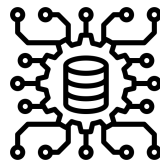# Data Manipulation Software Conversion

Prototype Report

The Cousins Photosynthesis Lab in
The School of Biological Sciences at WSU

Data Pirates

Ritik Agarwal, Zoe Parker

Table of Contents

I.   Introduction

Our team has been tasked with converting an old LabView software platform to a Python application. The old platform performs data acquisition, manipulation, and presentation on inputs received from instruments in Cousins Photosynthesis Lab in The School of Biological Sciences at Washington State University. The new application will replicate the current solutions ability to collect data and make calculations and manipulations, but will also enhance the efficiency and usability. The application will take the form of a Tkinter Desktop Application supported by other Python libraries. The end goal of this project is to provide an updated Python application that is more user-friendly and efficient than the current software.

I.1   Background and Related Work

Currently, Cousins Photosynthesis Lab is using an old LabView software that performs data acquisition, manipulation, and presentation on inputs received from instruments in Cousins Photosynthesis Lab in The School of Biological Sciences at Washington State University. Our project requires us to update the old LabView software to more efficient and user-friendly LabView software using python as the primary programming language.

Python is the best programming language for this project, as Python programming language is known for its versatility, readability, and extensible data manipulation and representation packages. The project requires an advanced understanding of Python programming language. We will be referring to the python documentation for any sorts of anchors and help. Since we are developing a desktop application - we need a GUI framework. We will be using the Tkinter GUI toolkit. Tkinter provides a powerful object-oriented interface to the Tk GUI toolkit. Creating a GUI application using Tkinter is an easy task due to the availability of extensive documentation. We will also use Test Driven Development to achieve fewer bugs and errors, and to produce a higher overall test coverage and, therefore, better quality of the final product.

Good software requires good coding practices and documentation. We will use Software Design Principles to develop the new LabView desktop application. We will also use UML for designing the software architecture. Our goal is to design a desktop application that is scalable, reliable, and extensible.

I.2   Project Overview

The Cousins Photosynthesis lab is focused on better understanding how photosynthesis in terrestrial plants has adapted to climate changes and how they can enhance the photosynthetic efficiency of key food and biofuel crop species. The lab builds and develops instruments to study key photosynthetic enzymes. One instrument in particular collects raw data (in the form of voltages) from different inputs at a high frequency (about every 2-3 seconds). The data is acquired in small snapshots and sent to a computer that packages it into .csv files.

The current program that accesses these files and manipulates and plots the data was created through LabView by a previous engineer. LabView is a graphical environment engineers use to develop automated research, validation, and production test systems. LabView utilizes a drag and drop interface to create its programs. However, this interface has proved to be complex and hard to decipher, making it difficult for lab members to change and improve program features.

The Data Pirates team, under guidance of our team mentor and the Cousins Photosynthesis Lab, will address the shortcomings of the current LabView software by designing, building, and delivering a Python application that performs data acquisition, calculation and manipulation for the lab team. The application will replicate the current solution, but will also enhance the current functionalities and be easier to use and update.

The Data Pirates team will achieve this by first decoding and understanding the current software so it can be recreated and updated in Python. Some features that the new program should support are the ability to read input files, plot the input data in near real time, and extract key data points and calculated parameters at specific timepoints throughout data acquisition. These features are present in the current solution, but will be enhanced or improved in the new program as needed.

The Cousins Lab conducts experiments that can run anywhere from 3 to 8 hours per day, generating a lot of data, some of which is not needed. The new program will also have the ability to exclude or hide data plots that aren't needed.

The current LabView software is complex and hard to read. So, another feature for the new program is the ability for the lab team to update the program without needing much coding experience. The lab should be able to change or add features as needed on their own.

The Cousins Lab requires a Windows-like interface for the program. Thus, our team will be creating a Python desktop application. At the end of the project, our team will train the lab members on how to use the application and update the code.

In terms of tools to be used for the new desktop application, Tkinter will be used to build the GUI. Tkinter will allow us to add text, buttons, and input entries for the application. Additionally, a few Python libraries will be needed for data presentation and manipulation. The Python library matplotlib will be used to create interactive data visualizations, and the numpy library will be used for data processing and calculations.

In order to successfully achieve these goals outlined in this overview, the team will frequently communicate and meet with The Cousins Photosynthesis Lab for project evaluations and design reviews.


I.3   Client and Stakeholder Identification and Preferences

Our client is The Cousins Photosynthesis Lab in The School of Biological Sciences at WSU. They will use the new LabView software for conducting experiments and visualizing the data. The Cousins Photosynthesis Lab requires us to develop the old LabView Software into a new LabView Software written in Python. The researchers in the lab will get trained to use the software.

Our second stakeholder is our mentor from the class CPTS 421/423.The mentor will guide us along the project to implement the best solution. Mentor will also serve as the communicator between the Data Pirates and The Cousins Photosynthesis Lab. The mentor will also coach the agile development approach, and the project is developing without any anchors.

