PIT Tracker

Dr. Chen: Senior Project I

Nathan Newcomer: Computer Engineering Technology

Caleb Cordis: Computer Science

Jeremy Bugay: Computer Science

Ian McGee: Computer Science

Instructor Comments/Evaluation

Table of Contents

Abstract **3**

Description of the Document **4**

System Description **5**

System Modeling **9**

Figure 1 **9**

Figure 2 **10**

Figure 3 **13**

Dataflow Diagrams **16**

Figure 4 **16**

Components / Tools Needed **17**

References **18**

Appendix A: Technical Glossary **19**

Appendix B: Team Details **21**

Appendix C: Report from the Writing Center **22**

Abstract

The PIT (Powered Industrial Truck) Tracker is a device that is used to track the PIT machines in a warehouse. For this project, the focus is on one Home Depot location, which will be the model for testing purposes. The PIT Tracker is intended to make the location of PITs in a warehouse setting easier and less time consuming, improving customer wait periods and offering time efficiency to employees. The end user will be required to access a website that will display the locations of PITs on a map of the warehouse, which will update as the machines move to different locations in the store. This specification document will go into detail on the project, including use cases and general system description.

Description of the Document

Purpose and Use:

The purpose of this document is for the developer and client to agree upon the specifications of the PIT Tracker scope. This document will include an outline of the functionality and parameters of the PIT Tracker. The developers and client have the ability to discuss any revisions that may be required to the document to the client's needs. These revisions must be made within a time frame specified by the client and must be able to be completed by the developers. If the client and developers agree, this requirement document will become a contractual agreement.

Intended Audience:

This document is intended to be used by both the client and software developers. The clients will be given an opportunity to view this document and make changes if they so wish, but changes must be made against this document only. This specification document will create constraints that the developers will be beholden to. The programmers will create software in accordance with the client's specified needs. This document will assist the clients in understanding the functionality and structure of the software. Included will be diagrams that should enable understanding of, and aid in the ability of the development team to execute, the structure and layout of the software.

System Description

Overview:

The PIT Tracker is a business facing software application that will enable employees in a customer service environment to interface with a computer and locate a powered industrial truck within a retail environment. The two main structural pieces of the software will consist of user interaction with a web client, while the back end will consist of an Arduino GPS tracker whose location will be displayed by the web client. When the PIT Tracker is moved to another location within the retail space, the GPS location will be updated to the web client.

Environment and Constraints:

- End User Profile
    - The intended end user for this system will be employees who work in a warehouse setting. They must be able to have access to the internet and be able to navigate to homepage of the PIT Tracker via warehouse workstation. The end user will use the displayed layout of the store to navigate to the PIT's displayed location. The location should update continuously, so the user need only navigate the store layout to the displayed PIT.
- User Interaction
    - User interaction will be limited to interfacing with a web client to locate the displayed PIT. The user will launch the web client application via warehouse workstation, and will be presented with a user interface of the hypothetical store layout and the last location of the tracked PIT. If the employee moves the PIT to

another location, the location will be automatically updated on the web client for the next employee who logs on to the application.

- Hardware Constraints
  - In order to provide an affordable tracking solution, hardware constraints will be kept to a minimum. The only hardware needed will be what is required to construct the tracking device. The end user will not have to carry a separate device around to use the PIT Tracker software. There will need to be a computer terminal within the store for the employee to access the application.
- Software Constraints
  - The software constraints are mainly the programming languages whose syntax is difficult for having the Arduino GPS device report to the website. Arduino is based off the C programming language. Another constraint is finding the best place to host the website.
- Time Constraints
  - Time constraints will be specific to the end-user's environment and their ability to connect to the internet. Ideally, the user must have an internet connection equivalent to landline internet found in the United States (56 bps). Data transmission will be limited to the initial socket connection to the website. If the internet is down, the device will not be able to report to the site. Other time constraints will consist of building and implementing the hardware and software to receive a connection and report back to the web client.

- Cost Constraints
  - Cost constraints include cost of GPS transmitter/receiver, Arduino prototyping board, logger, and enclosure for the unit above. Other cost constraints may consist of web client hosting and upgrade costs.

- Other Concerns
    - Strategic placement of the PIT Tracker where the driver of the PIT will not damage the device. Also, the device needs to be able to have a non-obstructive area to be able to transmit the data to the web client. Recalibration may have to take place from time to time to ensure location accuracy.

