NeoCharge:
Software Requirements Specification
version 1.0

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October 9, 2019

Contents

Credits

Name	Date	Role	Version
Joshua Boe	October 9, 2019		1.0
Lauren Hibbs	October 9, 2019		1.0
Casey Daly	October 9, 2019		1.0
Pranathi Guntupalli	October 9, 2019		1.0
Hannah Kwan	October 9, 2019		1.0

Revision History

Name	Date	Reason for Changes	Version
Team	October 9, 2019	Initial version	1.0

1 Introduction

1.1 Purpose

1.2 Document Conventions

1.3 Intended Audience and Reading Suggestions

1.4 Project Scope

1.5 References

2 Overall Description

2.1 Product Perspective

For EV (electric vehicle) owners, charging their vehicle comprises a significant part of their EV ownership experience. NeoCharge helps alleviate some of the overall cost for EV owners, creates a charge with less impact on the environment, and provides a simple and non-costly setup. Our application will give owners of NeoCharge EV chargers more insight into and control over the charging process. We want users of NeoCharge products to be able to control and view their products without needing to be anywhere near the hardware they have purchased.

2.2 Product Features

All of the major features that will be implemented into the NeoCharge app will fall into two basic categories, those that give the user insight into the charging process, and those that control and scheduling charging sessions. Insight into the charging process will include features that will let the user view their charging history, which includes prices they have paid for charging recently, their power usages, and how green their usage of power was. It will also have features that will view the status of current charging sessions. In terms of control over the charging session, users will be able to schedule charging sessions through the server and set limits on when they would want to charge, whether this be by cost or by time of day.

ADD IN DATA FLOW DIAGRAM THAT SHOWS DATA GOING FROM APP TO SERVER TO HARDWARE AND VISA VERSA

2.3 User Personas

Jonathan Sinclair

Age: 28
Author: Casey

Jonathan is a young software developer in San Francisco, who lives with his girlfriend of two years. Jonathan loves to immerse himself in nature, whether it be hiking, biking, or his new favorite hobby: kayaking in the San Francisco Bay. He has noticed more and more on these excursions the amount of pollution and trash there is on the coast, and has decided to start volunteering for beach clean ups. Even though he already owns a Tesla due to his high paying salary, Jonathan loves to find new ways to be more environmentally conscious.

One problem he has been reading into recently is the fact that electric vehicles like his own are not always as green as they are made out to be. For example, if the electricity

that charged the car was generated through non-renewable energy sources, it would not be as good for the environment as using energy produced from solar panels. As he does not know exactly where the power to his house comes from, he doesn't know if his car charging is as green as it should be.

Jonathan has done a lot of research into how he might be able to find where his energy comes from, but to little avail. He found out that the EPA provides certain tools to do this, but they are difficult to use and not always accurate. He wishes there was some way to easily see where the energy he uses to charge his Tesla comes from. If he found out his energy usage was green, he could put his mind at ease. If he found out it was not, he could try to receive his power from a greener source.

John Miller

Age: 25
Author: Pranathi

John recently completed 3 years of working at Apple. John is extremely invested in the environment and has been taking public transportation to get to work. Taking BART adds an extra 45 minutes to John's commute each morning, but John feels morally conflicted about buying a car due to the fact that carbon emissions negatively impact the environment.

Recently, John has been needing to go to work extremely early because his new project involves talking to a team in Europe. John decides that public transportation adds to much extra time to his commute and decides to buy an electric vehicle.

John spends the money he has been saving for the past few years to buy a Tesla. Initially, John planned on charging his Tesla through the standard 110v plug that already exists in his home utilizing the free adapter that comes with the car. Quickly, John realizes that it takes up to 4 days to fully recharge an empty Tesla car battery using the regular wall outlet and realizes that he needs his car every day and the standard outlet is too slow. Because he spent all his savings on attaining the car, John cannot afford to hire an electrician to install a specific wall connector for his Tesla. John is now looking for alternative, cheaper ways to charge his new vehicle.

Ye Wenjie

Age: 32
Author: Lauren

Ye Wenjie is a single mother who is a manager at a department store in Orange County. Her schedule is very busy. Before having her daughter, Ye would take public transportation to her job. It would take up to 45 minutes per commute, but she has

little money and has less now that she has a new child. Ye lives close to her mother and grandmother who are happy to help care for her new child. However, Ye's family lives on the other side of the city from her job. After a few months, she decides to move in with her parents and face a commute of over an hour an a half a day. But as a hard worker, Ye isn't satisfied. Ye decides she would like to go to school so that she can get a higher paying job with her daughter to take care of. A family friend offers to sell her a used Toyota Prius at a discount. Ye doesn't know much about electric cars but she jumps on the offer to have a cheap car.

