**HARAMAYA UNIVERSITY**

**COLLAGE OF COMPUTING AND INFORMATICS DEPARTMENT OF INFORMATION SYSTEMS**

#### Report on the Practical Attachment in Software Engineering Department prepared by:

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**Declaration**

We therefore certify that all materials and data in this Practical attachment document are obtained and presented in compliance with guidelines of Software Engineering Department. We also declare that, this work is entirely original and has never been presented or used by any other departments.

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As an authorized Advisor, We have approved the submission of this Practical Attachment document.

###### Advisor Name: Yohans S.

Signature Date

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**Executive summary**

This internship report tries to justify more or less about our overall stay and exposure at Space Science and Geospatial Institute (SSGI) during our Internship period. The main purpose of internship is to apply what we have learned, get experience for our future, and learn different skill that is important in work place. This internship gave me opportunity to know and understand work environment, meet and communicate with different tech persons having more than decades of experience and also implement what I knew on real life scenarios.

Accordingly, this report is comprised of four sections. The first section discusses the introduction part of the internship report which provides pertinent background information activities. The second section deal with our overall internship experience which was in Space Science and Geospatial Institute (SSGI) and the tasks that we have done during our internship period. And the next and third section describes the overall benefits gained from the internship. Finally, the conclusion, result and our recommendation for both Haramaya University and hosting organization will proceed in the fourth section.

**Introduction**

The internship experience is a fundamental component of academic and professional development for students pursuing careers in software engineering. It offers a unique opportunity to bridge the gap between theoretical knowledge gained in the classroom and practical application in real-world scenarios. This internship report aims to provide a comprehensive overview of our internship at the Space Science and Geospatial Institute (SSGI), where we had the privilege of working on the "Satellite Imagery and Catalogue Classification System."

**Background**

Space Science and Geospatial Institute (SSGI) is a renowned institution at the forefront of cutting-edge research and innovation in the fields of space science and geospatial technology. During our internship, we were fortunate to be part of this dynamic and forward-thinking organization, which has a long-standing history of contributing to space exploration, satellite technology, and geospatial information systems.

Our internship took place in the context of SSGI's commitment to fostering collaboration with aspiring software engineers. Under the guidance of three dedicated employees of the institute, we embarked on a challenging project that aimed to harness satellite imagery and advanced data classification techniques.

**Project Overview**

The central focus of our internship was the development of the "Satellite Imagery and Catalogue Classification System." This project aimed to address the growing need for efficient and accurate classification and management of satellite imagery data. With the increasing volume of satellite imagery being collected for various purposes, from environmental monitoring to disaster management, the importance of an effective system for organizing and analyzing this data cannot be overstated.

Our team of five interns, comprising software engineering students, was entrusted with the responsibility of designing, developing, and implementing this system. Throughout the internship, we collaborated closely with our mentors from SSGI, who provided invaluable guidance and insights, ensuring that our efforts aligned with the institute's goals and industry best practices.

In this report, we will provide an in-depth account of our internship experience, detailing the project's objectives, our roles and responsibilities, the technologies and methodologies employed, challenges encountered, and the outcomes achieved. Furthermore, we will reflect on the knowledge and skills gained during our time at SSGI, illustrating how this internship has enriched our academic journey and prepared us for future endeavors in the field of software engineering.

**Internship Activities**

Project Development: The central focus of our internship was the comprehensive development of the "Satellite Imagery and Catalogue Classification System." We undertook the entire software development lifecycle, encompassing design, coding, and rigorous testing to ensure a robust and functional system.

Detailed Documentation: In addition to our development efforts, we produced a documentation that encapsulated our journey from inception to implementation. This documentation was crafted, starting from a problem statement provided to us. It served as a foundational guide, outlining the project's objectives, scope, and requirements.

Teamwork: Collaborative efforts were pivotal to our success. We maintained a cohesive team dynamic with fellow interns, engaging in intricate discussions, code reviews, and collaborative design sessions. This synergy enabled us to tackle complex challenges collectively.