Acceptance Test Criteria:

- Testers:
    - The primary testing will be the responsibilities of the PIT Tracker development team. Much of the time will be spent developing and testing the software for the PIT Tracker to ensure the application works appropriately. There will be a beta test once major testing and error checking has been completed and designated developers within the programing team will be in the beta.

- Criteria for User Acceptance:
    - The goal is to have the utmost reliability and convenience so that the employees can quickly reach the PIT Tracker.
    - The user interface must be quick and convenient to access and easily readable at a quick glance.
    - Icons must be clear and unambiguous. Each tracking device is strategically placed on each PIT to receive the best signal possible for the GPS to report to the Web Client
    - The user will be able to search for any PIT in the building via the Web Site and do so effortlessly

Integration of Separate Parts and Installation:

The integration will be between a network application on the front end and the Arduino GPS in the back end. The front end of this application will be able to access through a web client that will be hosted onto the internet and easily available on the computer. The user will then navigate to the website that will have an icon on the desktop which when opened by the user leads them to the webpage containing the map layout and location of the PIT Tracker. The back end will be handled by the Arduino chip that will upload its location to the web client. The webpage will be easily accessible and installed onto the desktop for ease of use. The website will be maintained through JavaScript.

Hardware Requirements

1. Number of employee workstations to allow for user interaction
2. Internet connection
3. Arduino UNO 3
4. GPS Logger
5. GPS Unit

Software Requirements

1. Up-to-date Windows 10 OS
2. Supported Internet Browser (NO INTERNET EXPLORER)
    a. Google Chrome and Mozilla Firefox are preferred

System Modeling

Functional: Use Cases & Scenarios:

The use case for the system is the same as the previous document:

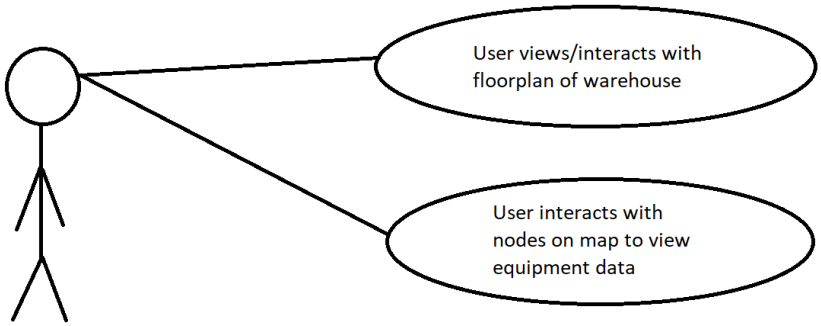

Figure 1

The scenarios we've listed below will explain the step by step process:

1. The user will access the website via the link on each individual workstation.

2. The workstation will launch the web interface which will show a map of the specific store.

3. The web client continually receives a signal from each individually PIT Tracker device in the environment.

4. The web client will then take the coordinates from the PIT Tracker and turn it into a location in the store.

5. The web site will display each individual PIT represented by a different colored dot.

6. The end user sees where their desired PIT is located and closes out the web interface.
7. The end user will then locate the machine, use it, and put it in a new location
8. The location of the PIT is then updated and sent to the web client.

Entity: Class Diagrams:

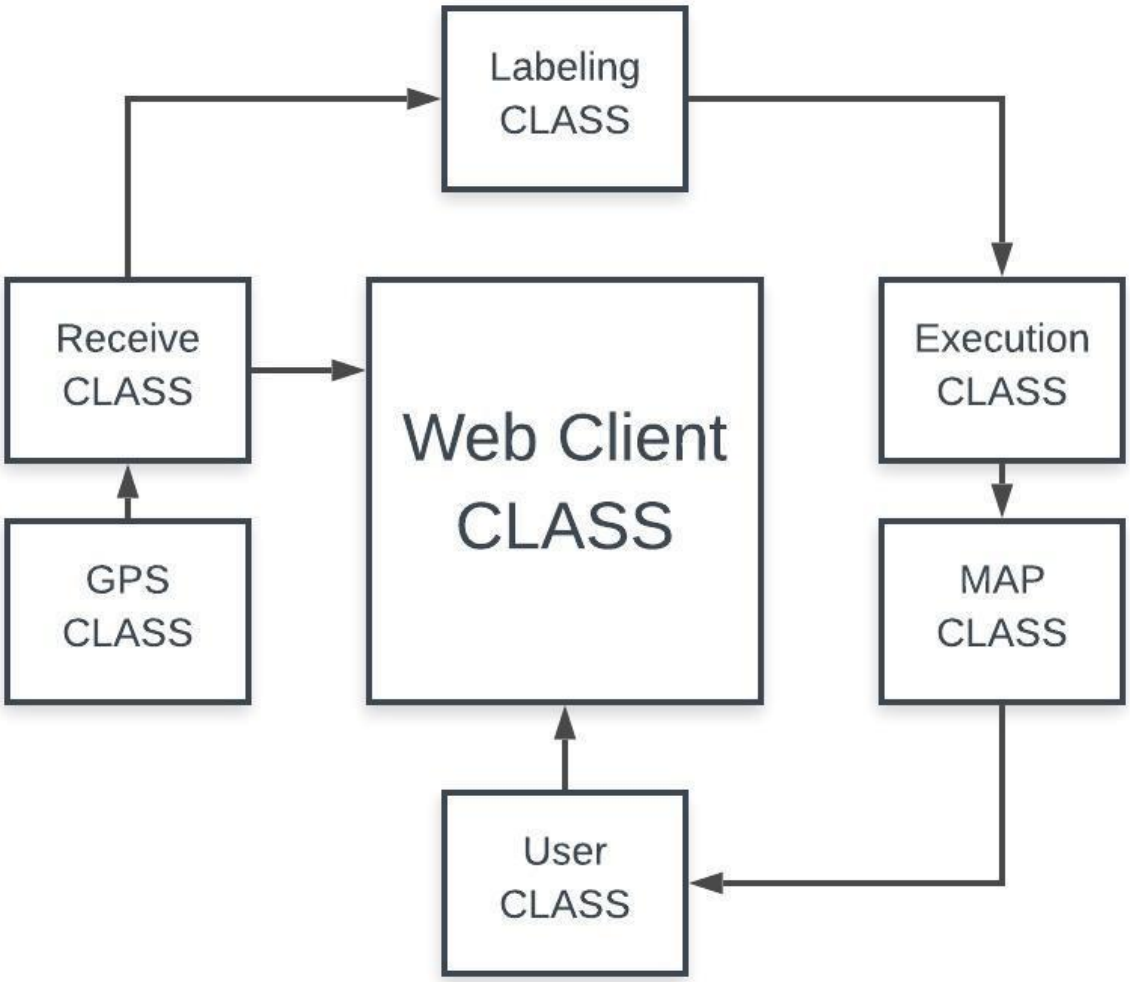

Figure 2

- Class name / description / type

GPS (Send) Class

The GPS class is a boundary that will send the coordinates of the tracker to the web client. This includes the whole PIT Tracker as the GPS unit needs to be connected to the Arduino to report the coordinates back to the web client.

Receive Class

The Receive class is a boundary that will receive the data from the GPS device. The web client gets the information and then converts the coordinates to a place in the store

Map Class

The Map class is the layout of the store. The map will have several different locations set to report to the web client. Each PIT will be color coded accordingly to distinguish between each individual PIT.

Web Client Class

The Web Client class is responsible for hosting the website for PIT Tracker. The web client receives the information from PIT Tracker and then converts the coordinates to a location on the store map.

Execution Class

The Execution Class is the controller that handles the message in and out processes of the execution phase. Once the user presses enter the corresponding view object, the execution class will send a message to the back-end server. When the server sends text back, the execution class puts the message back on the screen.

Labeling Class

The Labeling Class will take care of labeling and distinguishing between each PIT. In order to do this, there are 6 different PITs. Those are the Reach, Stock Picker, Pacer, Small Sitdown Forklift, Large Sitdown Forklift, and Electric Pallet Jack. Each PIT will be represented by a colored circle on the map. The map will display each PIT location by this colored circle. The labeling will be as follows: Reach will be a red dot, Stock Picker will be blue, Pacer will be yellow, Small Sitdown Forklift will be green, Large Sitdown Forklift will be orange, and the Electric Pallet Jack will be purple. A legend will be displayed on the map informing the user on how to distinguish between the PITs.

User Class

The User class is the end user end of the operation. The end user will be able to access the website via URL address (in the future hyperlink on each workstation) to access the PIT Tracker map.

