Oregon State University
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CS Capstone Requirements Document

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Axolotl

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Abstract

This document is a SRS or software requirements specification that will outline the purpose, scope, and requirements of the NVIDIA Jetson TX2 infotainment and black box system we are to build. It will discuss the system's constraints and desired user demographic, list the assumptions we will make in approaching the development of this system, and detail our vision as to how users may interact with the system. Additionally, the document will describe the functionality said system will subsequently provide and offer a tentative timetable for fulfillment of project goals and requirements.

CONTENTS

1 INTRODUCTION

1.1 Purpose

The purpose of this software requirements specification (SRS) document is to outline and detail the capabilities of the NVIDIA Jetson TX2 infotainment and black box our group will develop, known henceforth as the Axolotl Infotainment System and Axolotl Software. Doing so will enable us to describe the requirements of the Axolotl Infotainment System and Axolotl Software such that we and our client will have a detailed understanding of the form factor and capabilities of the deliverable system we will develop. The intended audience for this SRS includes our client, the CS Capstone Instructors, and our group.

1.2 Scope

Our project entails the development of an infotainment system and black box that can be divided into two products: the Axolotl and the Axolotl Software. The Axolotl will connect vehicle sensors, controllers, receivers, and a touchscreen to a NVIDIA Jetson TX2 computer in a package that can be installed in a vehicle. The Axolotl Software runs on the Axolotl and provides users with media playback, navigation, and vehicle data logging capabilities.

2 DEFINITIONS

- NVIDIA Jetson TX2: A versatile, efficient, and high-performance computer made by NVIDIA to be used in robots, drones, and smart cameras.
- OBDII: On-Board Diagnostics II, a standardized connector installed in all automobiles sold in the United States since January 1st, 1996. Devices connected via a car's OBD-II port can read the vehicle's sensor data on the fly.
- CAN-bus: Controller Area Network Bus, a system that allows sensors and microcontrollers within a motor vehicle to communicate with each other without a central computer.
- LIDAR: Light Detection and Ranging, a method of using laser pulses to determine the 3D properties of a faraway object.
- AHRS: Attitude, Heading, and Reference System, a system used in modern aircraft to determine and display roll, pitch, and yaw.
- Infotainment: A portmanteau of "information" and "entertainment". When we use the term "infotainment", we are referring to the center console touchscreen that gives drivers access to information and media in modern cars.
- RDS: Radio Data System, a method of transmitting the current track information of an FM radio broadcast.
- UPS: Uninterruptible Power Supply, an auxiliary power source that enables a device to function for a limited time if its main power source is unavailable.
- SATA: Serial AT Attachment, an interface standard that connects computers to mass storage devices.
- MP3: A common digital audio coding format that uses lossy compression. MP3 files are given the .mp3 file extension.

2.1 References

This SRS references one document, titled "Federal Motor Vehicle Safety Standards; Rear Visibility; Final Rule", Report Number 66 of Volume 79 of the Federal Register, dated April 7th, 2014. This document can be obtained from the US Government Publishing Office at www.gpo.gov.

2.2 Overview

The remainder of this SRS contains an overall description of the system we are to develop in terms of the necessary hardware and software. The SRS will describe the intended functionality of the product, how it interfaces with users, and the necessary components that will make the specified functionality and interaction possible. Specific requirements, both required and optional, are listed in order of priority and desirability, respectively.

3 Overall Description

3.1 Product Perspective

The Axolotl Infotainment System is comprised of the Axolotl Head Unit and the Axolotl Software. The Axolotl Head Unit consists of all of the necessary sensors, receivers, and controller hardware connected physically and wirelessly with the NVIDIA Jetson TX2 system. The Axolotl is designed to be integrated into a car to either provide or replace an in-car infotainment system. Users will not interact directly with the sensors, receivers, or controllers.

The Axolotl Software will be installed on the Axolotl Head Unit's TX2 unit and directly interface with the user. The software will operate on Linux, as it is the base operating system installed on the TX2. The Axolotl Software will interact with the hardware and provide users with the ability to control media playback, conduct mapping and routing with navigation, and also exert limited control over system settings.

3.2 Product Functions

The main functions of the Axolotl are:

- The Axolotl will allow users to play media from multiple sources including: USB, Bluetooth, Auxiliary, and FM.
- It will also offer navigation with destination entry, mapping, and offline capabilities.
- The black box portion of the Axolotl logs output from a dashcam and all sensors tied into a car's OBD-II port. Users are able to download the black box data to a storage device or clear all black box data.
- The Axolotl display will also switch to the backup camera whenever user is reversing the car.

