Problem Statement and Goals
Software Engineering

Team #11, OKKM Insights
Mathew Petronilho
Oleg Glotov
Kyle McMaster
Kartik Chaudhari

Table 1: Revision History

Date	Developer(s)	Change
9/18/2024	Mathew Petronilho	Added Problem, Challenge level and Extras
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

There is currently a lack of high-quality, labeled satellite imagery datasets tailored for specific use cases. Many industries require specialized data for tasks like disaster response, environmental monitoring, urban planning, or defense, but building these datasets manually is time-consuming, costly, inefficient and may require expert data analysis. This hinders the development and deployment of accurate computer vision models for critical use cases across these various industries.

Our team at OKKM Insights aims to solve this problem by creating an online platform that accelerates this process and brings transparency to satellite imagery data analysis. Using an AI-powered crowd-sourcing model, our platform will allow users to label commercially available satellite images, helping us

to build datasets. These datasets will then be used to train custom computer vision models for various use cases. At its core, the platform will offer a paid service for identifying objects within satellite images, and in turn, distribute the earnings to the users who contribute to the labeling effort.

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 —SS]

2 Goals

2.1 High Data Accuracy

Description: The system should have high classification accuracy for objects reported in the images.

Rationale: The core problem this system must solve is extracting useful information from the provided images. One key metric to determine the utility of the information found, is the classification accuracy of objects identified in the images. If the system is not able to determine what is contained in an image, it will not be useful to stakeholders.

2.2 Ease of use

Description: The system should be very easy for stakeholders to use. There should be very low friction for users to classify images and objects found within images, with minimal training. It should also be simple for users to upload images to be analyzed.

Rationale: To maximize the information gained from users who are contributing to classification efforts, the system must ensure it is simple for users to get started with, and continue using the system. This is necessary to build a large enough user base, which will make it more likely to get insights in an acceptable amount of time.

2.3 Minimizing Cost to Analyze Images

Description: The system should minimize the cost for users request insights from images. This could be implemented through intelligent algorithms for task

delegation.

Rationale: Users of the system who upload images are interested in getting an appropriate return for their investment. If the cost to analyze is too high, the platform will not retain a sufficiently large user base of purchasers.

2.4 Results Returned Within Appropriate Timeframe

Description: The system should ensure the time it takes to obtain information from images is within a specified limit, as determined by users who upload images.

Rationale: Purchasers will have some time limit they require the system to process images within. To ensure timing needs are met, the system should provide realistic timelines and stick to them.

2.5 High System Reliability and Accessibility

Description: The system should be useable remotely for purchasers and labellers, and have minimal downtime.

Rationale: The system should allow purchasers to upload images without being physically located where the system is hosted to ensure flexibility of use. The same should also be true for labellers, as they should be able to perform their tasks remotely. In both cases, the system should have low down time as to not introduce additional friction into the completion of tasks.

3 Stretch Goals

3.1 Automatic Data Labelling

Description: The system should be able to use our extensive data set to automatically label new images.

Rationale: The introduction of automatic data labelling will improve the speed and reduce the cost to label images. This will allow the system to provide more value to purchasers, and allow the labellers to focus on harder to label images.

3.2 Multi-Source Integration

Description: The system should combine additional geo-spatial datasets, such as weather or census data, to obtain additional information from satelite imagery.

Rationale: Additional data sources will improve the value of data collected

for purchasers. This is especially true for those interested in predicting future trends from the data found in their satelite images.

4 Challenge Level and Extras

4.1 Challenge Level

We anticipate this project to be advanced due to our limited domain knowledge of satellite imagery and the complexity of the implementation. To begin, we will be developing a web application from scratch, which poses a challenge as most team members lack experience in front-end development. Additionally, we need to figure out how to seamlessly and automatically acquire paid satellite images for labeling from third-party providers upon customer request. We also need to consider how to break down and distribute image-labeling tasks. This may involve algorithms for splitting larger images into smaller pieces for analysis, identifying images with relevant objects, and determining which users are best suited to label specific images. We will also need to design a consensus algorithm to ensure accurate labeling, likely incorporating a user accuracy system and a statistical model—both of which will require research to understand and implement effectively. Once a dataset is validated, we will face additional challenges in the realm of computer vision models. Our team has minimal experience in this area, so selecting, tweaking, training, and testing the appropriate model for optimal accuracy across diverse datasets will require significant effort. Moreover, we aim to automate the training of the model once a labeled dataset is complete, which will add to the complexity. The application will also need to handle secure payments from customers and distribute payments to users and third parties. Since we have no experience with online monetary transactions, this will involve additional research and effort to ensure security and reliability. Finally, we must integrate all these components seamlessly and deploy the system in a way that ensures efficiency and an excellent user experience.

Overall, with the complexity of the implementation and our current knowledge gaps, we believe that the extra research and level of development will make this an advanced project.

4.2 Extras

- Usability Testing: Conducted by allowing users to test the application interface and provide feedback to us through a questionnaire
- Demonstration Video: Create a video demonstrating how to use the product and its various features
- Formal Proof: Come up with a proof of convergence for labeled images to show that they have a certain level of consistency and accuracy

[State your expected challenge level (advanced, general or basic). The challenge can come through the required domain knowledge, the implementation or some-

thing else. Usually the greater the novelty of a project the greater its challenge level. You should include your rationale for the selected level. Approval of the level will be part of the discussion with the instructor for approving the project. The challenge level, with the approval (or request) of the instructor, can be modified over the course of the term. —SS]

[Teams may wish to include extras as either potential bonus grades, or to make up for a less advanced challenge level. Potential extras include usability testing, code walkthroughs, user documentation, formal proof, GenderMag personas, Design Thinking, etc. Normally the maximum 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)?