

CLARE: Lab Availability Tracker

Design Document

SDDec23-04

Mohamed Selim

Ahmad Nazar

Evan Uhlmeyer: Meeting leader

Frank Sullivan: Team website and image manager

Jorge Ortiz: Main client contact

Tyler Rolston: ETG and external contact

Joel Neppel: Course assignment manager

sddec23-04@iastate.edu

<https://sddec23-04.sd.ece.iastate.edu/>

Executive Summary

Development Standards & Practices Used

ISO/IEC/IEEE 29119 (1 – 4)

ISO/IEC/IEEE 23026-2015

IEEE 1016-2009

Summary of Requirements

- Get an accurate count of the number of people in a lab
- Use a website to display the current usage of lab rooms
- Have the website be easy to use
- Integrate the website into Canvas

Applicable Courses from Iowa State University Curriculum

- Com S 227: Object-oriented Programming
- Com S 309: Software Development Practices
- Com S 319: Construction of User Interfaces
- Com S 474: Introduction to Machine Learning
- Cpr E 308: Operating Systems
- Cyb E 324: Legal, Professional, and Ethical Issues in Cyber Systems
- S E 329: Software Project Management
- S E 339: Software Architecture and Design
- S E 417: Software Testing

New Skills/Knowledge acquired that was not taught in courses

- Learning Management System platform
- Python web frameworks
- Machine learning
- Frontend web technologies
- YOLOv5

Table of Contents

1	Team	4
1.1	Team Members	4
1.2	Required Skill Sets for Your Project	4
1.3	Skill Sets covered by the Team	4
1.4	Project Management Style Adopted by the team.....	4
1.5	Initial Project Management Roles.....	4
2	Introduction	5
1.6	Problem Statement	5
1.7	Requirements & Constraints.....	5
1.8	Engineering Standards	5
1.9	Intended Users and Uses	6
3	Project Plan.....	7
3.1	Project Management/Tracking Procedures	7
3.2	Task Decomposition	7
3.3	Project Proposed Milestones, Metrics, and Evaluation Criteria	7
3.4	Project Timeline/Schedule.....	8
3.5	Risks And Risk Management/Mitigation	9
3.6	Personnel Effort Requirements	9
3.7	Other Resource Requirements	10
4	Design	11
4.1	Design Context	11
4.1.1	Broader Context	11
4.1.2	User Needs	11
4.1.3	Prior Work/Solutions	12
4.1.4	Technical Complexity	12
4.2	Design Exploration	12
4.2.1	Design Decisions	12
4.2.2	Ideation	12
4.2.3	Decision-Making and Trade-Off	13
4.3	Proposed Design	13
4.3.1	Design Visual and Description.....	13

4.3.2	Functionality	14
4.3.3	Areas of Concern and Development	14
4.4	Technology Considerations	14
4.5	Design Analysis	14
4.6	Design Plan	14
5	Testing.....	16
5.1	Unit Testing.....	16
5.2	Interface Testing	16
5.3	Integration Testing	16
5.4	System Testing	16
5.5	Regression Testing.....	17
5.6	Acceptance Testing.....	17
5.7	Security Testing.....	17
5.8	Results	17
6	Implementation	18
7	Professionalism	19
7.1	Areas of Responsibility	19
7.2	Project Specific Professional Responsibility Areas.....	22
7.3	Most Applicable Professional Responsibility Area	23
8	Closing Material.....	24
8.1	Discussion	24
8.2	Conclusion	24
8.4	Appendices	24
8.4.1	Team Contract	24

List of figures/tables/symbols/definitions

Figure 1	Design Diagram	13
Figure 2	Image Processing Output.....	18

1 Team

1.1 TEAM MEMBERS

- 1) Evan Uhlmeyer
- 2) Frank Sullivan
- 3) Jorge Ortiz
- 4) Tyler Rolston
- 5) Joel Neppel

1.2 REQUIRED SKILL SETS FOR YOUR PROJECT

- Frontend/UI development (creating GUI for lab tracker app)
 - (Undecided) HTML, CSS, JavaScript
- Backend development (sending lab data to the front end)
 - Python,
- Database management (storing/retrieving data from the lab computers)
- Image processing
 - YOLOv5, OpenCV

1.3 SKILL SETS COVERED BY THE TEAM

Every team member has taken Com S 309 and has some backend and frontend development experience. Some team members have taken database management classes (such as Com S 363) or have otherwise worked with databases

1.4 PROJECT MANAGEMENT STYLE ADOPTED BY THE TEAM

Each member has a non-technical role to maintain team organization and will have a technical role later.

The team creates a list of tasks and group members decide for themselves which tasks they will work on. This allows everyone to work on tasks relevant to their experience and comfort level.