Supervision: We benefited from the guidance of three seasoned professionals from SSGI who served as our mentors. Their wealth of experience allowed them to provide invaluable insights and constructive feedback, ensuring that our work aligned with industry standards.

Coding and Programming: Proficiency in various programming languages, including JavaScript and Python, was essential for realizing the system's functionality. We diligently crafted code, adhering to best practices and established coding standards.

Meetings: We conducted regular progress meetings with our mentors. These meetings served as a platform for reporting our advancements, discussing encountered obstacles, and formulating effective solutions. They were instrumental in maintaining project coherence.

Testing and Debugging: Rigorous testing procedures were imperative to validate the system's reliability. We conducted exhaustive testing, including unit testing and system integration testing, to detect and rectify any anomalies, ensuring a seamless user experience.

Research: Our project involved implementing advanced data classification techniques, necessitating thorough research. We engaged in literature reviews, consulted academic papers, and explored industry case studies to inform our decision-making process.

Skill Enhancement: The internship provided a unique platform for enhancing our programming, teamwork, and problem-solving skills. Through real-world challenges, we honed our abilities, equipping us with practical expertise for future endeavors.

Final Presentation: The culmination of our internship was the presentation of our project to the SSGI team. This formal presentation allowed us to demonstrate our achievements, articulate our methodologies, and showcase the system's capabilities in a professional context.

**Main Customers or End-Users**

The primary customers or end-users of the "Satellite Imagery and Catalogue Classification System" were twofold:

Company Employees: The system primarily served the needs of Space Science and Geospatial Institute (SSGI) employees. These internal users relied on the system to efficiently catalog, classify, and access satellite imagery and related data for various research, analysis, and operational purposes within the organization.

External Users: In addition to SSGI employees, the system was designed to be accessible to external users, such as researchers, scientists, and professionals from other organizations, academic institutions, or government agencies. This broader user base aimed to facilitate collaboration and data sharing beyond the boundaries of the institute.

**Overall Objective of the Internship Task**

During our internship, the specific task we undertook within the broader context of the project was multifaceted:

System Development: Our primary objective was to actively contribute to the design, development, and implementation of the "Satellite Imagery and Catalogue Classification System." This encompassed tasks such as coding, software architecture design, database development, and user interface design.

Documentation Production: We also had the responsibility of producing comprehensive project documentation, starting from a provided problem statement. This documentation included detailed technical specifications, user manuals, and system documentation to ensure clarity, maintainability, and future scalability of the system.

Testing and Quality Assurance: As part of our task, we rigorously tested the system, performing unit testing, integration testing, and quality assurance procedures. The aim was to identify and rectify any software defects or inconsistencies to deliver a reliable and stable product.

Research and Knowledge Acquisition: Throughout our internship, we engaged in research activities to explore advanced data classification techniques and industry best practices. This knowledge acquisition was vital to inform our decision-making and implementation strategies.

Presentation and Knowledge Sharing: As a culmination of our internship, we prepared and delivered a final presentation to the SSGI team, showing our achievements, explaining our methodologies, and highlighting the system's capabilities to both technical and non-technical audiences.

**CHAPTER FOUR: Overall internship experience and our specific work**

**4.1 section of the company, we have been working and why?**

Starting from April 1 2015(EC) for an around four months we worked in ETHIOPIAN SPACE SCIENCE TECHNOLOGY INSTITUITE (ESSTI) as an intern. First of all 5 students from HARAMAYA UNIVERSITY COLEGE OF COMPUTING AND INFORMATICS (CCI) were assigned to ETHIOPIAN SPACE SCIENCE TECHNOLOGY INSTITUITE (ESSTI) for internship program.

**Background of the Company**

On October 14, 2016, the Council of Ministers approved the Establishment of Ethiopian Space Science and Technology Institute and Council, pursuant to article 5 and 39 of the Definition of Powers and Duties of the Executive Organs of the Federal Democratic Republic of Ethiopia proclamation No. 916/2015.

