SGC - Siesta Gardens Controller

Software Requirements Specification

SRS Version 1.0

Team 03
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1 Introduction

"B-STACK" is a software design group consisting of Brandon Stringham, Shreeman Gautam, Tanner Hunt, Amun Kharel, Cody Crane, and Krista Conley. In this Software Requirements Specifications (SRS) document, B-STACK details the project plan for the development of the "Siesta Gardens Controller" software (SGC). This project is funded by billionaire philanthropists who have given the team an unlimited, spare-no-expense budget. Therefore, Siesta Gardens will be an amazing vacation experience with all the state-of-the-art technology and an advanced scientific feat of a real live T. rex for the viewing pleasure of the guests, for a nominal fee. The purpose of this project is to design a theme park control system to track and transport guests safely to and from the T. rex exhibit. This document is intended for developers, designers, and testers working on the "Siesta Gardens Controller". This document will include a summary of: FEEDBACK =

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- General description of the system
- External Interfaces with input/output events with the physical devices
- Control logic with OMT diagrams, a system overview, and the technical approach to the system
- Design constraints of the system
- Definition of terms

2 General Description

The Siesta Gardens Controller (SGC) is a security and automation system that handles the logistics and safety of the Siesta Gardens Theme Park. The SGC has a central controller, the heart of the system, which coordinates and displays information from three subsystems that handle the park's integral tasks. These three subsystems include the token subsystem, the transportation subsystem and the security subsystem.

The Token subsystem will be responsible for the distribution of unique smart devices to park guests that are used as access tokens to transportation vehicles while also providing real time location data and a means of contacting and informing individual guests.

The Transportation subsystem controls the park's fleet of self-driving vehicles, tracking their passengers, location, and status, and is capable of handling stranded or broken down vehicles. These vehicles each have their own unique identifier and will register their passengers when they board, via the passengers' unique tokens, and will not leave the exhibit without all of their passengers being accounted for, unless in the case of an emergency.

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The Security subsystem monitors the security measures for the exhibit itself. It displays all security camera footage in the central control building, monitors heartbeat data, and monitors logs from the security cameras, electric fence and the T. rex monitor. It also monitors security cameras from around the park and the location data of all visitors, and is also equipped with a PA system. The security subsystem also has a notification system via the guests unique tokens that it can use to alert all guests in the case of an emergency.

All in all, the SGC consists of the unique token system for the guests, the automated car system, and the security system for the exhibit and the rest of the park. FEEDBACK =

Commented [3]: The operators are not mentionsd in this general description. Will you also have security guards? Those that will go in person to a stranded vehicle or take care of other contingencies?

Figure 1. displays the physical layout of the components. The security cameras and PA speakers all around the key communicate with the central control building via buried cables. The electric fence and token kiosks also communicate with the central control via buried cables. The RFID scanners around the park used to locate guest bracelets are connected together via a network of buried cables that then connect to the central control. The RFID bracelets

communicate with these scanners and the kiosks using near field radio signals. The self driving cars communicate with the central control via radio signals as they drive around the park.

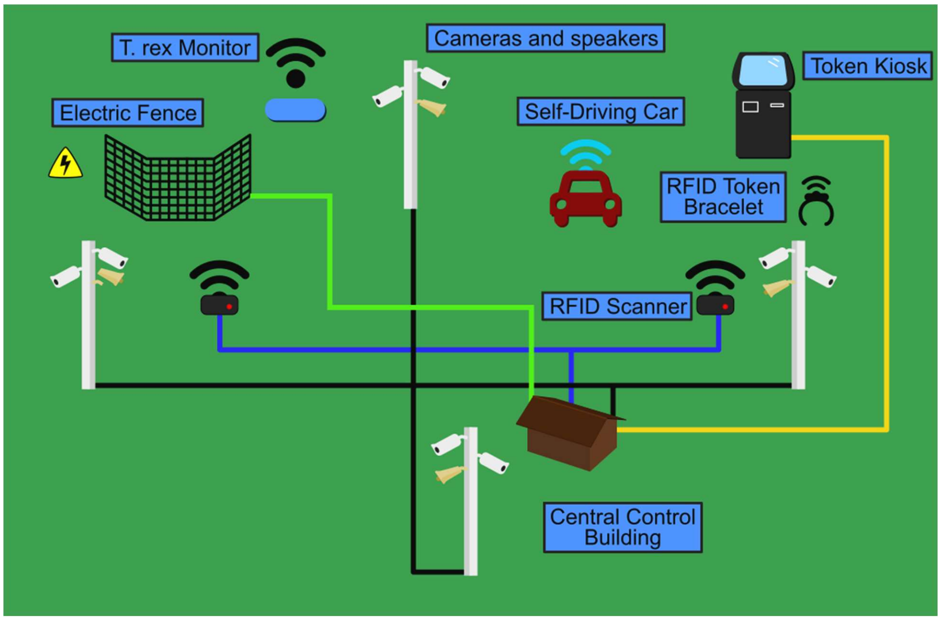

Figure 1 - The physical diagram

3 Specific Requirements

This section details the specific requirements for the system. These requirements include the external interfaces that the system needs to be able to communicate with to accomplish its goal, and the control logic that it needs to implement to function properly. Figure 2 shows the logical diagram of the system.