1.5 INITIAL PROJECT MANAGEMENT ROLES

- Evan Uhlmeyer: Meeting leader
- Frank Sullivan: Team website and image manager
- Jorge Ortiz: Main client contact
- Tyler Rolston: ETG and external contact
- Joel Neppel: Course assignment manager

2 Introduction

2.1 PROBLEM STATEMENT

The lab rooms in Coover Hall at Iowa State University tend to be full many hours during the day depending on lab schedules, how many classes use it, and how close project deadlines are. Currently, there is only a limited website to check lab usage without going to the lab. This presents a problem for both ECE (Electrical and Computer Engineering) students and faculty by making it harder for students to work on classwork and harder for faculty to help students with work in the labs. Our project aims to resolve this problem by creating a website that displays current lab usage data and the lab's class schedule. This will allow both students and faculty to better plan their work in the labs.

2.2 REQUIREMENTS & CONSTRAINTS

- Create a website that displays the lab schedule and usage statistics
- Start with a single lab then expand to all Coover Hall labs
- Provide Canvas integration
- Have an easy way to update the lab schedules every semester
- Have lab capacity data on the website be current (updated within 10 minutes) (**constraint**)
- Website page loads within 3 seconds while on the ISU network (**constraint**)
- Website is easy to navigate and use
- Website presents data in a format which can be read quickly and easily

2.3 ENGINEERING STANDARDS

ISO/IEC/IEEE 29119 (1 – 4)

This standard is a collection of four international standards that apply to software testing. They include concepts and definitions used in the standard, test processes, test documentation, and test techniques. This standard applies to our project since every software project needs to have a robust approach to testing, to ensure that the project meets the requirements we set for it. ([IEC 29119](#))

ISO/IEC/IEEE 23026-2015

This standard defines requirements for the life cycle of websites. This includes strategy, design, engineering, testing and validation, and management and sustainment for Intranet and Extranet Environment. The primary focus of our project is to develop a website to provide data to our users. This standard will be useful in defining requirements for how we manage our website after it is deployed. ([ISO/IEC/IEEE 23026-2015](#))

IEEE 1016-2009

This standard dictates how Software Design Descriptions (SDDs) should be written. It includes the content and organization of these documents. This standard will be useful in guiding the writing of our projects design description as we move forward with our design process. ([IEEE SA - IEEE 1016-2009](#))

2.4 INTENDED USERS AND USES

Who benefits from the results of your project? Who cares that it exists? How will they use it? Enumerating as many “use cases” as possible also helps you make sure that your requirements are complete (each use case may give rise to its own set of requirements).

Students

- Able to view lab schedules
- Able to see number of seats available

Faculty

- Provide tool to students
- Plan when to schedule office hours

TAs

- Plan when to schedule office hours
- Determine when students are in the lab and would be a good time to go help

3 Project Plan

3.1 PROJECT MANAGEMENT/TRACKING PROCEDURES

We will be using the agile method to manage our project. The lab availability tracker will have a public website, so we will want to get feedback from our client and users throughout its development. Agile will work better since there will be more opportunities to make usability or functionality changes before spending too much time on it.

GitLab will store our code to manage change history and share work between team members. We will also use GitLab's task management features to track team members' progress and review code changes.

