Software Requirements Specification

For

Chariot

Submitted by

Juan Garcia, Christopher Mak, Kamalludin Colaire, Enioluwa Segun, Ryan Hassing, John Ho, Medard Azandegbe

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| --- | --- |
| **Instructor:** | Dr. Gregory Hislop |
| **Team Members:** | 7 |
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Grading Rubric - Requirements Specification

This rubric outlines the grading criteria for this document. Note that the criteria represent a plan for grading. Change is possible, especially given the dynamic nature of this course. Any change will be applied consistently for the entire class.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Achievement** | **Minimal** | **Exemplary** | **Pts** | **Score** |
| **Content** | Section(s) missing, not useful, inconsistent, or wrong. | Provides all relevant information correctly and with appropriate detail |  |  |
| Introduction |  |  | 10 |  |
| Overall Description |  |  | 10 |  |
| Functions and Constraints |  |  | 40 |  |
| Logical Database |  |  | 20 |  |
| **Grammar and Spelling** | Many serious mistakes in grammar or spelling | Grammar, punctuation, and spelling all correct | 10 |  |
| **Expression** | Hard to follow or poor word choices | Clear and concise. A pleasure to read | 5 |  |
| **Tone** | Tone not appropriate for technical writing | Tone is consistently professional |  |  |
| **Organization** | Information difficult to locate | All information is easy to find, and important points stand out | 5 |  |
| **Layout** | Layout is inconsistent, visually distracting, or hinders use | Layout is attractive, consistent, and helps guide the reader |  |  |
| **Late Submission** |  |  |  |  |
| **Total** |  |  | 100 |  |

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# Introduction

## Purpose

This document shall provide a description and the requirement specification for Chariot, an IoT sensor framework for the development and operation of heterogeneous sensor networks. Chariot is built upon the foundations provided by Dr. Mongan’s IoT Sensor Framework, but Chariot will expand and adapt from it and other IoT Sensor Frameworks. This document shall outline the requirements that will be used by stakeholders and the product development team for development and review of the final product.

## Definitions

This section describes technical terms commonly used in the Software Requirements Specification.

1. Internet of Things (IoT) - the interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data.
2. IoT device – a hardware device that records data about its environment and has the capability to connect to a network and communicate with other devices.
3. Data Collection Episode – the timeframe during which Chariot is actively collecting and storing data received from IoT devices
4. Received Data – data transmitted, or in transmission from an IoT device that has not yet been stored
5. Collected Data – data received from an IoT device that has been saved to a storage unit
6. Storage Unit – where collected data is saved, be it a database, csv file, or other format or data structure
7. Network - a collection of configured, connected IoT devices
8. Module – an addon to Chariot that adds functionality or compatibility tools to the system

# Overall Description

The Internet of Things (IoT) is a system of connected devices capable of collecting and transferring data. Different users of IoT devices may be interested in different types of data. A gardener might want to track the pH value of their soil and the air humidity. A city planner may look for a way to track pedestrian traffic in common spaces. A factory manager might look for a way to track the status of machinery and production rates.

IoT infrastructure has exploded in the past decade, so there are devices on the market to collect data for a wide variety of applications. But the wide variety of devices require special considerations. A Wi-Fi 4K camera connects to a network much differently than a home thermometer. A motion detector may collect and transfer data in a different form than a pressure sensor.

So, despite progress in the IoT industry, it is still difficult to integrate different types of devices into a unified system. Chariot solves this problem. Chariot is a platform for IoT device management, data storage, and analysis. Users can add, remove, and configure a variety of devices on a single network. With Chariot a gardener could purchase off the shelf pH and humidity IoT devices and gather data from all from one convenient interface

## Product Functions

Chariot will provide the following functions:

* Easy addition and removal of IoT devices on a network
* Configuration of devices
* Simultaneous usage of heterogeneous devices on a single network
* Real-time data collection
* Device status reporting
* Flexible data export, including a web API
* Data analysis tools for data visualization and processing
* Modular expansion

## User Characteristics

This section identifies and describes the user types Chariot is designed for.