Since Ye's family rents, she needs to find a way that she can quickly and easily install a car charger without hiring an electrician. Ye is not interested in the environmental savings of an electric vehicle. She is mostly looking for transportation as cheaply as possible. Additionally, Ye shares this car with her family members. She does not come home every night on a regular schedule, and sometimes the car does not have long to charge before it is needed again.

Phoebe Hunter

Age: 35
Author: Hannah

Phoebe is a lawyer who lives in Newport Beach with her husband, Todd. Phoebe practices business law and Todd is a finance manager. They like to be eco-friendly. They recently installed solar panels on their house and they tried to buy energy-efficient appliances when they moved into their home. Their friends have had a Tesla for a while, and Phoebe and her husband liked the luxury and its use of clean energy.

Recently, they purchased two Tesla Model S vehicles, and also hired an electrician to install an outlet for their electric vehicle charger. For the last few months, Phoebe and her husband have shared the electric vehicle charger, switching the charger between cars. Unfortunately, one night, they forgot to switch the charger and Phoebe did not have enough charge to get to work. Phoebe and her husband would have to pay thousands of dollars to get another charger installed. They are looking for a solution so that they can charge both of their cars at once.

David Butler

Age: 66
Author: Joshua

David is a mechanical engineer who lives in Beaverton, Oregon alongside his wife of 43 years, Samantha. David and Samantha have three sons and one daughter, but all of whom dispersed throughout Oregon and California over 10 years ago. David works

for Comcast Cable and assists in the planning, designing, integrating, testing, deploying and supporting of Comcast's X1 TV Box product. He considers himself a a tech-savvy person and enjoys keeping up to date on the market's newest technologies.

David has always been fascinated by the autopilot technologies many electric cars have to offer, but it was not until recently that he and Samantha decided to sell David's current car and purchase one of their own. After ample research and comparing different companies and models, David and Samantha were most impressed with the value of the Tesla Model 3 and so they decided they would to purchase one. Before making the purchase, they were researching the requirements of installing a charging outlet when they stumbled upon the NeoCharge website.

David and Samantha are now trying to determine whether the NeoCharge product would be a good fit for them. They have a water heater in their garage connected to a 220V outlet, so it is a viable option. They like the idea of a charger that is coupled with a mobile app for simple, remote scheduling maintenance. The Tesla will primarily be driven by David, since it is replacing his current car and Samantha has a nice car of her own. However, Samantha would sometimes like to drive it in order to cut down on fuel costs and emissions. David and Samantha would like if they could connect both of their phones to the same charger and each have the ability to receive notifications and adjust charger scheduling.

2.4 User Classes and Characteristics

2.5 Operating Environment

As the end goal is to have a mobile application, this software will be operating on a mobile device. It will be run in an Android operating system environment, and this application must have the prerequisite of owning a NeoCharge charging device.

2.6 Design and Implementation Constraints

Developers will be limited to an Android development environment throughout the development process. In terms of databases to be used, Because the NeoCharge hardware has limited RAM, and because it would over complicate the line of communication from user to hardware, developers will be interacting with this hardware through a server. This server will serve as an interface to all communication from the mobile application to the charger hardware. All communication from the server to the hardware is out of the scope of this project, and the development will center around only communication between the mobile application and the server.

2.7 User Documentation

At the end of the development of most or all other features, one of the last features to be implemented will be the user tutorial. This user tutorial will take first time users

through the experience of using the mobile application.