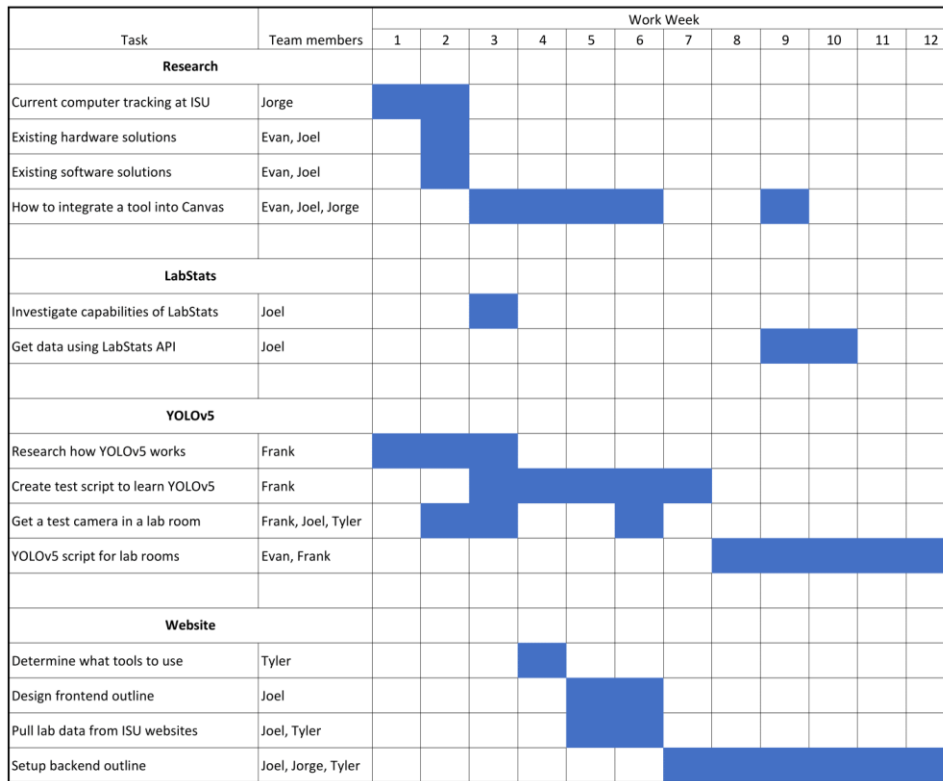
3.2 TASK DECOMPOSITION

- Setup YOLOv5 to identify how many people are in a lab room
 - Python code to identify people in a controlled environment
 - Identify people in a real lab
- Create a database that stores lab data
 - Add lab schedules for each lab room
 - Read and write current lab usage data
- Create a website to display lab data
 - Overview home page that displays list of tracked labs and current usage
 - Page for each lab room with more detailed information including lab schedule, capacity, and usage
 - Integrate website into Canvas
- Create a server to integrate components
 - Run the YOLOv5 code to get an image from a lab room and determine current lab usage
 - Write the lab usage data from YOLOv5 to the database
 - Display the current lab data on the website

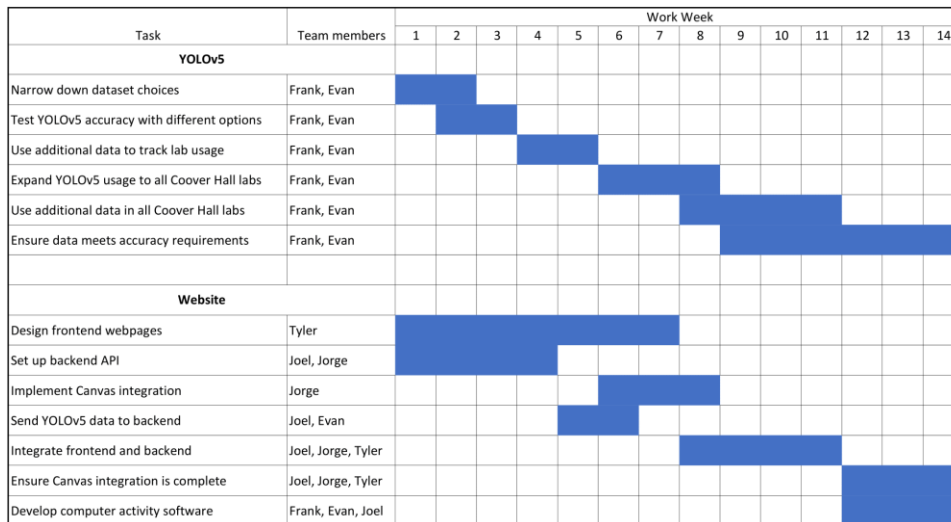
3.3 PROJECT PROPOSED MILESTONES, METRICS, AND EVALUATION CRITERIA

- Website will display current lab usage at an accuracy of 90%
- Website load within three seconds of user access
- Number of labs tracked:
 - Milestone 1: Capable of tracking one lab in Coover Hall.
 - Milestone 2: Capable of tracking all labs in Coover Hall.
- Website will be integrated into Canvas and be able to be added to specific Canvas courses in platform
- Website displays accurate lab schedules for labs in Coover Hall

3.4 PROJECT TIMELINE/SCHEDULE



Gantt chart for spring semester



Gantt chart for fall semester

- May 2023: Configure YOLO v5 to be able to accurately track people in select labs
- May 2023: Gather lab data and use that to accurately track computers currently in use in select labs

- August 2023: Set up basic website
- September 2023: Figure out how Canvas integration works and implement it to website
- September 2023: Expand YOLO v5 to accurately track people in all labs within Coover
- September 2023: Use lab data to determine computers used in all labs within Coover
- October 2023: Have website be fully functional
- November 2023: Ensure Canvas integration is complete
- November 2023: Ensure data has 95% accuracy
- December 2023: Ensure everything is completed

3.5 RISKS AND RISK MANAGEMENT/MITIGATION

- Setup YOLOv5 to identify how many people are in a lab room
 - a. The machine learning algorithm is not accurate enough to be useful : $p = 0.1$
 - i. Rely on labstats or create a labstats replica to base room usage on computer logins
- Create a database that stores lab data
 - a. The classes website is changed resulting in the schedule scraper breaking : $p = 0.05$
- Create a website that displays lab schedules and current usage
 - a. There won't be enough time/resources to create a UI that is adequate for production : $p = 0.5$
 - i. Reach out to Iowa State IT about collaborating on UI
- Create a server to integrate components
 - a. Website is not able to scale to many users : $p = 0.1$

3.6 PERSONNEL EFFORT REQUIREMENTS

Task	Person-Hours
Setup YOLOv5	
Identify people in a controlled environment	70
Identify people in a lab	100
Create Database	
Add lab schedules	50
Read/Write lab usage	25
Create Website	
Overview page	80

Individual lab room page	60
Integrate components	
Run YOLOv5 on the server	20
Write usage data to the database	20
Read and display usage data from the database on the website	30

These time estimates include the time to develop and test each task. YOLOv5 is new to everyone on our team, so we have a large amount of person-hours scheduled for that. In addition to the learning, it will just take time to get it working properly due to the variety of places the camera will be.