Dynamic: Statechart:

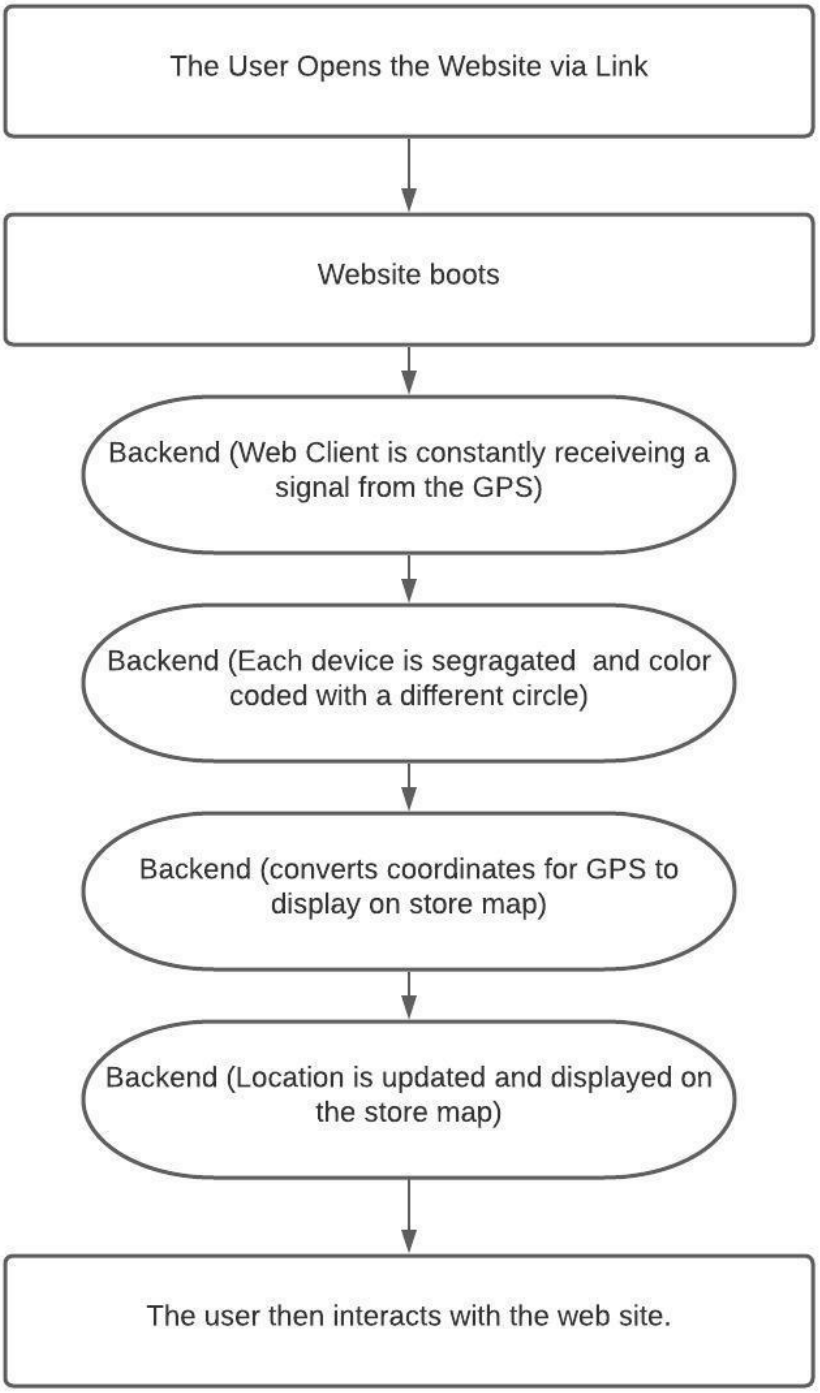

Figure 3

- States
    - The user accesses the website: The user accesses the website via a web address or link embedded on each workstation.
    - Website boots: The website is displayed on the workstation and is receiving the data form the host.
    - GPS signal sent: The GPS signal is constantly being sent via the GPS unit built into the tracker device.
    - The GPS data is sent in the form of NMEA Sentences
    - Backend server converts NMEA sentences: The server will convert the coordinates of the GPS unit from the PIT Tracker to a location in the store.
    - Map location: The location is then put onto the store map.
    - Color Coded Legend: Each PIT will be color coded in a legend. There are five classes of PIT with some stores having multiple of one PIT.
    - Updating of location: The PIT location will be updated every time the webpage is refreshed.
    - Results sent over to the web client: If the machine is moving, the colored circle will blink indicating the PIT is in motion. This will be sent in real time over to the web client.
    - End user interacts with the web site: When the end user is ready to find one of the PITs to use for a customer, they will find a workstation within the store and log on. Ideally after testing, a hyperlink will be posted on the main employee web page for easy access to the PIT Tracker site. As for now, the site will be accessed via link sent over from IT after testing is 95% complete.