2.8 Assumptions and Dependencies

2.9 Business Rules

3 Use Cases

3.1 Use Case 1: View Power Usage

Use Case ID:	1
Use Case Name:	View Power Usage
Created By:	Casey Daly
Last Updated By:	Casey Daly
Date Created:	October 6, 2019
Date Last Updated:	October 9, 2019
Actors:	User
Description:	A user accesses the NeoCharge application from their mobile device. They navigate to the Power Usage page, select the time period which they would like to view power usage over, and then the user can view how much power their electric vehicle has been using by kWh or by USD for that time period.
Preconditions:	1. User has downloaded the NeoCharge mobile application. 2. User has set up their NeoCharge mobile application with their charger.
Postconditions:	1. User has knowledge of how much power, or money, their electric vehicle has used to charge over the period of time chosen.
Normal Flow:	1.0 View Power Usage in kWh 1. User navigates to the power usage tab. 2. System displays an initial graphical representation of the users power usage for the last week in kWh. 3. User optionally selects a different period of time to view their power usage. 4. System displays updated graphical representation with new period of time. 5. User optionally selects a different graphical representation of the power usage. 6. System displays updated, new graphical representation of the data. 7. User can adjust graph's settings and scales to better picture the data being viewed.
Alternative Flows:	1.1 View Power Usage in USD (after step 2)

	1. User selects option to display power usage in USD as opposed to kWh 2. System reflects this change in the data being displayed. 3. Return to step 3.
Exceptions:	1.0.E.1 Time period selected is longer than user has owned NeoCharge charger (at step 3) 1. System chooses longest period of time possible to user that is less than the period of time requested. 2. System displays power usage metrics for this period of time.
Includes:	None
Priority:	High
Frequency of Use:	Approximately 5 users, average of three usage per week
Business Rules:	TBD
Special Requirements:	1. User shall be able to change time intervals and types of data (USD and kWh). (Priority = medium)
Assumptions:	None
Notes and Issues:	1. The default time range is the last week's worth of data, and the default graph displayed is a line graph. 2. If user doesn't have any data to be displayed then a message will appear to the user stating such.

3.2 Use Case 2: Schedule Charge Session

Use Case ID:	2
Use Case Name:	Schedule Charge Session
Created By:	Pranathi Guntupalli
Last Updated By:	Pranathi Guntupalli
Date Created:	October 7, 2019
Date Last Updated:	October 7, 2019
Actors:	User

Description:	A user accesses the NeoCharge application from their mobile device. The user navigates to the Schedule Charge page in order to schedule a charge session by inputting a date as well as a start and end time. The car will start charging at the specified time automatically.
Preconditions:	1. User has downloaded the NeoCharge mobile application. 2. User has set up their NeoCharge mobile application with their charger.
Postconditions:	1. User will have a vehicle that has been charged during the specified times.
Normal Flow:	1.0 Schedule a Charging Session 1. User navigates to the schedule charge tab. 2. System displays date and time fields color coded by most cost effective to least cost effective times. 3. User selects a date, as well as a start and end time for the charging period. 4. System displays the selected time period in order to get a confirmation from the user. 5. User can optionally adjust the times presented and 'confirm' the selected schedule. 6. System sends the information to the server and the charge will start automatically at the specified time. 7. System notifies the user when the charge session begins. 8. System notifies the user when the charge session ends.
Alternative Flows:	4.1 User decides to cancel the scheduled charge 1. User presses the 'cancel' button 2. Return to step 2.
Exceptions:	1.0.E.1 Scheduled charging session unable to start because user did not connect the charger to the vehicle (at step 6) 1. System notifies the user that the charging session will not begin until the user connects the car with the charger.

	2. User connects the charger to the car correctly. 3. System notifies the user that the charge session is in progress.
Includes:	None
Priority:	High
Frequency of Use:	Approximately 5 users, average of one usage per day
Business Rules:	TBD
Special Requirements:	1. User shall be able to cancel the charging session at any time. (Priority = medium) 2. User shall be able to view history of previous charging sessions scheduled. (Priority = low) 3. System shall notify the user if scheduled charge session is disrupted for any reason. (Priority = high)
Assumptions:	None
Notes and Issues:	1. If scheduled charge session is modified while car is actively being charged, how will the system react?

3.3 Use Case 3: Adjust Settings

Use Case ID:	3
Use Case Name:	View/Adjust Settings
Created By:	Joshua Boe
Last Updated By:	Joshua Boe
Date Created:	October 8, 2019
Date Last Updated:	October 8, 2019
Actors:	User, NeoCharge Device
Description:	A User navigates to the Settings page within the NeoCharge mobile application, views the settings currently in place (cost/kWh, size of battery TOU, WattTime API settings and notification settings), and makes any preferred adjustments to them.
Preconditions:	1. User has downloaded the NeoCharge mobile application. 2. User has associated their NeoCharge mobile application with a NeoCharge charger.