The create database and website tasks have their first subtasks start longer and then are reduced; this is because the first parts will need some time spent learning the tools and methods while the second part will mainly be implementation. The Create Database tasks are the shortest since our team already has some experience and has a relatively limited scope for what it needs to do.

The Integrate Component tasks are not expected to take very long since each component will be completed and thoroughly tested by that point.

3.7 OTHER RESOURCE REQUIREMENTS

Identify the other resources aside from financial (such as parts and materials) required to complete the project.

- Cameras to monitor lab usage
- Server space
 - Database
 - Website hosting

4 Design

4.1 DESIGN CONTEXT

4.1.1 Broader Context

Area	Description	Examples
Public health, safety, and welfare	Affects the productivity of students, adds convenient options for faculty	Increases opportunities for students to use their time efficiently
Global, cultural, and social	Privacy concerns	Some students may not wish to be in view of a camera designed to identify people
Environmental	Energy usage Equipment production	Running the camera and server will consume energy, but we can make optimizations to reduce energy usage during times when lab activity is typically low We will need additional cameras that will have a manufacturing impact. Identifying if we can use old cameras can decrease new material usage.
Economic	Cost to buy cameras and run application	The total cost per lab room will need to be low and ideally will replace LabStats to save money Initial equipment cost can make app difficult to scale

4.1.2 User Needs

The ISU ECE Department needs a solution for lab tracking, in order to save money for other uses within the department.

ECE students at ISU need a reliable way to see lab availability since they are dependent on the labs in Coover Hall to complete their classes.

ECE professors at ISU need a reliable way to see lab availability in order to help their students meet the goals set for them as well as the goals students have set for themselves.

4.1.3 Prior Work/Solutions

A current lab availability website exists and uses a vendor service called LabStats to determine lab usage based on how many desktops are currently logged into. LabStats provides the basic functionality we require, including lab capacity, current lab usage, and lab scheduling, but it has limited capabilities. Not all labs will work with LabStats because LabStats does not support Linux. Lab capacity using LabStats also makes some assumptions that are not always accurate. For example, LabStats tracks users logged into desktops, so if someone comes to a lab to use other equipment and does not log into a desktop, the person will not be counted even though the space is being used.

There are many existing machine learning designs that can identify people from a camera feed. These are pre-trained models, so there may only be minor modifications required to have a reasonably accurate count of people.

Some solutions have additional hardware that can identify when someone is at a desk and can make reservations. This provides a reliable way to identify when a desk space is being used, but the additional hardware requires additional costs along with more technical management for each device.

4.1.4 Technical Complexity

Our design contains three distinct parts that will be working together to provide current lab usage data. The lab usage data will come from a camera using machine learning algorithms to identify people in a room. We will need a place to store the usage data along with other lab information, and this is where a database will come into play. The database will store lab information using multiple tables with relationships between them which provides quick and efficient access and storage of the data. Students will require a user-friendly interface to view lab data, and the website we are making will incorporate different tools and libraries to provide an elegant design.

Using a camera to identify people in a lab environment is a unique goal for machine learning. It will have people partially blocked by monitors, but we can expect people to be in a grid layout in the lab. These unique parts of identifying people in a lab will be a challenge to do reliably. The website and database for the lab data will also match industry standards to have load times people are used to along with a user-friendly interface.

4.2 DESIGN EXPLORATION

4.2.1 Design Decisions

1. How often will we get a new frame from the camera and run the YOLOv5 script to count how many people are in the lab?
2. What camera will we use in the labs?
3. What will we use to make the website?

4.2.2 Ideation

When considering what to use for our website, we needed to consider how to add integration for other websites and applications (such as Canvas) as well as where we would retrieve the website data from.

“What will we use to make the website?”

1. Create a website to display seating count information
2. Integrate website into Canvas
3. Retrieve site info from data table we maintain
4. Retrieve site info from LabStats data table
5. Use C++ for the back end
6. Use Python for the back end

4.2.3 Decision-Making and Trade-Off

We originally considered making an application that could work with existing apps like MyState, but that added a significant amount of overhead, so we decided to focus on making a web-based application with possible Canvas integration.

Retrieving data from the existing LabStats implementation is convenient but has a higher long-term cost, as well as not being compatible with labs running Linux. The downside of instead getting data from sensors or webcam feeds is that extra time must be spent developing a new system that may yield worse results. However, it has the possibility of having a lower maintenance cost.

OpenCV runs in C++ and Python, but YOLOv5 uses Python, so Python is the preferred choice.