### Technical – A user with technical familiarity with the system and its underlying code. They will have the knowledge to add or improve data models and IoT drivers for use by Chariot.

### Non-technical – This user does not need to interact with the system on a deep technical level. They use existing modules rather than creating their own with a focus on the final collected data.

# Specific Requirements

The below table describes the priorities of each requirement.

|  |  |
| --- | --- |
| **Priority** | **Description** |
| **Essential** | A requirement that is necessary for the final product to perform to stakeholder expectations. |
| **High** | A requirement that is not required but will significantly improve the quality of the final product. Will be added after Essential requirements, time permitting. |
| **Low** | A requirement that offers minor improvements to the final product. Will be added after High requirements, time permitting. |

## Functional Requirements

### FR1 – Installation

**Priority: Essential**

**Target User: All**

Chariot shall be packaged with a wizard that will streamline installation to complete in no more than 10 minutes.

### FR2 – Running Chariot

**Priority: Essential**

**Target User: All**

Upon system startup, Chariot shall prompt for the user to login, **See FR3**, and then connect to all known networks.

### FR3 – System Login

**Priority: High**

**Target User: All**

Chariot shall be accessed through a login system consisting of a username and password.

#### FR3.1 – Username

**Priority: High**

**Target User: All**

A username shall consist of an alphanumeric case-sensitive string of at minimum 4 characters and at maximum 32 characters.

#### FR3.2 – Password

**Priority: High**

**Target User: All**

A password shall consist of an alphanumeric case-sensitive string of at minimum 6 characters and at maximum 32 characters.

### FR4 – Logout

**Priority: High**

**Target User: All**

Chariot shall allow users to log out from the system, halting all operations and disconnecting from all networks prior to closing the program.

### Network Management

The following requirements indicate how Chariot manages IoT networks.

### FR5 – View Networks

**Priority: Essential**

**Target User: All**

Chariot shall display all networks connected to the system.

#### FR5.1 – View Network Devices

**Priority: Essential**

**Target User: All**

Chariot shall display all connected IoT devices associated with a network.

### FR6 – Network Initialization

**Priority: Essential**

**Target User: All**

Chariot shall be able to create new networks for the collection of IoT device data.

### FR7 – Network Deletion

**Priority: Essential**

**Target User: All**

Chariot shall be able to delete a network from its list of networks when the network is not in a data collection episode.

### FR8 – Network Name and Description

**Priority: Essential**

**Target User: All**

Chariot shall have fields for the user defined name and description of networks.

### FR9 – Manage Network Permissions

**Priority: High**

**Target User: All**

Chariot shall utilize a user configured access control system to grant, limit, or deny access to networks.

### IoT Device Management

The following requirements indicate how Chariot manages IoT devices on a network.

### FR10 – IoT Device Configuration

**Priority: Essential**

**Target User: All**

Chariot shall allow the user configuration of IoT devices prior to their addition to a network. Each device model will have its own set of configuration variables, defined by the associated IoT device module, **See FR13**.

#### FR10.1 – IoT Device Name and Description

**Priority: Essential**

**Target User: All**

Chariot shall have fields for the user defined name and description of IoT devices on a network.

#### FR10.2 – Save IoT Device Configuration

**Priority: Essential**

**Target User: All**

Chariot shall save configurations of IoT devices for future or external use.

#### FR10.3 – Load IoT Device Configuration

**Priority: Essential**

**Target User: All**

Chariot shall be able to load previously saved IoT device configurations in place of the manual input of configurations.

### FR11 – IoT Device Addition

**Priority: Essential**

**Target User: All**

Chariot shall interface with connected IoT devices for data collection by adding them to a network.

### FR12 – IoT Device Addition During a Data Collection Episode

**Priority: Essential**

**Target User: All**

Chariot shall be able to add, **See FR 11,** an IoT device to a network currently in a data collection episode.