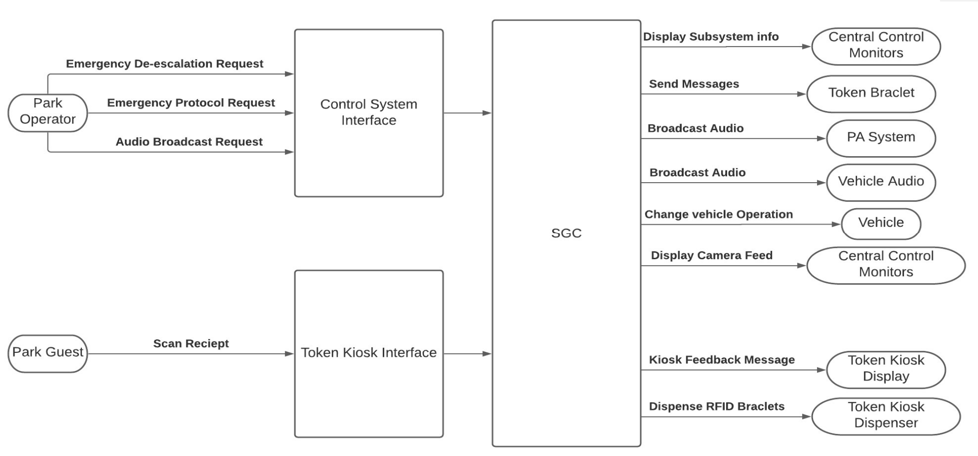

Figure 2 - Logical Diagram

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3.1 External Interfaces

The SGC system is a complex system made up of many moving parts. Each of these parts need to communicate with all of their attached devices. These are the external interfaces needed for the central controller: the token system with its bracelets and kiosks; the transportation system with its cars; and the security system with cameras, fence, RFID scanners, the T. rex monitor, and PA speakers.

3.1.1 Central Controller Interface

The Central Controller interface serves as the main hub for monitoring and controlling the various subsystems of the SGC. The interface is to be used by trained Siesta Gardens employee operators. It will be a graphical user interface running on a desktop machine connected to the SGC network and it will be installed in the Siesta Garden's control building.

Given the level of automation of the SGC subsystems, the Central Controller interface will largely be dedicated to monitoring the operational status of each subsystem. There will be a high-level table that displays each subsystem's overall status. Each subsystem will also be represented with a collapsible lower-level table that provides operators with operational information unique to the individual components included in each subsystem. All of these tables are updated in real time.

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Apr 18, 10:50 AM
Sounds complicated to visualize/format everything in tables, before showing it to the operators.

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3.1.2 Token System

The Token system will consist of the software and the external devices that the park guests first interact with upon arrival on the Key. There is two-way communication between the software system and the Token Kiosk and Token Bracelets external interfaces. The token system uses an API to validate token purchase receipts with the park website where guests pre-purchase their tokens.

3.1.2.1 Kiosk Interface

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The token kiosk is the hardware device that will accept receipts from the guests. The guest inputs their receipt into the token kiosk. The kiosk will either accept or deny the guest based on the validity of the receipt. If the kiosk system accepts the receipt, it will dispense the correct number of tokens, which are RFID bracelets, and then send the guest names, dates, and unique identifiers of each bracelet to central control. If the receipt is denied, then the kiosk software will send this error to central control and alerts the guests of this problem.

3.1.2.2 Token Bracelet Interface

The token Bracelets use RFID technology. The bracelets send out radio signals constantly to the RFID scanners located around the park and in the vehicles. This software interface is used to track the guests in real time to ensure their safety. It is also used by the vehicles to track on board guests.

The RFID bracelets have a smartwatch type display that will alert and display messages to the guests. It will also have haptic feedback and will vibrate the bracelet to get the guest's attention when there is an alert.

3.1.3 Transportation System

The transportation system involves the park's fleet of automated vehicles that transport guests to and from the exhibit. These vehicles are responsible for ensuring the passengers' safety during transit, and they transport the guests back to the barges in the event of an emergency. The transportation subsystem manages and relays the location, passenger list, and vehicle status data to Central Control where it is monitored. The vehicles will have names as identifiers so that the guests can easily remember which vehicle is theirs.