4.3 PROPOSED DESIGN

4.3.1 Design Visual and Description

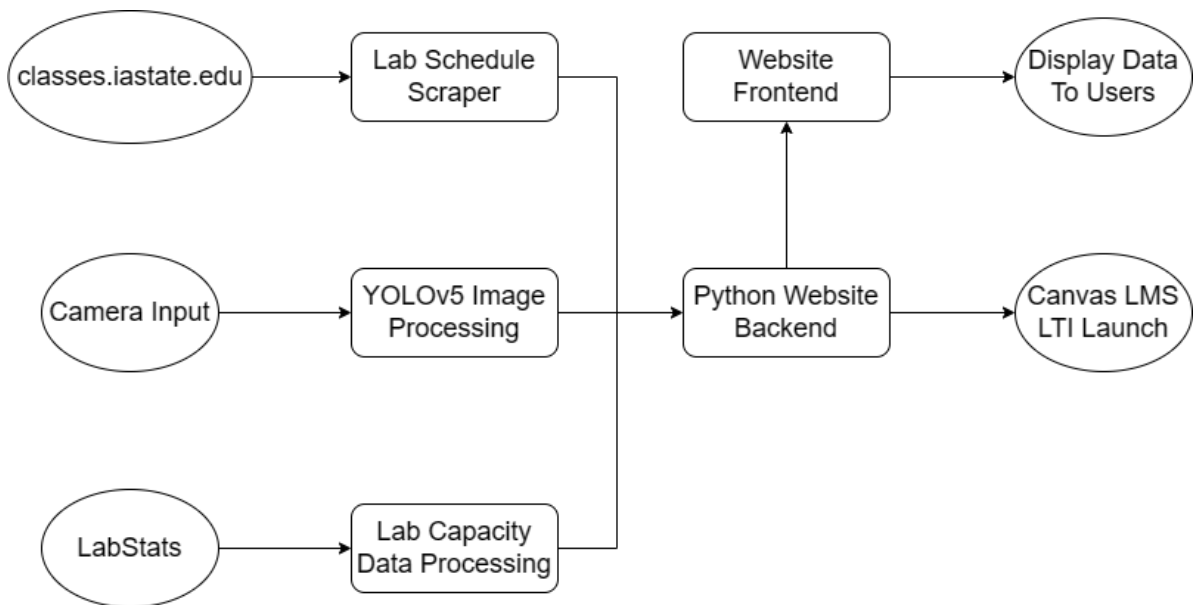


Figure 1

Our design diagram (Fig. 1) has three types of elements. The ovular elements represent Input/Output, the square elements represent software components, and the cylindrical element represents our database.

Our three inputs are at the left of this diagram, including Camera Input, LabStats, and the ISU class schedule website. The input from lab cameras is fed through software running the YOLOv5 image

detection framework. Camera data and LabStats data are processed and stored on the main database. The third input, classes.iastate.edu, is an official ISU website that lab schedules are pulled from. The lab schedules will be stored on the main database as well. All this data is used by the website backend to either send to the frontend for user display or displayed in the integrated Canvas page.

4.3.2 Functionality

As people use a lab throughout the day, a website will display the current lab usage along with a schedule of the classes in the lab. The lab usage will be updated periodically using a camera to count how many people are in a lab. Students wanting to use the lab can quickly check the lab usage at any time to know if there is an open space for them.

Our proposed design will meet all of the requirements by having a website that displays the desired data with an easy-to-navigate layout and a load time of a matter of seconds. The count of people in a lab space is expected to be updated at least once every 5-10 minutes, so the website will always have current data.

4.3.3 Areas of Concern and Development

The data would ideally be real-time to maximize its usefulness for users. Due to the use of cameras with YOLOv5, this approach would require a lot of processing power and take up a lot of space memory wise. We will most likely need to reduce the frequency in which data is updated, but it is unclear how exactly this would affect accuracy.

The application should be visible, unlike previous implementations, so that it can be found and used easily. Our plan to improve visibility is to use canvas integration. This would allow students to find it on the class Canvas page. One potential area of concern is instructors not enabling the Canvas embed and consequently students not seeing it on the Canvas page.

4.4 TECHNOLOGY CONSIDERATIONS

Selecting a camera will impact how well the ML script works. A higher resolution will provide more detail to YOLOv5, but it will take longer to process.

Another big decision which web framework to use. Some, like Flask, have built a lot of built in features that simplify development. Others will require us to choose many different technologies that will offer more flexibility and control but increase development time and complexity.

4.5 DESIGN ANALYSIS

Our current design includes using LabStats along with image processing to track capacity, but in the future, we are planning to phase out LabStats. LabStats costs the university a flat fee per computer, and our solution could save remove that cost.

4.6 DESIGN PLAN

The backend will be the main control point that will handle the lab data to present to the user. The camera runs on a separate script that regularly takes a still frame and counts the number of people in the room. It communicates with the backend to store the number of people in the lab. The

backend combines the camera data with desktop usage reported by LabStats and returns information requested by a user. These events may be happening simultaneously, so it will need to handle concurrent use of the data. Users access the data through a website. This main interface will need to be easy to find and get information from.

5 Testing

5.1 UNIT TESTING

The backend will be the main part using unit tests. The main part of the backend will be handling API requests, and each request will be handled in its own function that will be tested individually. These functions are the main way people will be getting information along with the camera giving lab usage information, so these functions will need to be very reliable. We will design the API functions to have a defined and limited operation so they can be easily and thoroughly tested.

5.2 INTERFACE TESTING

The main software component that will require interface testing is the API for the webserver. We will need to ensure that data provided to the API is correctly interpreted by the server, and data given to the user by the API is correctly interpreted by the user's software. We will also require interface testing between the camera and the machine learning algorithm to ensure that we interpret the image format correctly.