### FR13 – IoT Device Removal

**Priority: Essential**

**Target User: All**

Chariot shall be able to remove a connected IoT device from an associated network. Removal will prevent the further receiving and collection of data from that IoT device onto the network.

#### FR13.1 – Prevent Data Collection from an IoT Device

**Priority: Essential**

**Target User: All**

Chariot shall prevent the receiving and collection of data from a removed IoT device.

### FR14 – IoT Device Removal During a Data Collection Episode

**Priority: Essential**

**Target User: All**

Chariot shall be able to remove, **See FR13**, a connected IoT device from an associated network during a data collection episode.

### FR15 – IoT Device Module

**Priority: Essential**

**Target User: All**

Chariot shall utilize IoT device modules for the compatibility and configuration of IoT devices to the system.

#### FR15.1 – Add IoT Module

**Priority: Essential**

**Target User: All**

Chariot shall have an interface for the addition of IoT device modules to the system for future use.

#### FR15.2 – Remove IoT Module

**Priority: Essential**

**Target User: All**

Chariot shall be able to remove IoT device modules of devices currently uninvolved in a data collection episode. This will disassociate the module from the system and prevent its use or appearance in Chariot.

### FR16 – IoT Device Status

**Priority: High**

**Target User: All**

Chariot shall record and make accessible the status of all IoT devices on a network. A device status will include the device ID, uptime, resource utilization, and other information pertinent to the model of device.

Data Collection

The following requirements indicate how Chariot manages data collection from devices on a network.

### FR17 – Data Collection Episode

**Priority: Essential**

**Target User: All**

Chariot shall take received data from a network’s IoT devices and save it as collected data into a storage unit during a data collection episode.

#### FR17.1 – Initialize Data Collection Episode

**Priority: Essential**

**Target User: All**

Chariot shall be able to initialize a data collection episode to receive data from the network’s connected devices and save it to a storage unit.

#### FR17.2 – Pause Data Collection Episode

**Priority: Essential**

**Target User: All**

Chariot shall be able to pause an ongoing data collection episode, suspending the receiving of data from a network’s IoT devices. The system shall also prevent the collection of additional data to the storage unit.

#### FR17.3 – Resume Data Collection Episode

**Priority: Essential**

**Target User: All**

Chariot shall be able to resume a paused data collection episode. This will allow for the further collection of data to the storage unit and the receiving of data from the network’s IoT devices.

#### FR17.4 – Terminate Data Collection Episode

**Priority: Essential**

**Target User: All**

Chariot shall be able to terminate data collection episodes that have gone through their full duration or allow for the user to preemptively terminate a data collection episode. This will suspend the further receiving of data from the network’s IoT devices and terminate the collection of data to the storage unit.

### FR18 – IoT Device Data Collection

**Priority: Essential**

**Target User: All**

Chariot shall receive and collect data from at least one IoT device from a single network during a data collection episode.

### FR19 – Concurrent IoT Device Data Collection

**Priority: Essential**

**Target User: All**

Chariot shall be able to receive and collect data from at least two IoT devices from a single network simultaneously during a data collection episode.

### FR20 – Concurrent Heterogenous IoT Device Data Collection

**Priority: Essential**

**Target User: All**

Chariot shall be able to receive and collect data from at least two heterogeneous IoT devices from a single network simultaneously during a data collection episode.

### FR21 – Data Collection Episode Configuration

**Priority: Essential**

**Target User: All**

Chariot shall utilize data collection episode configuration to define what data is to be collected from the network’s IoT devices, the storage unit to use; **See FR24** formatting of the collected data, and duration of the data collection episode.

#### FR21.1 – Save Data Collection Episode Configuration

**Priority: Essential**

**Target User: All**

Chariot shall save data collection episode configurations for future or external use.

#### FR21.2 – Load Configuration for Data Collection

**Priority: Essential**

**Target User: All**

Chariot shall be able to load previously saved data collection episode configurations in place of the manual input of configurations.