II. System Requirements Specification

II.1 Use Cases
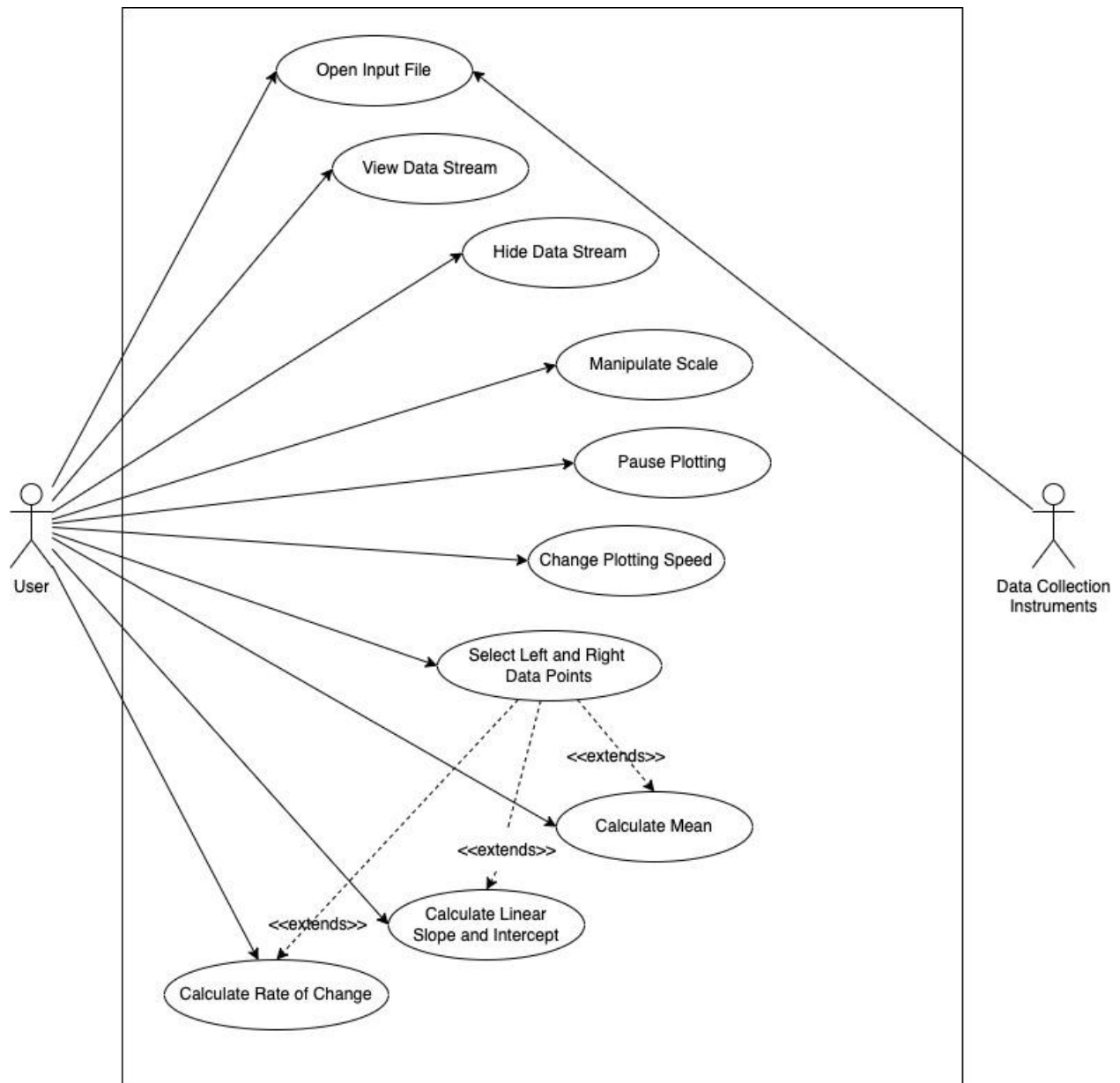
II.2 Functional Requirements

II.2.1 Data Acquisition

Acquire Data: This application must provide the ability to acquire data in the form of .csv files from a file system. If the program runs out of data or tries to read data before it has been created, it shouldn't crash.
Source: The client with Cousins Photosynthesis Lab originated this requirement. The requirement is necessary for users to use and see data.
Priority: <u>Priority Level 0</u>: Essential and required functionality

II.2.2 Data Plotting

Plot Inputted Data: This application must provide the ability to plot the data from the input files on a graph. This graph must be animated so data can be plotted in near-real time and this graph must plot multiple data streams at the same time.
Source: The client with Cousins Photosynthesis Lab originated this requirement. The requirement is necessary for users to use and see data.
Priority: <u>Priority Level 0</u>: Essential and required functionality