5.3 INTEGRATION TESTING

There are a few critical integration paths in our design.

1. Integrating YOLOv5 output with data from labstats
 - a. The data from both is generated very differently but needs to be compatible with each other
 - i. Test by mixing YOLOv5 output and labstats data and ensuring there are no compatibility issues
2. Integrating data into our database and ensuring combined data is consistent
 - a. If the data does not integrate properly into our database, it cannot be displayed
 - i. Run unit tests with different sets of camera info and lab data and ensuring head count is expected
3. Integrating our website into Canvas
 - a. If done improperly, Canvas integration can completely break and make our website inaccessible from Canvas, defeating the purpose of the project
 - i. Ensure we properly interact with Canvas API

5.4 SYSTEM TESTING

System level testing will largely be providing input to the camera and checking output on the website. By providing data to the camera, it will traverse our whole system before it is displayed on the website. We will most likely not use testing tools to do this testing, but rather this will be conducted at late stages of implementation by members of the group, rather than being automated.

- Check real lab capacity by counting people in lab, ensure website is displaying the correct count for the lab
 - Check timing of accurate data as part of this testing
- Check lab schedules at classes.iastate.edu, ensure that this data is displayed accurately on the website

5.5 REGRESSION TESTING

We will be using GitLab which has some features to automate tasks, and we will use this feature to run our tests whenever a merge request is completed. The automated tests will consist of all the unit tests and any other tests that do not require human interaction to complete.

The automated test should catch most unintended changes in individual components, but it will be harder to make automated tests for the system as a whole. The manual tests to test more complex system functions will require manual actions that will take time, so we will only perform these tests monthly or after a large change.

5.6 ACCEPTANCE TESTING

We will collect data on how often the occupancy number refreshes. We will compare the data with information from LabStats or manually count the people in a frame to validate the accuracy of our data. After implementation and release, the users of our system could be involved in a survey on their experience with CLARE.

5.7 SECURITY TESTING

For security testing, the main thing we need to worry about is the security of images being provided by the cameras. Our team will perform some light penetration testing to ensure that the security is robust and will make use of static analysis tools.

5.8 RESULTS

Due to the timeline of this project, we do not currently have testing results. This section will be updated when implementation reaches a testable stage, and we generate results.

6 Implementation

The upcoming semester will be focused on implementing the design developed throughout this semester. The team will be split into two main groups, one working on the YOLOv5 camera script and the other working on the website.

The camera group will start by continuing the script to process the camera data. The script currently gets a still frame from the camera and counts the number of people in a room. Additions to the script will be to give the count of people to the backend and improve the accuracy of the count. This team will also likely research additional techniques for image recognition, such as creating our own dataset based on footage from labs.

Output from the current Computer Vision functionality can be found in Figure 2.

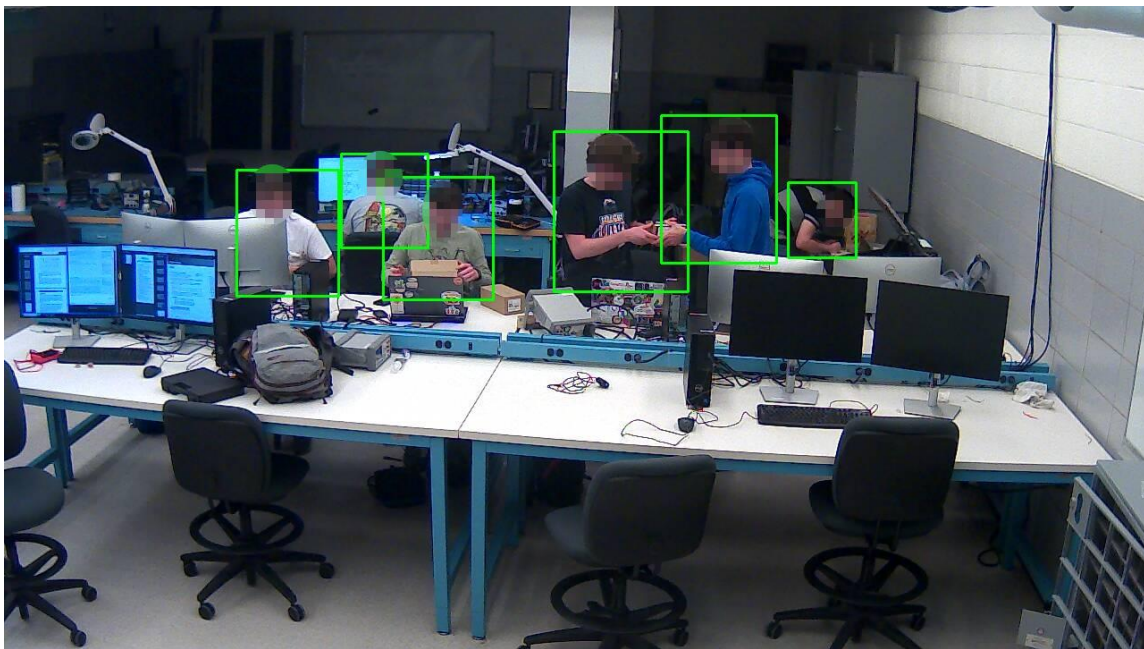


Figure 2

The website group will start development of the website. Current progress is researching different web frameworks and tools. After deciding what tools to use, the website team will further split into a frontend and backend team. The backend will focus on developing an API to get and set lab usage data and the frontend will develop the website UI.

