude and longitude of the drone to determine the exact location

B1.3 Input/Output remote control signals to control the drone

B1.4 System outputs to control propellers, camera direction and motors

B2. Operational Requirements

Many systems can operate in a number of different modes e.g. normal, self-test/maintenance, sleep/awaiting input, fail-safe/recovery, etc. Operational requirements should capture the operational modes of the system. They describe externally observable behaviour of the system, in all conditions. Operational modes can be modelled as "states" of the system and are clearly shown using state-space diagrams. You can include a state-space diagram here if that is applicable to your system.

B2.1 The four operation modes are: Power on/off, recalibration, movement, grab/release, troubleshooting.

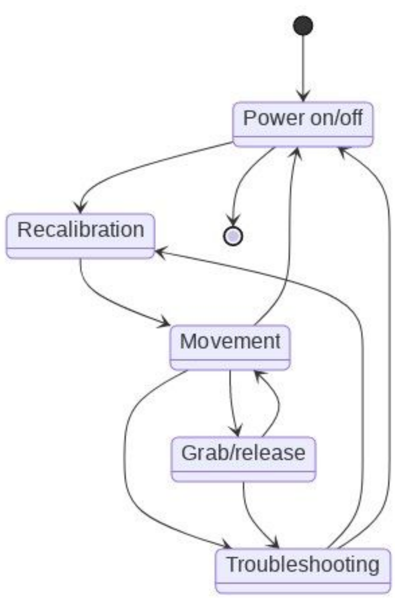
B2.2 Power on/off mode: The drone is activated/deactivated. Each of its subcomponents are tested individually. If all components are operational, the drone either moves on to recalibration mode or turns off.

B2.3 Calibration mode: The drone calibrates its motors, balance according and camera feed according to real-time information. This step helps ensure drone flight is stable and will not overturn. This mode switches to movement mode on completion.

B2.4 Movement mode: The user is able to control the drone using the remote controller. The drone can either move horizontally, rise up or lower down depending on user input.

B2.5 Grab/release mode: The drone is lowered and grabs an object directly below it, or releases an object to the ground. This mode is used to obtain and transfer supplies to victims.

B2.6 Troubleshooting mode: This mode is activated when the drone's sensors are imbalanced, usually caused by the drone running into surrounding objects, or the drone being damaged by the disaster environment. The drone either moves to power on/off mode or calibration mode, depending on how operational each of the components are.



B3. Functional Requirements

Functions relate inputs to outputs and specify tasks that the system needs to carry out to fulfil its purpose. System's functions are hidden from the user. They help formulate the design problems for the system, and subsequently, the design solution.

B3.1 The drone will be able to tell its location with the input from the GPS at any point

B3.2 At any point of the drone flying, it will be able to detect any infrared radiation and display it to a camera.

B3.3 On the boundary, it will be controlled by the controller signal(devices such as phone, pad) to do corresponding jobs.

B4. Non-functional Requirements

These include performance, sustainability, resilience (disaster recovery), reliability, durability, end-of-life management, and other requirements not describing the function of the system but rather it's other characteristics important for the system operation.

B4.1 *The drone must be able to fly miles upon miles, therefore it must be equipped with a resilient and high quality propellers. If the propellers are damaged during its flight, it must be equipped with replacement propellers.*

B4.2 *Plan for component disposal will be created and taught to staff who will apply it when the drone completes its life. The component disposal will be in accordance with local best practices and regulations and e-waste EU and UK regulations. For example, disposal of the rechargeable battery as well as the metallic frame of the drone.*

B4.3 *The drone will be made with materials that are relatively environmentally friendly and carbon-free so when the drone accidentally drops dead mid flight it will be safe for the environment.*

B4.4 *The drone will be designed so that it can endure physically extreme situations like a fire, and high winds.*

B4.5 *The human recognition percentage must be higher than 99 % to recognize people through thick cover like trees and other warm blooded life.*

PART C: KEY DESIGN CHALLENGES

Consider the key challenges that you identified through background research, problem definition, and specification of system requirements. Consider the "HOW?" of implementation: how would you implement, plan, design and implement the system given the requirements?

C1: The main problem for this drone will be battery life. It performs many functions all while flying which is sure to have a great effect on its battery life. The solution would be a battery backup which can last for an extra 5 min for a drone this size. Five minutes may not seem long but it is enough to save lives .

C2: Another issue is the signal range; the drone can lose contact with its controller which can have disastrous effects. A solution is to have multiple controllers around a certain perimeter, this allows the drone to connect with the other controller using wifi and not cause it to crash. Another fix for this issue is to program the drone to stay still after it loses contact to allow the person to come closer and regain control.

C3: Weight for flight is another trade off we must think off. The aircraft must be light to fly and also not collapse with the simplest collision. The solution is to use Magnesium alloy (magnesium, Aluminum,Zinc) to make the drone and coat it with a layer of aluminum to make the drone withstand extreme temperatures.

C4: Infrared and the normal camera can cause a problem because of the weight they will add to the drone and their accuracy and resolution. There is a trade-off between the price paid for the drone and maximum resolution and accuracy of both cameras. The more the consumer pays the better camera he will get