Fig. 1. PRT - Morgantown, WV. Adapted From [1]

WVU PRT System Data Collection and Analysis:
Problem Statement, Feasibility, and Requirements Specification

PRT Capstone (Group 4)
Andrew DeGarmo
Sam Desai
Emma Kupec
Kevin Meyers
Omar Ndiaye
Greyson Weimer

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1 Problem Statement

Even though the PRT operates with a movement rate of roughly 15,000 students per day, it is not without faults or need of improvement. During consistently busy times of the day, wait times are much longer than expected and at other times, commuters are left waiting at a platform as empty cars leave. By equipping PRT cars with a telematics device, these types of scenarios can be avoided. Furthermore, equipping cars with sensors to track data such as power consumption, GPS location, and passenger capacity allows for analysis and thus provides further insights into how the PRT system can be more efficient in both transportation and energy consumption.

2 PRT Background

The PRT, or Personal Rapid Transit, has been a main source of transportation for the students of West Virginia University since 1975. The project was government-funded in order to research more methods of transportation and was developed by Boeing. Since its completion, the PRT has serviced about 83 million students and averages around 15 thousand students per day, with up to an additional 10 thousand on days with football games [2]. In order to construct the PRT tracks, former industrial engineering professor Samy Elias was tasked with overseeing the development of the tracks in the 1970's. Originally, the tracks only connected four stations, Walnut, Downtown, Engineering, and Towers, and had 45 PRT cars to service the rides. However, they decided to extend the tracks in July 1979 to include a destination on the Health Sciences campus as well as add 28 additional PRT cars [2].

Prior to the completion of the PRT, classes were required to be scheduled that allowed 2 hours of transportation between campuses due to traffic. After the construction of the PRT, the transportation time between campuses lowered considerably, allowing schedules to be tightened and more enrollment of students [3]. In order to allow the PRT to run successfully, a control room was built in order to monitor the PRT cars as well as the PRT platform. Typically, it is run by two people, watching the cameras installed at each PRT station as well as monitoring the state of currently running PRT cars [3]. While the tracking isn't fully accurate, it allows for the control station to notice when there is a PRT car that has broken down mid transport.

3 Feasibility

Due to the lack of realization of this capstone project in previous years, our group can be the first to implement this necessary solution. The lack of ability to analyze data associated with PRT use is detrimental to understanding the system and its points of inefficiency. The PRT has diligently served the students of West Virginia University for nearly 50 years. Throughout that time, technology has advanced drastically. Now, there is more reason than ever to invest time and energy into capturing data for analysis to provide future Mountaineers with an efficient and reliable form of rapid personal transportation.