7 Professionalism

7.1 AREAS OF RESPONSIBILITY

Area of responsibility	Definition	NSPE Canon	IEEE Code of Ethics
Work Competence	Perform work of high quality, integrity, timeliness, and professional competence.	Perform services only in areas of their competence; Avoid deceptive acts.	<p>(2) A conflict of interest can reduce the quality of an engineer's work since they may not want it to be successful or will be more focused on something else</p> <p>(3) Maintain timeliness by providing accurate estimates</p> <p>(6) High-quality work can only be performed when the engineer is qualified</p> <p>These codes differ from NSPE because IEEE is more specific is what an engineer should do.</p>
Financial Responsibility	Deliver products and services of realizable value and at reasonable costs.	Act for each employer or client as faithful agents or trustees.	<p>(2) Having a conflict of interest may make the engineer make a decision that will benefit themselves more than their client which can increase costs</p> <p>(4) Rejecting bribes will help keep material costs competitive</p>

			These codes relate more to costs than the NSPE Canon.
Communication Honesty	Report work truthfully, without deception, and understandable to stakeholders.	Issue public statements only in an objective and truthful manner; Avoid deceptive acts.	(1) Making decisions good for the public will be truthful and benefit stakeholders (3) Says to be honest (6) Overstating abilities is a form of deception (9) Performing false or misleading actions may damage reputations NSPE emphasizes being objective with public statements while IEEE focuses on truthfulness.
Health, Safety, Well-Being	Minimize risks to safety, health, and well-being of stakeholders.	Hold paramount the safety, health, and welfare of the public.	(1) Accept responsibility for decisions that may affect the public, disclose factors that may cause harm (9) Avoid injuring others through malicious actions IEEE is different in that it specifies that not disclosing certain information may endanger the public (i.e., specific ways to value public safety).
Property Ownership	Respect property, ideas, and	Act for each employer or client as faithful	(2) Be faithful to clients and employers

	information of clients and others.	agents or trustees.	<p>by disclosing conflicts of interest</p> <p>(4) Bribery will only cause someone to behave in bad faith</p> <p>(7) Giving proper credit to contributions is respectful and allows transparency</p> <p>(9) Malicious actions may damage the reputation of employers or clients</p> <p>This differs from NSPE in that it gives specific actions that should be taken or actions that should be avoided while NSPE just says to act faithfully.</p>
Sustainability	Protect environment and natural resources locally and globally.	Adhere to principles of sustainable development to protect the environment for future generations	<p>(1) Do not damage the environment</p> <p>This item differs from NSPE because it does not directly reference sustainability but instructs to protect the environment which is directly related to sustainability.</p>
Social Responsibility	Produce products and services that benefit society and communities.	Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and	<p>(5) Improving the understanding of potential consequences of technology allows one to be more ethical in their conduct</p>

		usefulness of the profession.	<p>(9) Avoiding false or malicious actions allows someone to maintain their honor and reputation</p> <p>The NSPE places more emphasis on how an individual's actions affect their profession overall. IEEE does mention accepting the personal obligation to the profession, but also makes note of responsibilities toward colleagues and communities.</p>
--	--	-------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

7.2 PROJECT SPECIFIC PROFESSIONAL RESPONSIBILITY AREAS

Work Competence (High): We have clear cut obligations and an expectation to push out a high-quality product for the student population to use. We plan to have our product be used by the general student population, so it has to be reliable and easy to use

Financial Responsibility (Low): It is very likely that our project will rely only on software, which we expect to be cost-free. In the event of the project requiring hardware, we will need to take cost into account, but since we are limiting scope to only Coover hall, we will not need to produce more than 10 – 20 hardware units.

Communication Honesty (Medium): Since our project deals with providing data to users, we will need to ensure that our data is accurate to avoid misleading users. The data we will provide is not essential, and providing inaccurate information will inconvenience users, not endanger them. It is also important to be honest with our Client/Advisor since they have a stake in the project.

Health, Safety, Well-Being (Low): Our project will need to consider data security, especially if we implement a design that uses a video camera to monitor labs. Our project does not have any components that we expect to have an effect on the physical health or safety of our users.

Property Ownership (Medium): It is important to respect the property of the University as we implement our design. The university owns the property our product will interact with. It is also important to respect our users and protect information about them, such as which people are in a lab at a specific time.

Sustainability (N/A): Because of our project's primary focus on software, environmental sustainability is not a major focus of our group. If our project does require hardware

implementation, it will be a long-standing installation, not a disposable device that needs to be recyclable or degradable.