The main objectives of Establishment of Ethiopian Space Science and Technology Institute(ESSTI) are to enable the country to fully exploit multidimensional uses of space science and technologies; to produce demand based knowledgeable, skilled and attitudinally matured professionals matured professionals in the field of aerospace science that enable the country to become internationally competitive in the sector; to develop and strengthen space science and technology infrastructures to speed up space science and technology development in the country; and enable the country to be robust contributor for the development of aerospace science and technology.

The Space Council will have power and duties to provide directions and leadership support by evaluating space science policies, plans and strategies. It will also provide the necessary guidance and support for the proper and timely implementation of the Space Science and Technology plans of ESSTI.

The Approval of the ESSTI is one big step forward for the development of Ethiopian Space Science activities that will give advantage for Ethiopia to be effective and extensive user of space science and technology for its sustainable developments.

**Vision**

In 2022 E.C. to see a competitive institution built in Africa in the space and geospatial sector,

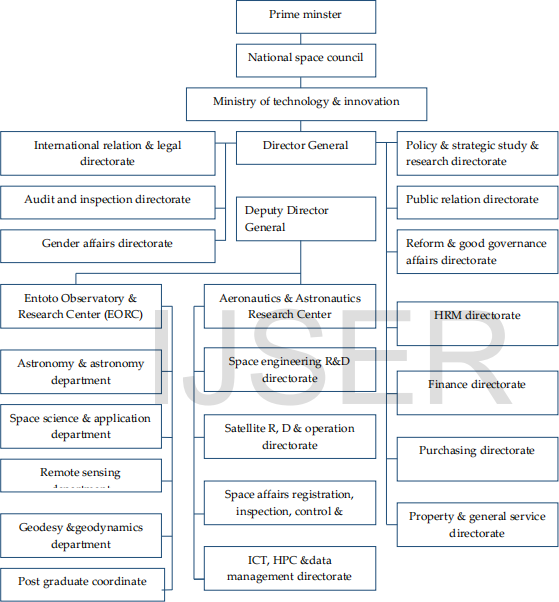
**Mission**

Ensuring international competitive research, timely and reliable information supply, technological development, social and economic development in the field of human resources in the field of technology and industrial transfer.

**Core Values**

* Space for Peace
* We Explore the World for the Benefit of Our People
* Excellence
* Sense of Belongingness
* Synergy
* Thirst for Knowledge
* Servant

## Organizational Chart



*Figur**e 1:-Organizational Chart*

So, our mentors decided to make a group 5 and to participate on a single project so our group was assigned to the department called SO (SATELLITE OPERATION).

**4.2 The work flow in SO (SATELLITE OPERATION)**

The work flow in this department of the organization is as follows there are 13 members in the department each with a different roll and the department has 2 sub system called GAS and GCS and those two subsystems has their own different subsystems, in a person wise there is one general director of the department and one co director and the so each person in this department has its own task and all the members by being two person at a time should go to ground station controller of etress1 and they will perform their tasks there but in a day only two peoples go to the station and the rest will be at the bureau of ESSTI performing their daily activity.

**4.3 work piece or work tasks we have been executing**

After knowing our department the next step was talking with the director of the department and two other members of the department then they told us that what they wanted from us in detail.

And they wanted us was to develop ESSTI Satellite Imagery catalogue, Analysis and data dissemination system (EDAAS).

The development of satellite image cataloging, management, and dissemination systems has been a focus of large satellite data providers for worldwide change study. Satellite imagery catalog system is developed for the user’s need regarding the utilization of satellite imagery for various applications. The system is used to set up metadata catalogs, and provide browsing, visualization and online downloading of data. In addition, the system is used to managing and distributing earth remote sensing data. These systems cover a wide range of tasks, including not only receiving, storing, and distributing satellite data, but also processing capabilities for generating standard products from the data, and archiving and management of related data (such as corresponding ground observations) and derived products. The need to catalog and handle the large volumes of data generated by earth-orbiting satellites, and the major problem of making such data known to and accessible to researchers, are driving systematic attempts to develop these systems. The ability of systems to enable access to store large data, aiding individual research efforts, and fostering collaboration among many researchers is critical to scientific success in understanding global environmental change.in this regard, this project is going to develop ESSTI Satellite Imagery catalogue, analysis and data dissemination system.

