Problem Statement and Goals
Mechatronics

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Table 1: Revision History

Date	Developer(s)	Change
Date1	Name(s)	Description of changes
Date2	Name(s)	Description of changes
...	...	...

1 Problem Statement

[You should check your problem statement with the problem statement checklist. —SS]

[You can change the section headings, as long as you include the required information. —SS]

1.1 Problem

1.2 Inputs and Outputs

[Characterize the problem in terms of "high level" inputs and outputs. Use abstraction so that you can avoid details. —SS]

1.3 Stakeholders

1.4 Environment

[Hardware and Software Environment for the users. The developer environment is summarized as part of the developer plan. —SS]

2 Goals

2.1 Create a 3D model of a tight space with little to no natural light

The primary goal of the project is to make accurate models of crevice caves. These often have no light from the outside and require the caver to bring their own lighting. The space is also constrained, often narrowing to passages not much larger than what a person can pass through. The exact format of the output is not yet determined but could be a point cloud or a 3D mesh.

2.2 Total cost of project is under $750

Typically, professional systems for mapping spaces use 3D Li-DAR scanners and cost multiple thousands of dollars. The total cost of the sensors and hardware used needs to be limited for the requirements of the capstone, but keeping a low cost would be an important goal regardless of this. We will be able to reuse equipment purchased by a previous capstone group, which will lower our expenses, but even if the sensors we already have are included in the budget, the cost should remain well under $750. The goal is to lower the barrier to entry for these types of mapping tasks while maintaining a reasonable level of accuracy.

2.3 The operator's ability to explore crevice caves is not hindered

Spelunking is a physically demanding activity. The system should be wearable by the user in a way that does not impede their ability to navigate through challenging caves. The space that the system uses should be small and the components be located to minimize disruption of the caver's experience. The system should also be light, to avoid fatiguing the user, and the battery charge should last long enough to avoid having to halt a caving session for recharging.

2.4 Use of the system does not pose any danger to the operator or others

There should be no risks to the user caused by the mapping system. Specifically, the system should not decrease the effectiveness of existing safety equipment such as harnesses or helmets. Furthermore, the batteries should be stored in a secure manner such that a fall does not cause further issues related to battery safety . This is related to the previous goal, but the focus of this goal is on the safety of the user and any others who could be affected.

3 Stretch Goals

3.1 Local Data Processing

Implement the capability of processing the collected data from the sensors on the system in real time.

3.2 Camera Improvements

Design a camera mounting system with 30° range of motion, with 1° micro-movement via an interface. Add a RGB camera to capture color information to generate colored 3D models.

3.3 Phone Application

Develop an application to access previously made images and 3D mappings.

3.4 Machine Learning

Implement a learning mechanism that allows the option to reject images, and will train on accepted images.

4 Extras

[For CAS 741: State whether the project is a research project. This designation, with the approval (or request) of the instructor, can be modified over the course of the term. —SS]

[For SE Capstone: List your extras. Potential extras include usability testing, code walkthroughs, user documentation, formal proof, GenderMag personas, Design Thinking, etc. (The full list is on the course outline and in Lecture 02.) Normally the number of extras will be two. Approval of the extras will be part of the discussion with the instructor for approving the project. The extras, with the approval (or request) of the instructor, can be modified over the course of the term. —SS]

Appendix — Reflection

[Not required for CAS 741 —SS]

The purpose of reflection questions is to give you a chance to assess your own learning and that of your group as a whole, and to find ways to improve in the future. Reflection is an important part of the learning process. Reflection is also an essential component of a successful software development process.

Reflections are most interesting and useful when they're honest, even if the stories they tell are imperfect. You will be marked based on your depth of thought and analysis, and not based on the content of the reflections themselves. Thus, for full marks we encourage you to answer openly and honestly and to avoid simply writing "what you think the evaluator wants to hear."

Please answer the following questions. Some questions can be answered on the team level, but where appropriate, each team member should write their own response:

1. What went well while writing this deliverable?
2. What pain points did you experience during this deliverable, and how did you resolve them?
3. How did you and your team adjust the scope of your goals to ensure they are suitable for a Capstone project (not overly ambitious but also of appropriate complexity for a senior design project)?