Social Responsibility (High): The focus of our project is to provide a resource that benefits our community (ISU). At the same time, our project may reflect on ISU if it is used directly by ISU as a method to help with lab congestion.

7.3 MOST APPLICABLE PROFESSIONAL RESPONSIBILITY AREA

The most applicable responsibility area for our group is Work Competence. Our project relies most highly on our ability to perform consistent, effective work to complete our product. Each member of our group is proficient in software development, which is paramount to our project's success. It is also important for our team to meet deadlines, and be on time in general, which we have succeeded at so far. Our team has been on time for our meetings, present in lectures, and able to complete our weekly goals.

8 Closing Material

8.1 DISCUSSION

None of the primary requirements for our project were met this semester, due to the timeline of our project stretching through to winter 2023. We successfully began implementation and have gotten a head start on the work that we have planned for next semester.

8.2 CONCLUSION

Our primary goal for this semester was to complete a design for the system that meets the requirements provided by our client. For the website side of this, we were successful and largely only have implementation remaining for next semester. On the data collection side, we would like to do more experimentation with machine learning and crowd counting before committing. Additionally, we are still considering other approaches to data collection such as creating software to collect login data.

One thing that was a bottleneck for our data collection system design progress was the administrative process of getting access to a security camera. Our plan of action to complete the data collection system design is to finalize the implementation of the crowd counting machine learning algorithm in conjunction with the development of the login counting software. Then we will compare the approaches to make a final decision.

8.4 APPENDICES

8.4.1 Team Contract

Team Members:

- 1) Evan Uhlmeier
- 2) Frank Sullivan
- 3) Jorge Ortiz
- 4) Tyler Rolston
- 5) Joel Neppel

Team Procedures

1. Day, time, and location for regular team meetings:

- Wednesday at 4:30, face-to-face

2. Preferred method of communication updates, reminders, issues, and scheduling:

- Discord

3. Decision-making policy:

- Consensus; discuss all ideas first, but decide as a group

4. Procedures for record keeping:

- Evan will keep meeting minutes, post them as a PDF to group members

Participation Expectations

1. Expected individual attendance, punctuality, and participation at all team meetings:

- Everyone should show up on time and make an effort to attend all meetings. If they cannot, they should give notice in the team Discord.

2. Expected level of responsibility for fulfilling team assignments, timelines, and deadlines:

- All members should complete their assigned tasks on time and participate in group assignments.
- If a member is stuck on something, they should ask for help.

3. Expected level of communication with other team members:

- Attend team meetings and reply to Discord messages within a day of a message needing a response.

4. Expected level of commitment to team decisions and tasks:

- Voice any opinion they have.

Leadership

1. Leadership roles for each team member:

- Evan Uhlmeier: Meeting leader
- Frank Sullivan: Team website and image manager
- Jorge Ortiz: Main client contact
- Tyler Rolston: ETG and external contact
- Joel Neppel: Course assignment manager

2. Strategies for supporting and guiding the work of all team members:

- Having a friendly, open team dynamic where members can be comfortable asking questions.
- Doing quick check-ins when we see each other outside of team meetings.

3. Strategies for recognizing the contributions of all team members:

- Work on the weekly reports together and review the progress made by the whole team.

Collaboration and Inclusion

1. Describe the skills, expertise, and unique perspectives each team member brings to the team.

- Every team member has taken Com S 309 and has some backend and frontend development experience.

2. Strategies for encouraging and support contributions and ideas from all team members:

- Every team member has company work experience that brings different management and development styles.

3. Procedures for identifying and resolving collaboration or inclusion issues:

- Team members should be direct about their issues and discuss them as they happen, so they do not build into bigger issues.
- Mention in advance if a group member anticipates other obligations (e.g., due dates for other classes) affecting their level of effort for the project

Goal setting, Planning, and Execution

1. Team goals for this semester:

- Create the basic layout and structure for a lab availability website set up
- Learn about website development

2. Strategies for planning and assigning individual and teamwork:

- Create a list of tasks and let team members volunteer for what they want to do

3. Strategies for keeping on task:

- During meetings, any team member may simply say “Let’s get back on track guys” when they feel the discussion is digressing.
- Research ahead of time, bring ideas or discussion points to meetings

Consequences for Not Adhering to Team Contract

1. How will you handle infractions of any of the obligations of this team contract?

- Discuss infractions privately or bring up concerns to group early on, attack the problem instead of the person.

2. What will your team do if the infractions continue?

- Have a group meeting to discuss infractions, speak openly about failure to meet expectations, formulate plan to move forward.
- If the situation escalates, go to an instructor or advisor to resolve issues.

a) I participated in formulating the standards, roles, and procedures as stated in this contract.

b) I understand that I am obligated to abide by these terms and conditions.

c) I understand that if I do not abide by these terms and conditions, I will suffer the consequences as stated in this contract.

1) Joel Neppel DATE 2/19/2023

2) Frank Sullivan DATE 2/19/2023

3) Tyler Rolston DATE 2/19/2023

4) Jorge Ortiz DATE 2/19/2023

5) Evan Uhlmeyer DATE 2/19/2023