- Map displayed: The user is welcomed with a map of the store and displays all the PIT's locations.

- Events

  - When a signal is received from one of the GPS transmitters, the program converts the NMEA sentences into a form that is readable by the program used for mapping. The program will also decide which type of PIT the signal is coming from and will color the indicator accordingly.

- Transitions

  Transitions occur when the user interacts with the website. The user will be able to hover over the colored circle and a pop-up window will show alongside the map. The window will give the specifics of which aisle and eventually after roll out which bay the PIT is located in. That will be the only interaction the end user will have within the website environment. After the end user is done looking up the PIT, the user will then log out of the workstation and retrieve the PIT.

Dataflow Diagram

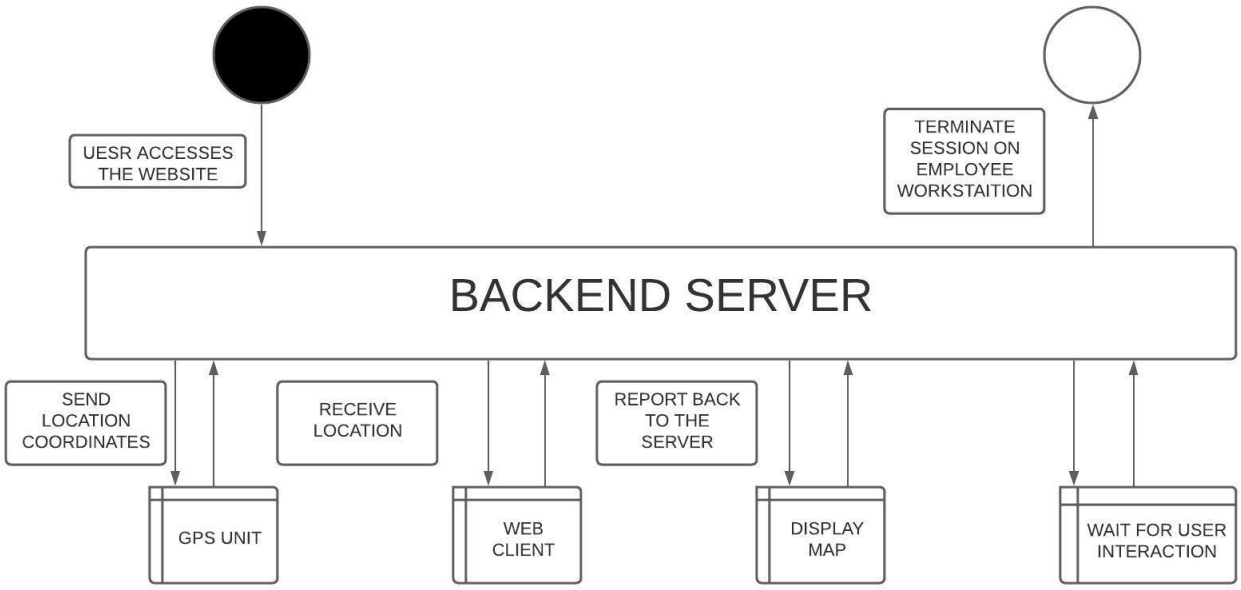

Figure 4

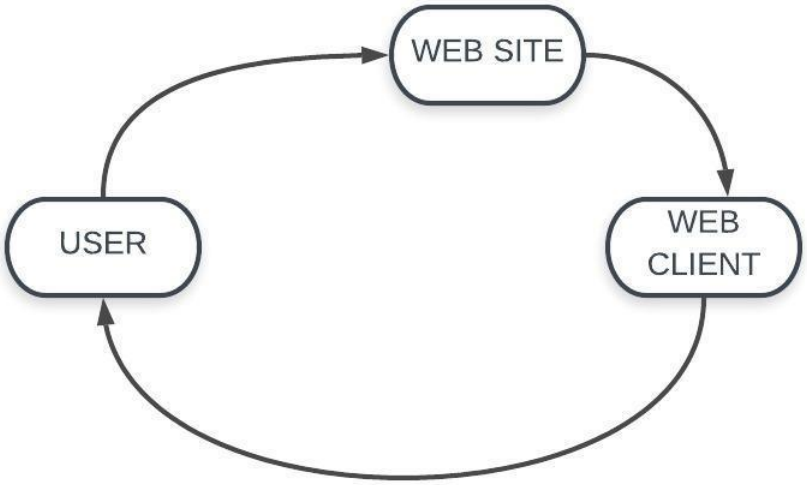

Figure 5

Components / Tools Needed

The components needed for the application include the components for the tracker, a web client, a device capable of reaching said client, and a Powered Industrial Truck to affix the tracker to. The tracker components consist of an Arduino, and a GPS device that will update to the web client. The user's device will be a warehouse workstation, and the PIT will be one of the vehicles outlined in the definition section. For testing purposes, the PIT Tracker can be used on its own, without the need for a PIT to attach it to.

References

M. (n.d.). Sandro: Your Personal GPS Assistant. Retrieved November 09, 2020, from https://create.arduino.cc/projecthub/Momy93/sandro-your-personal-gps-assistant-26dfa3?ref=tag

McWhorter, P. (2014, July 30). Lesson 22: Build an Arduino GPS Tracker. Retrieved November 09, 2020, from https://www.youtube.com/watch?v=OsMoowoB2Rg

Shawn. (2020, June 09). Arduino GPS Modules - Which one to use? Comparison and Arduino Tutorial. Retrieved November 09, 2020, from https://www.seeedstudio.com/blog/2019/11/06/arduino-gps-modules-which-one-to-use-guide-and-comparisons/

Team, T. (n.d.). HTTP Client. Retrieved November 09, 2020, from https://www.arduino.cc/en/Tutorial/LibraryExamples/HttpClient

Vehicle Tracking System Based on GPS and GSM. (n.d.). Retrieved November 09, 2020, from https://create.arduino.cc/projecthub/muchika/vehicle-tracking-system-based-on-gps-and-gsm-57b814?ref=tag

Appendix A: Technical Glossary

Arduino- The Arduino Uno is an open-source microcontroller based on the Microchip ATmega328p microcontroller.

Microcontroller- A microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system.

GPS- A device used to communicate with satellites to report position on the globe.

NMEA- NMEA is a standard data format supported by all GPS manufacturers.