Postconditions:	1. Changes to the settings are saved within the app and persist until edited again. 2. The settings displayed on the Settings page immediately reflect any changes. 3. Edits to settings are written into a JSON (or other standard) format and delivered to database over REST request for use by the NeoCharge charger.
Normal Flow:	1.0 View Settings 1. User taps the gear icon to navigate to the settings page. 2. App displays the settings page with a list of categories (Notifications and possibly WattTime and Vehicle). 3. User selects category of settings they would like to view by tapping it. 4. App displays various adjustable settings for the selected category with the values they are currently set at.
Alternative Flows:	1.1 Adjust Setting(s) (branch after step 4) 1. User taps a setting they would like to edit. 2. App toggles the setting to be enabled/disabled or gives a list of options for the user to select from. 3. Repeat the previous 2 steps for as many settings as the user would like to change. 4. User taps "Apply Changes" button to save the current settings state. 5. App writes the setting changes into a JSON (or other standard) format. 6. App sends the setting changes over REST request to a server to be read and used by the user's NeoCharge charger in real time.
Exceptions:	1.0.E.1 Server is down (at 1.1 step 6) 1. App informs User that connection to the server was not reached and the settings changes won't be sent and take effect until a connection can be established. 2. App saves the settings data and continually tries to establish a connection.

	3. App sends the most recent settings data as soon as a connection is established. 1.0.E.2 User has no internet connection (at 1.1 step 6) 1. Same procedure as 1.0.E.1.
Includes:	None
Priority:	High
Frequency of Use:	Approximately 5 users, average of less than one usage per day
Business Rules:	TBD
Special Requirements:	1. None
Assumptions:	None
Notes and Issues:	1. The user must click "Apply Changes" button for any setting edits to be written to the server and take effect. 2. What settings are available and their default values are still TBD. 3. If the server is down, setting changes will not take effect until the server is brought back up.

3.4 Use Case 4: Receive Notifications

Use Case ID:	4
Use Case Name:	Receive Notifications
Created By:	Hannah Kwan
Last Updated By:	Hannah Kwan
Date Created:	October 8, 2019
Date Last Updated:	October 8, 2019
Actors:	User
Description:	A user receives notifications to their device when charging is interrupted.
Preconditions:	1. User has the NeoCharge application. 2. User registered their device with the NeoCharge application. 3. User has connected their phone and their device to Wifi. 4. User has notifications turned on for the NeoCharge application. 5. User has plugged their electric vehicle into the NeoCharge device.

Postconditions:	None
Normal Flow:	1.0 Receives a notification that charging has stopped. 1. System receives feedback from device that charging has stopped. 2. System informs User that charging was interrupted. 3. User opens the NeoCharge application to view the cause of the interruption. 4. System displays a description of the issue. 5. User fixes the issue. 6. System notifies User when charging has resumed.
Alternative Flows:	1.1 Interruption was caused by a incorrectly configured device (branch after step 4) 1. System displays instructions to reconfigure their device. 2. Return to step 5.
Exceptions:	1.0.E.1 User is unable to fix the issue (at step 5) 5a. System informs User that vehicle is still not charging. 5b. System restarts use case.
Includes:	None
Priority:	High
Frequency of Use:	Approximately 50 users, average of five usages per day
Business Rules:	TBD
Special Requirements:	None
Assumptions:	Assume User stays connected to Wifi.
Notes and Issues:	None

3.5 Use Case 5: First time setup

Use Case ID:	5
Use Case Name:	First time setup
Created By:	Lauren Hibbs
Last Updated By:	Lauren Hibbs
Date Created:	October 8, 2019
Date Last Updated:	October 8, 2019
Actors:	User, Phone, Neocharge device

Description:	A User with a Neocharge device and smartphone pairs the two devices using the device's serial number. After pairing, the user enters relevant car information for setup and the app displays a tutorial of how to use the device.
Preconditions:	1. User has downloaded the Neocharge app. 2. User has not yet registered a Neocharge device.
Postconditions:	1. Neocharge application will automatically connect to the Neocharge device without setup. 2. Neocharge application will have basic information about the User's car and configuration. 3. User will have a basic understanding of how to use the Neocharge app.
Normal Flow:	1.0 First time app setup 1. User opens the Neocharge app for the first time. 2. App displays a page offering options to sign in or register a device. 3. User selects 'register a device'. 4. User is prompted to enter the device serial number, email, and create an account. 5. System creates an account in on the server and checks that the device serial number has not been claimed. 6. App displays when an account has been successfully made. 7. User is prompted to enter car information such as make, model, and battery capacity. This information is persisted to the server. 8. User is presented with an image demonstrating various features of the app. 9. User can tap the right side of the screen to progress to the next screens of the tutorial. 10. User finishes the tutorial. 11. The home page of the app is displayed to the user.
Alternative Flows:	1.1 Neocharge device number entered incorrectly (branch after step 5)