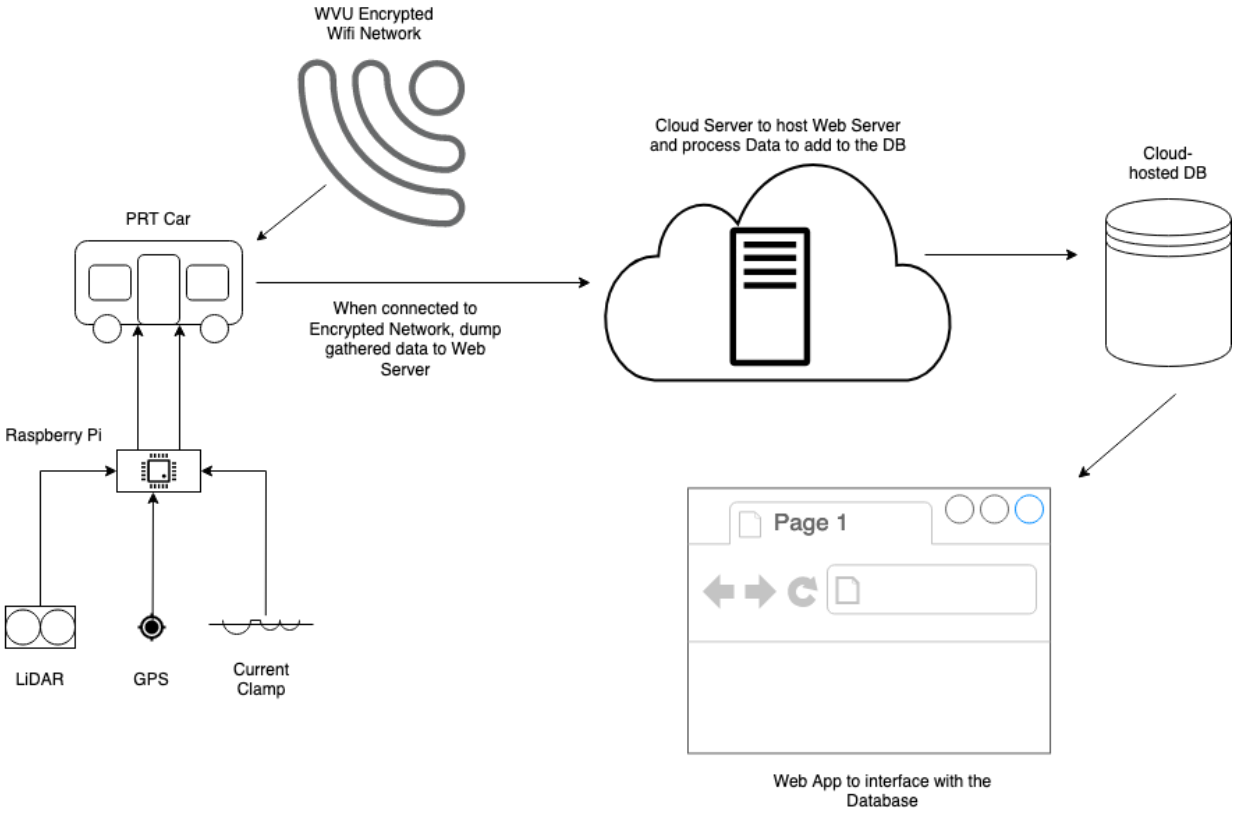
Our proposed solution is inexpensive, requiring only already-made components. The novelty of the design lies in how we combine components to solve the problem elegantly. Using a Raspberry Pi as a microcontroller provides a cost-effective solution for transmitting data to PRT engineers at the central maintenance station and incorporating devices like LiDAR and GPS. When connected to a GPS, the Raspberry Pi will determine its precise location in real-time, while a LiDAR sensor allows for real-time, high-accuracy identification of passengers on board the PRT while maintaining minimal costs.

As well as technical improvements, there are possibilities to improve the safety of passengers. Currently, when a vehicle experiences an issue, the PRT Engineers may not know with 100% certainty which car has a problem and where it is. Adding features to track capacity and location allows for the PRT Engineers to monitor the system. In the case of an emergency, they will be aware of necessary details in order to respond quickly and appropriately.