### FR22 – Concurrent Network Data Collection

**Priority: Low**

**Target User: All**

Chariot shall be able to receive and collect data from at least two separate networks simultaneously.

### FR23 – Concurrent Network Data Collection of Network Sharing IoT Devices

**Priority: Low**

**Target User: All**

Chariot shall allow for at least two separate networks that share at least one IoT device amongst their collections to perform concurrent data collection episodes if all shared devices have the same IoT device configuration, **See FR12**.

### Data Access

The following requirements indicate how Chariot manages user access to data.

### FR24 – Storage Unit Module

**Priority: Essential**

**Target User: All**

Chariot shall utilize storage unit modules that can interface and provide compatibility for storage units to the system.

#### FR24.1 – Add Storage Unit Module

**Priority: Essential**

**Target User: All**

Chariot shall

Chariot shall have an interface for the addition of storage unit modules to the system for future use.

#### FR24.2 – Remove Storage Unit Module

**Priority: Essential**

**Target User: All**

Chariot shall be able to remove storage unit modules currently not being used by the system. This will disassociate the module from the system and prevent its use or appearance in Chariot.

### FR25 – Live Data Access

**Priority: High**

**Target User: All**

Chariot shall allow for the accessing and usage of collected data during a data collection episode.

### FR26 – Timestamped Received Data

**Priority: Essential**

**Target User: All**

Chariot shall timestamp all received data from an IoT device to the storage unit with the time it was received.

### FR27 – Timestamped Collected Data

**Priority: Essential**

**Target User: All**

Chariot shall timestamp all collected data to the storage unit with the time it was collected.

### FR28 – Save Collected Data to a File

**Priority: Essential**

**Target User: All**

Chariot shall be able to save collected data from a completed data collection episode to a file based on the IoT devices and storage unit used.

### FR29 – Load Collected Data from a File

**Priority: Essential**

**Target User: All**

Chariot shall be able to load collected data from a file for use by the system.

### Data Analysis

The following requirements specify requirements for Chariot’s data analysis capabilities. Examples of a data analysis tool include visualizers, data processing tools and algorithms.

### FR30 – Data Analysis Module

**Priority: Essential**

**Target User: All**

Chariot shall allow for the utilization of data analysis modules that contain tools for the evaluation, interpretation and or visualization of collected data.

#### FR30.1 – Add Data Analysis Module

**Priority: Essential**

**Target User: All**

Chariot shall have an interface for the addition of data analysis modules to Chariot, associating them to the system.

#### FR30.2 – Remove Data Analysis Module

**Priority: Essential**

**Target User: All**

Chariot shall be able to remove data analysis modules currently not being used by the system. This will disassociate the module from the system and prevent its use or appearance in Chariot.

### FR31 – Data Analysis Tool Usage

**Priority: Essential**

**Target User: All**

Chariot shall use data analysis tools after a data collection episode on a network’s collected data.

### FR32 – Data Analysis Tool Usage during a Data Collection Episode

**Priority: Essential**

**Target User: All**

Chariot shall allow for the interaction with collected data during a data collection episode.

### Communication

The following requirements specify requirements for Chariot’s communication capabilities.

### FR33 – Ethernet Connection

**Priority: High**

**Target User: All**

Chariot shall be able to perform data transfers with IEEE 802.3 standard compliant IoT devices.

### FR34 – WiFi

**Priority: High**

**Target User: All**

Chariot shall be able to perform data transfers with IEEE 802.11 standard compliant IoT devices.

### FR35 – LoRa

**Priority: High**

**Target User: All**

Chariot shall be able to perform data transfers to IoT devices that utilize LoRa technologies.

### FR36 – Addition of Communication Standards

**Priority: High**

**Target User: All**

Chariot shall be able to add support for new network communication standards and protocols. The addition of new standards and protocols will not degrade functionality of existing communication methods.