IDE- A software for building applications that combines common developer tools into a single graphical user interface

Pacer- This is a stand up forklift. In lieu of sitting down, the operator stands and operates the PIT. This is helpful to get into narrow or tight areas. The forks do not extend on the pacer unit.

PIT machine- Powered industrial trucks such as forklifts or a lift truck

Reach Truck- PIT that is specialized for going down narrow aisles and grapping pallets on either side of the racking in an aisle. To achieve this, the forks extend in and then a retracted in to reciev the pallet.

Stock Picker- Or man up is a PIT that is used to grab bulk items from the racks. The operator rides up while the machine is in motion to retrieve the item the customer requests.

Web Client- A webpage used to host the GPS application.

Appendix B: Team Details

The leader for this part of the project was Jeremy Bugay. With his planning we aimed to complete the documentation early to allow for edits after submittal to the writing center. He organized our efforts in an efficient manner by splitting the document into pieces and assigning a member to each piece based on each member's strengths. The group stayed in contact through Microsoft Teams and Discord to ensure the document was finished in a timely manner.

Appendix C: Report from the Writing Center

Cal U Vulcan Learning Commons Report

Client: Ian McGee

Staff or Resource: Sarah C.

Date: November 10, 2020, 3:00pm - 4:00pm

What course was serviced by this visit?: CSC490

Did the student request that the instructor receive a visit report?:

Yes

Please provide any additional comments relevant to this session.:

I was only able to read and comment through page 10. Please make another appointment with the writing center to complete review of the paper.

How did the process of this consulting session address the established goals?:

This paper is relatively well written, but there are some issues with clarity. This largely boils down to the distinction between terms-- end user, web client, etc. Although these may be clear to people in the field, the lack of distinction makes the paper confusion for those reading who are unfamiliar with them. My biggest comment is this: focus on clarity.

Cal U Vulcan Learning Commons Report

Client: Ian McGee

Staff or Resource: Megan R.

Date: November 11, 2020, 3:00pm - 4:00pm

What course was serviced by this visit?: CSC490

Did the student request that the instructor receive a visit report?:

Yes

Please provide any additional comments relevant to this session.:

How did the process of this consulting session address the established goals?:

I reviewed the latter portion of the assignment. There were a few minor misspellings, punctuation errors, and clarity issues, but overall it was not severely problematic.