**Task Assigned**

Although our primary objective is to develop EDAAS, we pass through several major tasks along the way. From familiarizing ourselves with the work environment to becoming skilled in the tools and frameworks we used.

**Task One**

The first task we were assigned on was to read documents prepared by the organization which covers the overall idea of the project and digging and overviewing other websites which has similarity with the project we were going to build. In the course of this task, we encountered numerous novel aspects of satellite operation and ultimately concluded it with a comprehensive understanding of how satellite information is processed.

**Task Two**

Upon comprehending the fundamental concept of the project, we proceeded to draft the software requirement specification (SRS), which encompasses both functional and non-functional requirements, as well as all frameworks and tools utilized.

**Task Three**

Upon completion of the software requirement specification (SRS), we encountered a learning curve with the frameworks and tools utilized. Owing to our lack of familiarity with the tools and project, we experienced a learning curve in acquainting ourselves with the material we were provided. In light of this, we used Django as our server-side framework, PostgreSQL as our backend database management system, Leaflet and Folium for interactive mapping features, and other JavaScript libraries along with Bootstrap, HTML, and CSS for frontend development.

**Task Four**

Upon familiarizing ourselves with the tools, we proceeded to implementation. Following a discussion with our mentors, we employed agile methodologies to divide the implementation into different sprints. We also created a backlog that served as a guideline for us to refer to

**Sprint One**

• Implement search algorithm by coordinate, shapefile, kml/kmz file, GEOJSON/JSON, drawing AOI rectangle.

• Integrate drop and drag or upload the search area

• Access a metadata from database

• Design filter options (e.g., Satellite type (ETRSS-1, Superview, GF-1, GF-3, CBERS-4 ), Acquisition time (Start Date , End Date ) , Product Type (Level 2B), Cloud Percentage (progress bar), Image type )

• Implement filter functionality

• Integrate filters with search results

• Implement reset or clear search

**Sprint two**

Implement search result using the following parameter

* Image thumbnail
* Satellite name
* Product name
* Acquisition date
* Data Size
* Page limit and number of pages
* Download image data
* Zoom
* View product detail / preview
* Book mark
* Cloud percentage
* Sort (Instrument type)
* Add to map layer

**Sprint Three**

• Integrate map functionality with the layer selection

• Display satellite images on the map

• Integrate map layer options with the map interface

• Test and ensure smooth transition between map layers

• Enable map navigation and interaction functionality like zoom, on off and other.

**Sprint Four**

• Retrieve metadata for selected image and display metadata on the image details page

• Display interactive maps with selected image quick look,

**• Implement zoom and pan functionality**

**Sprint Five**

• Design download interface

• Grant downloads access for users

• Implement download functionality

• Support multiple file formats

• Ensure proper file compression and quality preservation

**Sprint Six**

• User registration (Full name (First, Second name, last name), (Password, Confirm password,) (Email, Confirm Email), Country, User Type (developer, ) (Select data usage purpose i.e. Agriculture , Cadaster, ), Institute (Organization, Student, and Researcher, Other….)

• User login

• User logout

• Registration verification email

• Forgot password with email

**Sprint Seven**

• Implement user feedback functionality with detailed user information i.e. (Full name, email, application name, feedback), feedback type.

**2.3 Methodology**

Methodology refers to the overall procedures of research used in our internship duration. To achieve the required results and to establish the objectives. We have passed through most software life cycle process. We only left deployment process and somehow the testing process.

**2.3.1. Method of data collection**

**Primary Source**

• Interview

We had contacted and interviewed some people who worked there to get information about the organization and also their experience with respect to their department in order to know detail about satellite image and detail of files in an image and cannot get it on documents or elsewhere. We also interviewed our coach on various occasions especially when having misconceptions and facing subject matter problems.

• Observation

It is one of the ways which helped us to collect numerous data. We mainly used this method to observe and adapt the work environment, and also to learn and understand several things from the SO team and our mentors while performing the satellite operation and image dissemination. It also helped as to know detail about satellite image.