3.3 User Interfaces

The Axolotl Software will be interacted via a touchscreen using an iOS-inspired graphical user interface divided into the content window and the dock. The dock offers touch zones that will change the content window to either the media, navigation, or system menu. Each content window will have a submenu that displays contextual options and a content box encapsulating the main interactive content that changes based on the option selected in the submenu.

3.4 Hardware Interfaces

The hardware components of the system will include: an OBDII connector which will receive information from multiple onboard car sensors, an FM receiver for FM radio capabilities, an auxiliary 3.5mm headphone jack adapter, a storage medium for the logging of all sensor data from the car, and a ten-inch HDMI touchscreen that will connect to the TX2 via HDMI. It is assumed that the NVIDIA TX2 has native support for all hardware that is being used.

3.5 User Characteristics

The Axolotl will be used by ourselves, our client, and the general public, specifically car owners with any level of technological experience.

3.6 Constraints

- This SRS is limited to using the NVIDIA Jetson TX2 as the computing hardware.
- This SRS must implement the backup camera such that the backup camera feed lingers on the screen for 4-8 seconds after shifting out of reverse, in accordance to federal motor vehicle safety standards.

3.7 Assumptions

- This SRS assumes the availability of an accessible WiFi network with internet connectivity.
- This SRS assumes the availability of GPS signal.
- This SRS assumes the availability of Linux.
- This SRS assumes that hardware that comprises the Axolotl Head Unit may be changed as necessary to fulfill the listed software requirements; thus, the Axolotl Head Unit will not have rigid specifications other than the required hardware that is specified as a constraint in Section 3.6 of this SRS.

4 Specific Requirements

4.1 External Interfaces

- The Axolotl Software is a Linux program that is installed on the NVIDIA Jetson TX2.
- Users interact with the Axolotl Infotainment System via a graphic user interface displayed on a touchscreen.
- Users are able to control media, navigation, and data settings at any time.
  - In the media menu:
    - Users may select either FM, Aux, USB, or Bluetooth as the audio source. Users will also be able to turn the audio system off.
    - Users may change the current FM radio station.
    - Users may pause/play as well as select previous track/next track with USB and Bluetooth media sources.
    - Users may use a volume slider to adjust master audio output volume.
  - In the navigation menu:
    - Users may view the map, input an address and navigate the destination, or view their current route itinerary.
      - Users may enter the address as house number, street, city, state, and zip code.
    - Users may stop navigation and cancel their route at any time.
  - In the data menu:
    - Users may use a toggle switch to turn off the system's WiFi connectivity.
    - Users may download or wipe the data stored in the black box. These interfaces are only available after entering a password.
- Users will also be able to interact with the system in a minimum of two of any of the following ways:
  - Navigation: Users may choose between 2D flat and 2D topographical maps for mapping.

