Cretaceous Gardens Controller

Requirements Definition Document

RDD Version 3.0

Team #3
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CS 460 Software Engineering

Contents

1 Introduction

The Tyrannosaurus Rex lives among us once again and the opportunity to provide an incredible experience has become a reality. The world will be able to experience that of which, until now, has only been dreamt. The Cretaceous Gardens experience will begin the second a visitor steps off the boat and onto the Isla Trueno. The visitor will be immersed in Cretaceous Gardens' unique, technological advancements: a truly one-of-a-kind luxurious experience. By the time they leave they will be already planning their next visit.

The purpose of this document is to define the requirements for the development of Cretaceous Gardens Controller (CGC) for our billionaire philanthropists customers in their new theme park on Isla Trueno near Costa Rica. The CGC is the main controller for components like the pay kiosks, cars, and electric fence. The CGC must provide sufficient safety, a great user experience, and ought to efficient.

Section 2 outlines the main objectives of the project, section 3 the overall system organization through a high level depiction, section 4 outlines interfaces, section 5 contains the capabilities of the system, section 6 provides all known design constraints, and the final section provides a reference for potentially unknown terms within the document [1].

2 Objectives

Four objectives believed to be critical for an optimal implementation of a Cretaceous Gardens Controller are identified here[2].

2.1 Safety

The main objective of the CGC is to provide safe and reliable experiences for the client and its end users. Whether it be electric fences or autonomous vehicles, ensuring safety is of highest priority. The end user ought to feel completely safe as should the client whose liability depends on this aspect.

[1] Introduction by Anas and Siri.
[2] Objectives by Anas, Siri and Zeke.

2.2 Positive User Experience

The realization of positive user experiences, in large part, depends on the seamlessness between subsequent interactions with each component of a system. For guests, the CGC should be as unimposing as possible in order to permit them the fullest immersion offered by Cretaceous Gardens. For the client, the system should provide peace of mind that the investment is worthwhile.

2.3 Maintainability

The states of the CGC and all *nodes* with which it is to communicate should be readily accessible and intelligible. The availability of this information will directly impact the diagnostic and repair speeds anywhere within the system.

2.4 Efficiency

The CGC is to engender high efficiency and robust functionality. Self-driving cars, pay kiosks, camera system, the global positioning system (GPS), electric fence panels, and all other nodes with which the CGC is to interact must not be burdened by inefficiencies of the CGC. On the contrary, the system should be expected to gracefully handle nodal malfunctions, failures, or inefficiencies.

3 Overall System Organization

The CGC will be centralized[3] and will manage all relevant components. Figure 1 shows a black box diagram of the CGC. The CGC receives input from sensors, user interfaces, and emergency systems like the *Global Alarm System* and responds through appropriate output actions as described below.

The Cretaceous Garden Controller will manage self-driving cars whose primary function will be to transport guests to and from the main exhibit. Pay kiosks, where guests are to buy admission tickets, will be locate in the southern region of the island. The admission tickets will be in the form of

[3]System Organization by Anas, Santi, Siri, and Zeke.

devices called *tokens*, which will grant guests access to their assigned vehicles as well.

The CGC will monitor the position of the T-Rex via GPS and cameras. In the event of enclosure failure, an emergency mode will be activated; island-wide alarm sounds will be transmitted, and the autonomous vehicles will prioritize transporting guests to safety.