Ability to Select Data Streams: This application must provide the ability to select which streams of data from the input files to plot on the graph. There will be multiple streams of data in the input data, but not all are relevant, so the user must be able to choose which streams they want to plot.
Source: The client with Cousins Photosynthesis Lab originated this requirement. The requirement is desirable for users to be able to ignore unnecessary data.
Priority: <u>Priority Level 1</u>: Desirable functionality

Ability to Pause and Change Speed of Data Plotting: The application must provide the ability to pause the plotting animation at any time, as well as change the speed at which the animation plots the data.
Source: The client with Cousins Photosynthesis Lab originated this requirement. The requirement is necessary for users to use the application easily and efficiently.
Priority: <u>Priority Level 0</u>: Essential and required functionality

Plot Calculated Data: This application must provide the ability to plot data resulting from calculations performed on other data.
Source: The client with Cousins Photosynthesis Lab originated this requirement. The requirement is necessary for users to use and see calculated data.
Priority: <u>Priority Level 0</u>: Essential and required functionality

Mean Bars: Two movable mean bars should be included in the application. The mean of the plot between the two bars should be calculable using these two mean bars.
Source: Requirement by the stakeholder.
Priority: <u>Priority Level 0:</u> Essential and required functionality.

Ability to Manipulate Scale: This application must provide the ability to manipulate the scale of the graphs in the application. The user should be able to edit the lower and upper bound of both the vertical and horizontal axes.
Source: The client with Cousins Photosynthesis Lab originated this requirement. The requirement is desirable for users to better see and scale the data plots.
Priority: <u>Priority Level 1</u>: Desirable functionality

II.2.3 Data Calculations

Calculate Mean Values: This application must provide the ability to calculate the mean value between two data points on a graph.
Source: The client with Cousins Photosynthesis Lab originated this requirement. The requirement is necessary for users to manipulate and calibrate the data.
Priority: <u>Priority Level 0</u>: Essential and required functionality

Calculate Rates: This application must provide the ability to calculate the rate of change between two data points on a graph.
Source: The client with Cousins Photosynthesis Lab originated this requirement. The requirement is necessary for users to manipulate the data.
Priority: <u>Priority Level 0</u>: Essential and required functionality

Calculate Linear Equations: This application must provide the ability to calculate the slope and intercept of a linear plot.
Source: The client with Cousins Photosynthesis Lab originated this requirement. The requirement is necessary for users to derive results form the data.
Priority: <u>Priority Level 0</u>: Essential and required functionality

UI Utility Buttons and Bars: There should be several UI buttons and bars in the program for processing, manipulating, and graphing data. The software should function properly when these UI buttons are used.
Source: Requirement by the stakeholder.
Priority: <u>Priority Level 0</u>: Essential and required functionality.

II.3 Non-Functional Requirements
Easy To Use
This application should be straightforward and should not be too difficult to learn.

Self Containment
The application needs to be self-contained and simple to use. The user should have no trouble using the program after receiving training. For upcoming developments, the application should include the software documentation.

Great UI
The user should have a great UI experience when using the application. The UI should be user friendly.

Design For Change

        The application has to be flexible. Future feature additions should be possible without significantly altering the present code, if necessary. Additionally, the code must adhere to accepted industry standards, be properly organized, and be simple to comprehend.

System Compatible

        The hardware and software configuration in the lab at this time ought to work with the program. The application shouldn't be susceptible to both software and hardware modifications in the long run.

Accurate

        This application will deal with important data that needs to be correctly plotted and calculated on. The application should accurately plot and calculate data.

VI.   System Evolution

        The Data Pirates team is creating the software while taking into account any modifications to both the hardware and the software. The application's compatibility with the lab's present software and hardware setups is the current objective. However, the environment in which the program will be used must have some software defaults. Hardware modifications will not have an impact on these requirements. The program will make use of Python 3.10.7, the most recent version. Python 3.6.0 must be installed at the very least on the system. Additionally, the system needs the installed versions of Tkinter, Matplotlib, and any additional programs required for development. An executable that installs the required software and drivers for the program will be made available. The team will also provide documentation which will include all the steps necessary to make the application work in the system. The team will also offer documentation that details every step required to implement the application in the system.

IV.   Glossary

Python: A high-level, general-purpose programming language, often used to build websites and software, automate tasks, and conduct data analysis.

LabView: A graphical programming environment used by engineers to develop automated research, validation, and production test systems.

Tkinter: An open source, portable graphical user interface (GUI) library designed for use in Python scripts

Matplotlib: A plotting library for the Python programming language. It provides an object-oriented API for embedding plots into applications using general-purpose GUI toolkits.

Numpy: A library for the Python programming language, adding support for large, multi-dimensional arrays and matrices, along with a large collection of high-level mathematical functions to operate on these arrays.

V.   References

"What is LabView? Graphical Programming for Test & Measurement," *NI*. [Online]. Available: https://www.ni.com/en-us/shop/labview.html. [Accessed: 20-Sep-2022].