	1. System displays "This Neocharge device number is invalid or already activated. Please re-enter the number or contact support." 2. Return to step 4. 1.2 Enter information about multiple cars (after step 7) 1. User clicks the option for "add multiple vehicles" on the setup screen and is prompted to enter more vehicle information.
Exceptions:	1.0.E.1 Neocharge device number is invalid because it is already in use (at step 1) 1. System checks database of claimed serial numbers and determines this serial number is already registered to an account. 2. App informs user that only one account can be made per Neocharge device. 3 . App prompts the user to login to an existing account or resend a password to the account email. 3a. System sends an email with a password reset link if requested. 4. User successfully logs in to account.
Includes:	None
Priority:	High
Frequency of Use:	Approximately 100 users, approximately one usage per device owned
Business Rules:	TBD
Special Requirements:	None
Assumptions:	Assume that the app is sufficiently complicated that a tutorial would be of benefit to users.
Notes and Issues:	1. Peak usage load for new account creation and logins will be when the product is first released.

4 System Features

4.1 System Feature 1

4.1.1 Description and Priority

4.1.2 Stimulus/Response Sequences

4.1.3 Functional Requirements

4.2 Scheduling (PG)

4.2.1 Functional Requirements

1. REQ-1: The user shall be able to schedule a charge session based on cost-data provided by the system.
2. REQ-2: The user shall be able to cancel a scheduled charge session through the mobile app.
3. REQ-2: The user shall be able to set up charge sessions at repeated times.

4.3 Notifications (HK)

4.3.1 Functional Requirements

1. REQ-1: The system shall receive feedback from the device when charging stops.
2. REQ-2: The system shall notify the user when charging is interrupted.
3. REQ-3: The system shall report what caused the interruption.

4.4 Settings (LH)

4.4.1 Functional Requirements

1. REQ-1: The user shall be able to input the car's make, model, and battery type.
2. REQ-2: The user shall be able to have multiple cars stored one one device.
3. REQ-3: The user shall be able to change the units that rates are displayed in.

4.5 Dashboard (JB)

4.5.1 Functional Requirements

1. REQ-1: The user shall be able to see the car's current charging rate.
2. REQ-2: The user shall to initiate a charge immediately.

3. REQ-3: The user shall be able to stop a charge immediately.
4. REQ-4: The user shall be able to set the car to wait for a scheduled charge.

4.6 Setup (CD)

4.6.1 Functional Requirements

1. REQ-1: The user shall be able to register their charging device with their app.
2. REQ-2: The user shall be taken through a tutorial upon opening app for first time.
3. REQ-3: The user shall be prompted to input their car's make, model, and battery type upon opening the app for the first time.

5 External Interface Requirements

5.1 User Interfaces

TBD

5.2 Hardware Interfaces

App —REST— Server —MQTT— NeoChargeDevice —HTTP— WattTime

5.3 Software Interfaces

TBD

5.4 Communications Interfaces

TBD

6 Other Nonfunctional Requirements

6.1 Performance Requirements

1. The system shall send the scheduling information that the user inputs to the servers immediately. (PG)

2. The chosen server host shall possess a reliable up time in order for the app to write and the device to reflect real-time scheduling and settings changes. (JB)

6.2 Safety Requirements

1. The system shall display the battery percentage of the car as accurately as possible, given what the user has entered.

2. The system shall notify the user if the charger behaves in any way other than as expected.(LH)

6.3 Security Requirements

1. Each device shall have a unique serial number that allows the user to register with the NeoCharge application. (HK)

2. Device serial numbers shall be secure, not easily accessible or able to be discovered through brute-force, in order to prevent unintended users from connecting to a charger. (JB)

3. Database queries shall have security measurements in place to prevent attacks (SQL injection). (JB)

6.4 Software Quality Attributes

1. The system shall have sufficient usability, where the user can start charging their vehicle in a few screen taps or less. (CD)

7 Other Requirements

1.

A Glossary

B Analysis Models

C Issues List