4 Requirements Specification

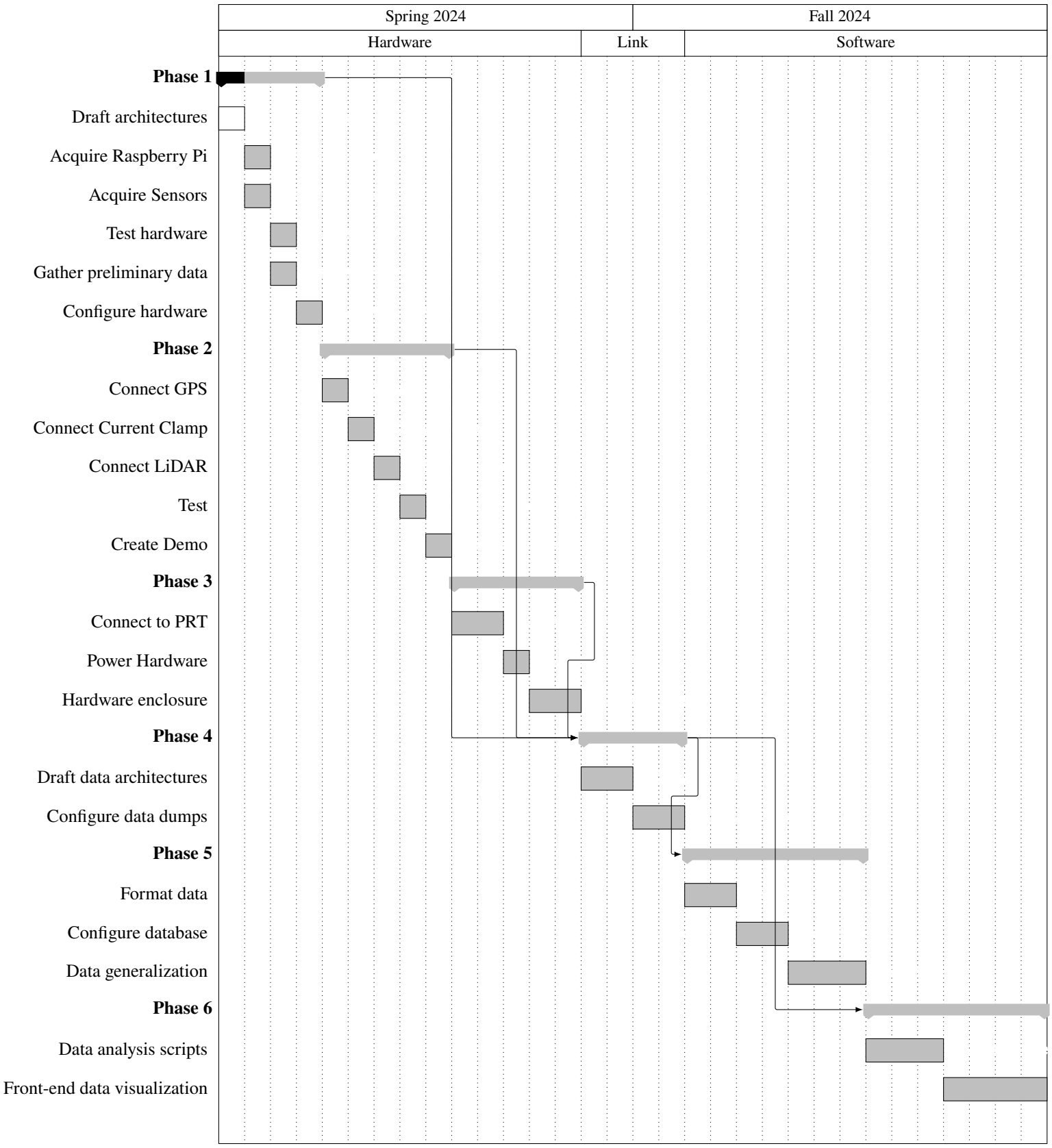
1. Equip a PRT car with a Raspberry Pi 4 model B.
2. The Raspberry Pi should be in an enclosure with a footprint that does not exceed the limitations presented by the PRT team.
3. The enclosure should not be seen by the occupants. The enclosure should not interfere with typical use or passengers.
4. Collect PRT car movement via GPS tracking.
5. Collect PRT energy consumption via a current clamp.
6. Collect occupancy via Lidar or Infrared.
7. Sync data from the car to the database via encrypted WVU Wifi.
8. Store data in an SQL database.
9. Analyze collected data to generalize PRT car behaviors.
10. Present data through a single-page front-end display.
11. Allow a user to perform analysis and visualization.

5 Proposed Architecture



6 Proposed Timeline

As a team, we have committed ourselves to developing our solution throughout the next two semesters (Spring 2024 and Fall 2024). It is our intent to create a demonstration of the solution's hardware within the current semester. This demonstration, or mockup, will be used as a tool to pitch our solution to stakeholders in order to begin implementing our solution on the PRT system. Long term, there should be a refined solution present in the PRT system from which data may be collected and analyzed.


Spring 2024
Fall 2024
Hardware
Link
Software
Phase 1
Draft architectures
Acquire Raspberry Pi
Acquire Sensors
Test hardware
Gather preliminary data
Configure hardware
Phase 2
Connect GPS
Connect Current Clamp
Connect LiDAR
Test
Create Demo
Phase 3
Connect to PRT
Power Hardware
Hardware enclosure
Phase 4
Draft data architectures
Configure data dumps
Phase 5
Format data
Configure database
Data generalization
Phase 6
Data analysis scripts
Front-end data visualization

7 References

[1] N. M, "Prt - morgantown, wv," Sep 2018. [Online]. Available: https://www.flickr.com/photos/nick-m/2861037302

[2] C. Booth, "The rails of morgantown; prt beginnings," *The Daily Athenaeum.*, Nov 2007.

[3] T. Trenkner, "America's one and only personal rapid transit system," *Governing*, Jun 2011.