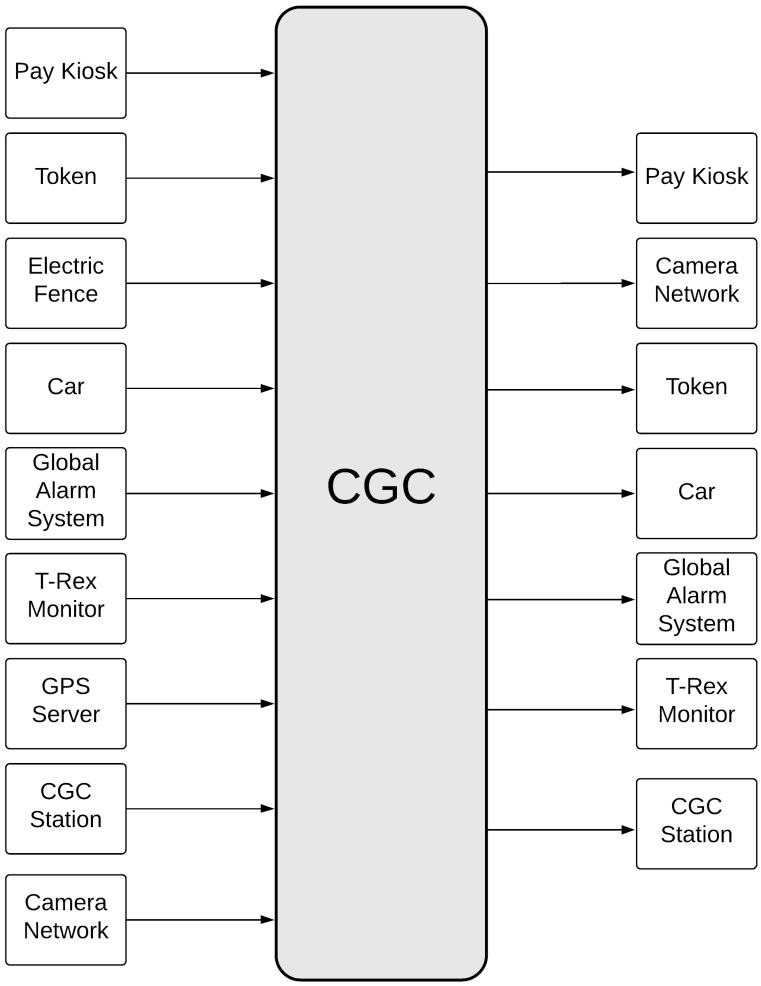

Figure 1: A black box of high-level inputs and outputs of the *CGC*.

4 Interfaces

The system interfaces[4] *have been grouped into several subsystems. The following list is composed of devices with which the CGC will interface, and includes the devices' sensors, hardware, and features.*

4.1 Pay Kiosk

The purpose of the the Pay Kiosk interface is to connect the physical Pay Kiosks to the CGC, the former of which possesses the following.

Sensors

Touch Screen: senses user interaction.

Credit Card: accepts all major credit and debit cards.

Cash Receptacle: accepts cash.

Hardware

Change Dispenser: dispenses change after the purchase of a token.

Token Dispenser: dispenses unique token to guest.

Features

Token Builder: generates unique token from given information (liability waver, name, etc.)

Transaction Logger: provides purchase receipts and stores transactions.

Maintenance System: enables staff to manage issues with the device and maintains device health information.

4.2 Token

The Token will act as an interface to multiple systems. It will provide valuable information about the visitor and also interact with the visitor.

[4]Interfaces by Siri, Anas, and Zeke

Sensors

Touch Screen: interacts with the users.

GPS Tracker: transmits location.

Hardware

RFID Chip: maintains a unique ID and is used for access to multiple systems and areas.

Speaker: transmits alerts and instructions to the guest.

Features

Localization: locateable via GPS.

4.3 Car

The autonomous car interface is that through which the CGC will manage all vehicles, and many of the functions of each vehicle.

Sensors

RFID Reader: senses tokens within a defined radius relative to the car, and counts guest tokens within the car.

Weight Sensor: measures weight on each seat, helps determine.

Camera: used by the car for autonomous driving and also is accessible by CGC.

Microphone: receives guest voice for use in an intercom.

GPS Tracker: transmits location of the car.

Hardware

Speaker: transmits alerts, instructions or general audio data.

Automatic Door Locks: engaged upon detection of movement.

Wireless Networking: communicate with the CGC.

Features

Maintenance System: enables staff to manage issues with the car and maintains car health information.

4.4 T-Rex Monitor

The T-Rex Monitor interface tracks and monitors the T-Rex. It is critical for employee and visitor safety.