## Nonfunctional Requirements

The statements below define the non-functional requirements for the system.

### NFR1 – Extensibility

**Priority: Essential**

**Target User: Technical**

Chariot shall be an extensible system that will utilize modules to increase the functionality and compatibility of the core system.

### NFR2 – Deployment

**Priority: Essential**

**Target User: Non-Technical**

Chariot’s deployment process shall be streamlined to the point that a Non-technical user described in Section **2.2.2** can install and begin data collection without external assistance.

### NFR3 – Data Integrity

**Priority: Essential**

**Target User: All**

Chariot shall maintain integrity of collected data in such a way that Chariot does not alter values during the collection process.

### NFR4 – Real-Time Data Collection

**Priority: High**

**Target User: All**

For every second of data sent to Chariot, Chariot shall fully capture the data sent in that one second interval to allow for real time analysis.

### NFR5 – Error Handling

**Priority: High**

**Target User: All**

Chariot must not crash due to the unexpected failure of an IoT Device or network. The system shall have error handling measures to ensure the continued, uninterrupted collection of data.

### NFR6 – Security

**Priority: High**

**Target User: All**

Chariot shall have configurable security options to protect the transmission, storage and access of data used by the system and its users.

### NFR7 – Documentation

**Priority: High**

**Target User: All**

Chariot shall be packaged with extensive internal and external documentation. Internal documentation will clearly describe how Chariot’s code functions. External documentation will describe how to operate the system.

## Data Requirements

The following table describes the various kinds of data expected to be utilized by Chariot

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Type** | **Size** | **Comment** |
| User information | Dictionary | Variable | Username/password information for each user of the system, **See FR3** |
| Access list | List | Variable | For each network, there is a list of users with access to network, **See FR9** |
| Networks | List | Variable | List of a connected networks. **See FR5** |
| Devices on network | List | Variable | List of devices connected to a network. **See FR5.1** |
| Device information | Dictionary | Variable | ID, name, and other information specific to a device. **See FR10.1** |
| Device configuration | Dictionary | Variable | Configurable settings of a device and their values. **See FR10** |
| Device status | Dictionary | Variable | Uptime, resource utilization, and other status information pertinent to device. Different from Device information, as Device status will frequently change. **See FR16** |
| Device data stream | Stream | Variable | Data received from device sensors. |
| Configuration | Dictionary |  | Configurable settings for the components of Chariot. **See FR10 and FR21** |
| Data collection episode status | Integer |  | Indicates if data collection episode is in progress, paused, or terminated. Also indicates errors in data collection. |
| Collected data | Various | Variable | Incoming data from data analysis episode is written to a database. Previously collected data can also be loaded from a file. The type is dependent on the storage unit used by the data collection episode. |

## Design Constraints

The following section specifies the design constraints restricting design of the system.

### DC1 – Graphic User Interface

The user shall be able to use the system via a graphic user interface. Stakeholders have expressed frustration using the command line for tasks this system would accomplish, so a graphic user interface is preferred.

### DC2 – External Library Usage

Chariot will make use of external libraries to interface with IoT devices. The system will use these libraries as specified.

### DC3 – LGPL Licensing

Chariot shall be licensed with the GNU Lesser General Public License (LGPL) (Free Software Foundation, Inc., 2007).

### DC4 – IEEE Standard Compliance

Chariot shall comply with IEEE standards relevant to IoT systems (Institute of Electrical and Electronics Engineers, 2018).

### DC5 – FCC Regulation

As a product developed in the United States of America, Chariot will comply with FCC regulations and guideline for the usage of IoT devices for FCC Approval (Federal Communications Commission, n.d.).

### DC6 – Adaptation of Drexel Wireless’ IoT Sensor Framework

Chariot will use and adapt related work in the field of IoT data collection. The system will use several key features of Dr. Bill Mongan’s IoT Sensor Framework (Mongan, 2019). Chariot will adhere to the conventions of original work and will document where work is used or adapted.

# References

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