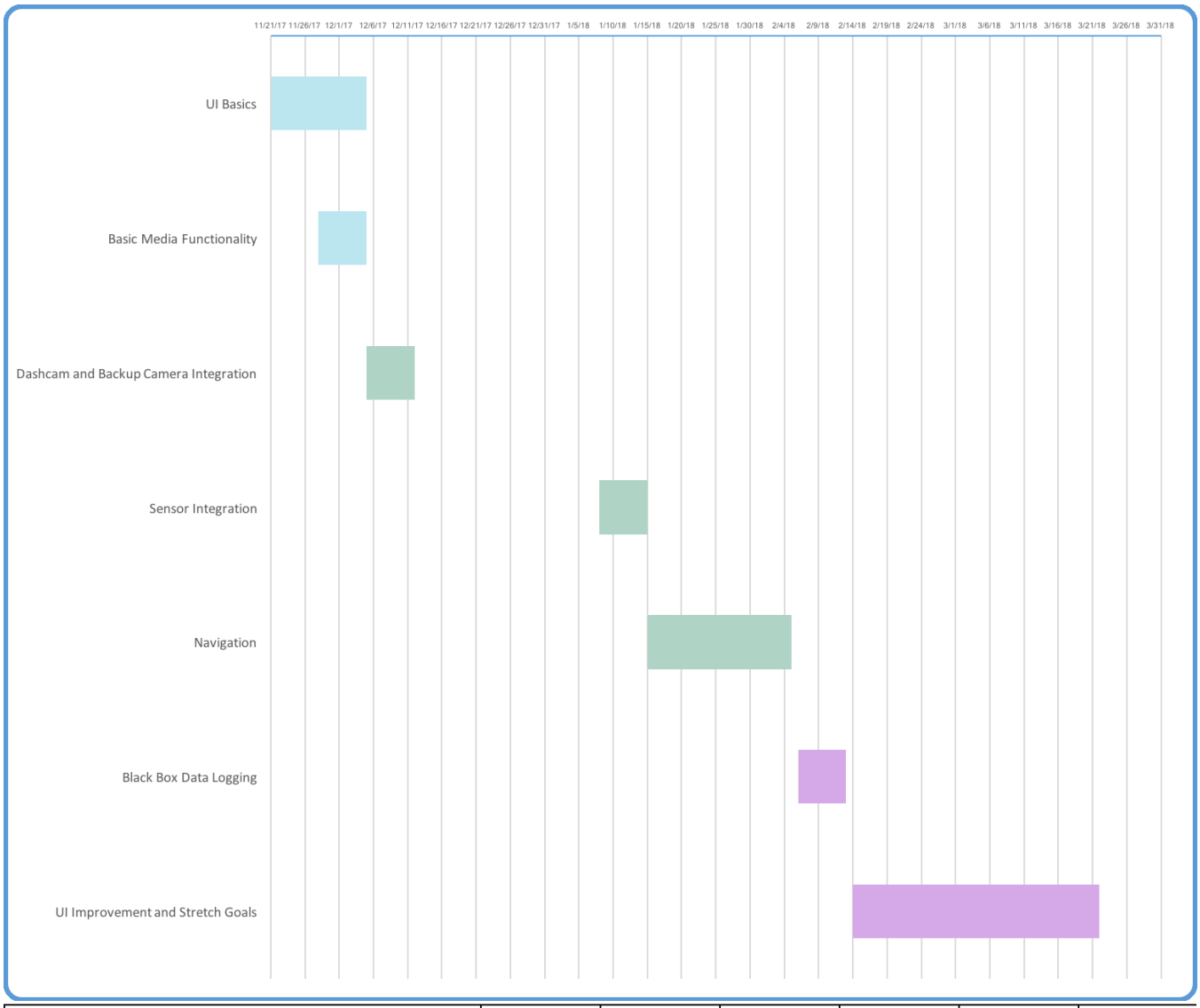
  - Media: Users can wirelessly download media from a home computer to a connected USB drive.
  - Data: Users may view their fuel economy statistics and also get tips on how to improve their fuel efficiency.
  - Media: Users may change the volume and tune radio stations using physical knobs.
  - MIscellaneous: Users may use a connected Bluetooth device receive phone calls.
  - Data: Users may view their AHRS data as it is recorded.
- The system receives input from sensors and stores it in a log.

4.2 Functions

- The system will parse incoming RDS data from the current FM radio station to generate FM station information displayed to the user.
- The system will search the connected USB media drive and display a list of playable tracks to the user ordered by filename for playback selection. Playback of .mp3 files is supported.
- The system will format data from an OBDII port, a connected dashcam, and AHRS sensors for logging.
- The system will utilize a single GPS receiver unit to determine the vehicle's current location for routing.
- The system will compensate for the loss of mobile data signal and allow for offline routing and mapping.
- The navigation system will be limited to addresses within the United States.
- The system will automatically switch to the backup camera feed when the vehicle is reversing.
- The system will also offer a minimum of one of any of the following optional functions:
  - The system will exert control over microcontrollers to manage supplemental turn signals and backup lights.
  - The system will use multiple GPS receivers throughout the vehicle to improve GPS location accuracy.
  - The system will utilize the dashcam to detect lane lines and provide lane departure warning.
  - The system will utilize a connected LIDAR system to provide passive parallel parking assist.

5 APPENDIX

5.1 Project Gantt Chart



Task Name	Start Date	End Date	Duration (Days)	Days Complete	Days Remaining	Percent Complete
UI Basics	2017/11/21	2017/12/05	14	0.00	14.00	0%
Basic Media Functionality	2017/11/28	2017/12/05	7	0.00	7.00	0%
Dashcam and Backup Camera Integration	2017/12/05	2017/12/12	7	0.00	7.00	0%
Sensor Integration	2018/01/08	2018/01/15	7	0.00	7.00	0%
Navigation	2018/01/15	2018/02/05	21	0.00	21.00	0%
Black Box Data Logging	2018/02/06	2018/02/13	7	0.00	7.00	0%
UI Improvement and Stretch Goals	2018/02/14	2018/03/22	36	0.00	36.00	0%