Sensors

GPS Tracker: transmits location of the subject.

Heart Rate Sensor: monitors heart rate (beats per minute) of the T-Rex and may be used to gauge stress, hunger, or aggression.

Hardware

Tranquilizer Injector: administrates tranquilizer to the subject.

Features

Biometrics Monitor: collects T-Rex biometrics.

Maintenance System: enables staff to manage issues with the device and maintains device health information.

4.5 Camera Network

The camera network interface communicates with every camera, to all redundant network camera links, and to the digital video recorder (DVR) system that is to record all cameras per retention policy.

Sensors

Cameras: stream video.

Hardware

DVR: stores and retains video streams.

Hardwired Ethernet: used for network communication with CGC.

Features

Viewing: ability to view any stream.

Maintenance System: enables staff to manage issues with the device and maintains device health information.

4.6 Electric Fence

The electric fence interface is that through which the enclosure panels are to communicate with the CGC.

Sensors

Electrical Conduction Sensor: measures electricity going through electric fence and has the ability to trigger the alarm system in the absence of current.

Hardware

Electrical Fence Panels: electrically conductive enclosure panels.

Hardwired Ethernet: used for network communication with the CGC.

Features

Maintenance System: enables staff to manage issues with the device and maintains device health information.

4.7 Global Alarm System

The global alarm system propagates alarm signals throughout the island.

Hardware

Speaker: communicates with a network of public address (PA) speakers.

Hardwired Ethernet: used for network communication with CGC.

Features

Maintenance System: enables staff to manage issues with the device and maintains device health information.

4.8 CGC Station

The CGC station interface interacts with staff and features a graphical user interface to analyze and interact with components managed and monitored by the CGC.

Sensors

Microphone: receives speech for the intercom and may be used for announcements through the Global Alarm System.

Touch Screen: provides access to the system.

Hardware

Speaker: transmits sounds to the station.

Hardwired Ethernet: used for network communication with CGC.

Features

Maintenance System: communicates with all other maintenance systems, and may initiate system checks.

4.9 GPS Server

The GPS server interface acquires and maintains locations of all active GPS devices (e.g. cars, or tokens)

Features

Tracking: tracks all GPS devices via longitude and latitude coordinates.

Services: third party service to provide GPS services.

5 Capabilities

The capabilities of the system are significantly expansive due to its central role in the operation of the resort. Thus, the complexity of the system naturally leads to a description of the broad topography of its capabilities. First is an overview of protocol-related capabilities, then emergency-supporting capabilities, followed by capabilities that reinforce safety features, and finally an overview of its monitoring capabilities.[5]

5.1 Dynamic Protocol Configuration

1. The CGC will have a set of specified protocols for directing the collection of autonomous vehicles. The protocols will vary among sets of vehicles. For example, a protocol for the visitor vehicles will be executed in the case of an enclosure breach, another for preparation before the arrival of visitors, after their departure (outside business hours), and yet another for scheduled maintenance of the island.

2. The CGC will enable the configurability of protocols through straightforward interactions with a graphical user interface. This configurability can be thought of as functionality for:

   (a) creation of new protocols.

   (b) addition of premade protocols.

   (c) removal or extraction of protocols.

   (d) modification of existing protocols.

3. The CGC will allow for the simulation of any given protocol.

[5] Capabilities by Zeke and Matt.

5.2 Emergency Features

With respect to its emergency mode(s), the CGC will be capable of doing the following:

1. Receive distress or failure signals and propagate responses through the siren and alarm network of the island.
2. Communicate with external authorities and emergency personnel.
3. Be disarmable only through human intervention or complete physical destruction.
4. The CGC will have the following protocol as a fallback. It should be noted that This can happen any time of day and, for the sake of argument, it will be assumed at that there is peak activity in the garden. In other words, it is assumed that there are *many* visitors at the north end of the island (viewing the T-Rex).
   (a) The electric fence interface reports a breach which triggers this *Emergency Protocol*.
   (b) The T.Rex monitor interface triggers the device to administer the tranquilizing agent to the subject and the subject's heart rate is reported to the CGC every second, as is the subject's location.
   (c) Through the Global Alarm System,
      i. *All speakers* emit the alarm (protocol-specific) sounds.
      ii. Instructions to find and enter the nearest vehicle are propagated through the speakers.
      iii. Instructions are also sent to all active token devices.
      iv. Interleaved reassurances that more available vehicles are headed north are also transmitted.
   (d) All *safely occupied* vehicles begin to shuttle people (guests and staff) southward.
   (e) All *safely inactive* vehicles are dispatched northward.
   (f) Once there, the safely inactive vehicles will receive people until *safely occupied*.
   (g) 4d, 4e, and 4f will be repeated emergency mode is deactivated or until all vehicles run out of energy.

5.3 Safety Features

The CGC will possess the following features that serve to fortify safety measures. The CGC will:

1. allow the monitoring of every panel of the enclosure.
2. allow the monitoring of every camera.
3. reinforce power backup measures.
4. maintain redundant uplinks on the network(s).
5. command a fleet of patrol vehicles around the island.
6. support a maintenance mode for the real-time repair of any node.

5.4 Surveillance and Monitoring Features

With respect to the acquisition of data, the CGC will be able to:

1. track all guests at all times, relative to:
   (a) others in their groups.
   (b) their assigned vehicles.
   (c) the whole island.
   (d) their current zone within the island.
2. track all vehicles at all times.
3. track the location and biometrics of the T.Rex at all times.
4. process live video streams of:
   (a) various locations on the island
   (b) the enclosure
   (c) the kiosks
5. perform regular or on-demand audits of the network state.
6. dynamically account for new nodes or for nodes that are taken out for any reason.

5.5 Financial Analytics

The CGC will have basic financial functionality as it will be able to:

1. provide financial information and basic summary statistics.
2. identify any striking patterns of cash flow.
3. maintain long term financial records.

6 Design Constraints

The various constraints [6] *for the Cretaceous Garden Control are as follows.*

6.1 General

- The Cretaceous Gardens is located on an island.
- The Cretaceous Gardens exhibit is dangerous.
- The exhibit will be in the northern of the island.
- Guests will arrive at the southern end of the island.
- Pay Kiosks will be in the southern end of the island.
- The T-Rex location must always be known.
- Vehicles may accommodate up to 10 guests.
- Vehicles must alert guests when their time at the exhibit is up.
- Tokens must function as GPS devices.
- There must only be one token device per guest.
- Live camera streams around the island must be available at all times.
- Token devices must be returned upon guest departure.

[6] Constraints by Santi

6.2 Safety

- There must be an emergency mode in the event of enclosure failure.
- Vehicles must alert and instruct guests in the event of an emergency.
- The Alarm System must be audible in the both the northern and southern regions.
- Vehicles must facilitate evacuation in the event of an emergency.
- There must be a surplus of vehicles at all times on either end of the island.
- Tokens must provide additional evacuation information.
- Cars must maintain safe speeds at all times.
- Cars must lock before moving.
- The CGC must communicate to external authorities.

7 Definition of Terms

Here we have some definitions to terms used in the document. This section will help clarify meanings for different areas of the document.[7]

CGC: Cretaceous Gardens Controller

DVR: Digital Video Recorder

Electrical Conduction: The movement of electrically charged particles through a transmission medium.

GPS: Global Positioning System

Hardwired Ethernet: This references the latest IEEE standard for Ethernet utilizing physical cables.

[7] Definition of Terms by Siri and Zeke.

Network: All nodes with which the CGC interacts, the links that connect them to each other and to the CGC, the CGC itself, and all related databases.

Node: The generic term that refers to any device connected to the CGC in any way. This includes autonomous vehicles, tokens, the T.Rex monitor, all electric fence panels, all kiosks, and all cameras.

Safely Inactive: A state in which a vehicle is fully functional and ready to be dispatched.

Safely Occupied: A state in which a vehicle contains at least one person, is locked, and is ready to depart.

Token: An interactive device used by the visitor that grants access to locations.