**Secondary Source**

• Organization’s document

There are numerous documents prepared by the organization which could give some insight how to process satellite image.

**2.3.2. Method of problem analysis**

After collecting data to understand real-world problems and meet user needs, we used the collected data to prepare software requirement specification (SRS). Based on the prepared SRS, we analyzed the problem domain to gain a better understanding of the problem and propose a solution design. Here is the problem statement after the analysis:

**Statement of the Problems**

Multiple government institutions and organizations in Ethiopia require satellite imagery to support their research. Ethiopian Space Science and Technology Institute is the only government agency with the goal of acquiring and disseminating satellite data for national needs, notably in the government's interest. The ESSTI ground station, which is located on the entoto premises, is in charge of controlling, mission creation, receiving, processing, and disseminating ESSTI satellite imagery. ESSTI receives a wealth of satellite images daily (around 21 GB) from Ethiopian remote sensing satellite (ETRSS-1) and satellite images from other satellite providers. During archiving and processing it is very difficult to easily manage those bulky daily image data. In addition, the cataloging and dissemination of the data is carried out manually. Furthermore, the existing system has a major hassle while downloading, archiving, and processing of huge data.. To this end, we propose to develop a satellite image catalogue, analysis and dissemination system. The system will simplify the process of cataloging, analyzing and disseminating satellite imagery easier and more cost-effective. The developed solution will give everyone the possibility to find ESSTI satellite imagery wherever in a simple and effective way. Furthermore, it maintains and improves customer loyalty.

**2.3.3. Software development methodology**

Then after the problem analysis the next step was to choose software development methodology that was feasible with the requirements. The software development methodology we used was agile development. Agile methodology is a project management framework that breaks projects down into several dynamic phases, commonly known as sprints.

Why agile development?

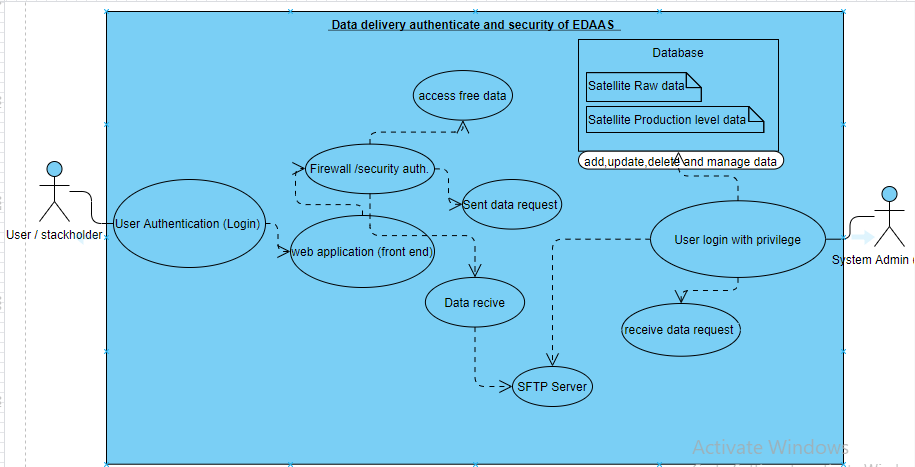
* Project scope was not certainly known from the outset.
* Due to the project was ongoing project.
* Predict risks and plan to ensure that the project runs smoothly.

**2.3.4. Proposed Solution (design)**

In-ordered to design the system and know the diction of the system we need to draw use case diagram after dictating functionality. In our case we also used use case diagram which is frequently used to analyze various systems. Based on the SRS, here is the product function and the use case diagram of the EDAAS.

## Product Functions

- The system will support retrieving data by Selecting a country, province and city which is queried by geographic coordinates, specification location, address, path/row inserted by user. -The results will be displayed according to their respective image time and product & archive time. - The system will do area editing using maps that provide functions such as polygon drawing, providing a point on the map and denoting a predefined area. - The system will support Shape file or kml file in the area of interest and allows users to download via FTP with preferred choice of datatype. - The system will retrieve metadata information from the satellite image for it will be regularly updated. - The system will allow users to access and purchase images by selecting from the satellites available. - The system should have user registration and login system. - The system should allow search and discovery of satellite image. - The system should allow satellite selection.



***Fig. 1:*** *EDAAS* ***use case diagram***

**2.3.5.System development (implementation)**

For implementation we tried to select a tech stack after completing the SRS.When selecting a tech stack for EDAAS, it is important to consider the requirements of the project. Django is known for its scalability, security, and ease of use. HTML, CSS, and JavaScript are commonly used for frontend development. HTML provides the structure of the web page, CSS is used for styling, and JavaScript is used for interactivity. PostgreSQL is known for its reliability, scalability, and performance. It is an excellent choice for large-scale applications that require high levels of data integrity and security. Leaflet and Folium are two popular libraries used for creating maps in Python. Leaflet is a JavaScript library that provides interactive maps, while Folium is a Python library that wraps around Leaflet and allows you to create maps in Python. By selecting these technologies, we planned to build a powerful and scalable EDAAS that meets your needs.

|  |  |  |
| --- | --- | --- |
|  | **Frame work used** | Description |
| 1.Backend | Django(Python Web Framework) | Is a Python-based free and open-source web framework that follows the model–template–views architectural pattern. |
| 2.Frontend | DHTML (Dynamic HTML) | DHTML means Dynamic HTML—which is exactly what the combination of HTML/JavaScript/CSS code is. |
| 3.Database | PostgreSQL | It is a highly stable database management system, backed by more than 20 years of community development which has contributed to its high levels of resilience, integrity, and correctness |
| 4.Map | Leaflet ,Folium | Leaflet is the leading open-source JavaScript library. It works efficiently across all major desktop and mobile platforms.  Folium is a Python library that makes it possible to visualize data on an interactive Leaflet map. |

**Why django as backend?**

Django framework is capable of displaying vector spatial data using libraries such as Folium. Django will allow manipulating geospatial data, in matricial or vectorial form.

**Why DHTML as frontend?**

Since the concept of the project was new and also using leaflet was must which is an open-source java script library to have interactive map.

**Why PostgreSQL as database?**

PostgreSQL is used as the primary data store or data warehouse for many web, mobile, geospatial, and analytics applications. Since our project focuses on geospatial data (satellite images) processing.

**4.4. How good we have been in performing our work tasks.**

During our internship period we were assigned to various tasks, while the main objective was to develop EDAAS. We pass through several major tasks along the way. From familiarizing ourselves with the work environment to becoming skilled in the tools and frameworks we used. As we have seen in the last titles about the tasks assigned. We have completed all the tasks that we have been assigned on successfully.

During implementation, they intended to make us work on some tasks by selecting from the backlog which was enough for our level but after completing them earlier than the time given, thanks to our mentors and also our teachers who have thought us several things, lessons and courses. We have been working on other additional tasks. Here are some of the screenshots tasks assigned and completed:

**What Major Findings Obtained?**

**Satellite imagery**

Satellite imagery is a type of remote sensing data that is collected by satellites orbiting the Earth. Satellites are equipped with a variety of sensors that can detect different types of radiation, including visible light, infrared light, and radar waves. These sensors can be used to create images of the Earth's surface, atmosphere, and oceans**.**

Satellite imagery is used for a variety of purposes, including:

* **Mapping and surveying:** Satellite imagery can be used to create maps and surveys of the Earth's surface. This information can be used for a variety of purposes, such as planning infrastructure projects, managing natural resources, and monitoring land use changes.
* **Disaster management:** Satellite imagery can be used to monitor and assess the damage caused by natural disasters, such as floods, earthquakes, and wildfires. This information can be used to coordinate relief efforts and to help governments rebuild affected areas.
* **Security and surveillance**: Satellite imagery can be used to monitor borders, track criminal activity, and identify potential security threats.
* **Environmental monitoring:** Satellite imagery can be used to monitor the environment and to track changes in the Earth's climate. This information can be used to develop and implement environmental protection policies**.**

Satellite imagery is a valuable tool for a variety of purposes. It provides high-resolution images of the Earth's surface that can be used to monitor changes over time, to identify areas of concern, and to make informed decisions. Here are some examples of how satellite imagery is used in different industries:

* **Agriculture:** Satellite imagery can be used to assess crop health, predict crop yields, and monitor irrigation systems.
* **Forestry:** Satellite imagery can be used to monitor forest cover, detect deforestation, and identify forest fires.
* **Urban planning:** Satellite imagery can be used to map urban areas, assess population growth, and plan for future infrastructure projects.
* **Military:** Satellite imagery can be used to monitor military activity, identify potential threats, and plan for military operations.

Satellite imagery is a powerful tool that can be used to improve our understanding of the Earth and to make better decisions about how to manage our planet.

**Satellite imagery catalogue:**

A searchable database of satellite images, typically organized by date, location, and other criteria.

**Satellite imagery analysis:**

The process of extracting information from satellite images, such as land cover, land use, and changes over time.

**Data dissemination:**

The process of sharing data with users in a timely and accessible manner.

**Challenges**

**Lack of domain knowledge**: We were not familiar with the area of space science, which made it challenging to identify the key requirements of the system and to choose the right technologies and approaches.

**Lack of experience with frameworks and tools**: We were not familiar with the frameworks and tools that are commonly used to develop satellite imagery cataloging, analysis, and data dissemination systems.

**Transportation:** There was always transportation issue due to the common transport route problem around Addis Ababa especially on the morning and afternoon.

**Work Space: During the first few months of our internship, we faced workspace challenges that caused us to lose focus and become frustrated, making it difficult to perform our job to the best of our ability.**

**Measures taken to overcome the challenges**

**Start by understanding the data:** Before we start developing the system, we focus on understanding the data that we will be working with. This includes understanding the data volume, complexity, heterogeneity, accuracy, and reliability.

**Choose the right technologies**: There are a variety of technologies available for developing satellite imagery cataloging, analysis, and data dissemination systems. It is important to choose the right technologies for your specific needs and requirements.

**Get feedback from Mentors**: We had weekly check-ins with our mentors to review our progress and receive feedback.

**4 Overall benefits gained**

**Improving our skills**

* **Technical skills:** we have gained experience software development. This skill have high demand in the tech industry, and it will make us a more competitive candidate for future jobs.
* **Problem-solving skills:** Developing a complex system like a Satellite Imagery catalogue, Analysis and data dissemination system requires strong problem-solving skills. We had to identify and solve a variety of challenges, such as integrating different data sources, developing efficient algorithms, and designing a user-friendly interface
* **Communication skills:** We had to communicate with a variety of people during our internship, including our manager, team members, and department staff. This helped us to improve our communication skills.

**Upgrading our theoretical knowledge**

* **Satellite imagery:** we learned a great deal about satellite imagery, including how it is collected and processed, and how it can be used for different purposes. This knowledge will be valuable in our future career as a software engineer, as it will enable us to develop innovative applications for satellite imagery.
* **New and improved methods for satellite imagery cataloging**: We developed new algorithms or techniques for cataloging satellite images in a more efficient and accurate manner.
* **New and improved methods for satellite imagery analysis:** We developed new algorithms or techniques for extracting information from satellite images in a more accurate and efficient manner
* **New and improved methods for data dissemination**: We developed new methods for sharing satellite imagery data with users in a more timely and accessible manner.
* **System design:** we learned about the principles of system design, such as modularity, scalability, and security. These principles are essential for designing and developing complex systems.

**Improving our interpersonal communication**

* **Collaboration:** Working on a team project requires strong collaboration skills. We had to work with other team members to develop and implement the system. This would have helped us to learn how to work effectively with others, even if we have different backgrounds and perspectives.
* **Presentation skills**: We had to present our work to our manager, team members, or other staff members. This helped us to improve our presentation skills, which are essential for any professional.