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Each car is equipped with a physical interface that handles the guests interaction with the vehicle and, through the vehicle, the Transportation system. This interface handles registering a token with a vehicle before it departs for the exhibit and ensuring that all guests that registered with that vehicle are accounted for before leaving the exhibit. To accomplish this, the vehicle uses the installed RFID scanner to scan the bracelets of each of its passengers when they enter the vehicle for the first time. After the thirty minute viewing period, the vehicle will sound an alert to guests in the area that they should begin boarding their assigned vehicles. This alert is accompanied by a message sent to the token bracelets of the vehicles' registered passengers. Once all passengers have boarded, as determined by the presence of their RFID tokens, the vehicle may leave the exhibit.

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3.1.4 Security System

The security system monitors the fence, streams security camera feeds, and has announcement speakers around the park for the safety of the guests. The electric fence has monitors that alert the security system if the fence goes offline, and the whole park is surrounded with security cameras which park staff can use to ensure there is no enclosure breach, or any other security issue.

3.1.4.1 Electric Fence Interface

The electric fence system consists of a main power supply and nodes along the fence that are constantly checking the status of the fence. The software controller for the fence communicates with the main power supply and each of the nodes through buried hard wires. Each node and the power supply will send status updates each second to the software informing the software that it is online and whether or not it has detected a drop in current on the fence, indicating a fault, or if the power supply is not high enough. If the software receives a bad status message, it will send a message to the central control center. It will also send a message to the central control if it does not receive a status update from a component for five seconds. This enables the resilience of the system and accounts for communication failures. FEEDBACK =

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3.1.4.2 Security Camera Interface

The security camera system consists of high resolution lenses which are distributed throughout the park to monitor the guests and the T. Rex. Each security camera will send video feeds to the security system. The security system then sends the video back to the central control system.

3.1.4.3 PA Speaker Interface

The loud speaker system consists of speakers which are distributed throughout the park to broadcast announcements and alerts from the central control system.

3.1.4.4 T. rex monitor Interface

The T. rex monitor system consists of a GPS tracking chip surgically embedded inside the dinosaur. The tracking chip sends the dinosaur's location to the security system and the security system sends that to the central control system.

3.1.4.5 RFID Scanner Interface

The RFID scanner system consists of RFID scanners which are distributed throughout the park and in the cars to track guest location. Each RFID scanner will send guest location data to the security system, which in turn, relays that information to the central control system.

3.2 Control Logic

The Control Logic of the SGC system explains all the different states that the subsystems have. The subsystems: Token System, Transportation System, and Security System will always start and end in the idle state and will have numerous states of transition based on each subcomponent. Central control works with all these subsystems to comprise the SGC.

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3.2.1 Transportation

The transportation system oversees and coordinates the components associated with transportation. Its functionality can be expressed with two distinct states: Idle and Message Management, laid out in Figure 3. The control flow always begins and returns to the idle state.

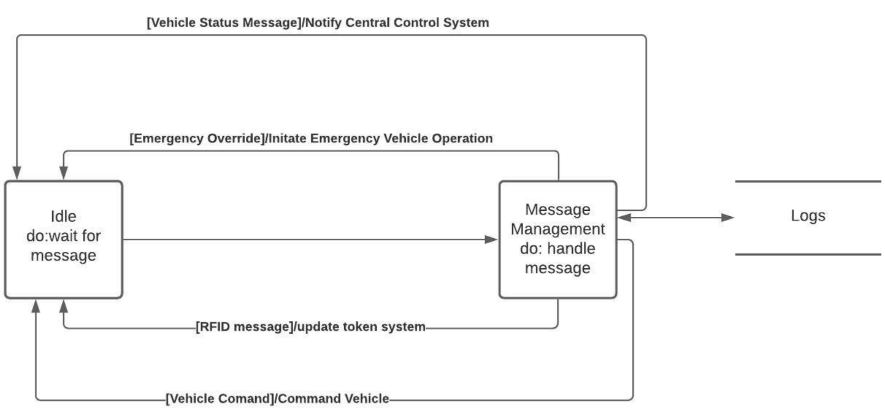

Figure 3 - Transportation System Control Logic

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In the idle state, the transportation system waits for a message and passes that message to the message management state. The message management state, depending on the message: 1) notifies central control if a vehicle status message has been received, 2) initiates an emergency vehicle operation if an emergency override message has been received, 3) updates the token system if a RFID message has been received and 4) commands a vehicle if a vehicle command message has been received. Every time a message is processed, a log of those events is recorded inside the subsystem.

3.2.1.1 Normal Vehicle Operations:

In normal operations, the functionality of vehicles can be expressed with ten distinct states: Idle, Registration, Capacity Check, Store Passenger Count, Departure, Passenger Count, Authentication, Token Update, Viewing Idle and Travel, laid out in Figure 4. The control flow always begins and returns to the idle state.

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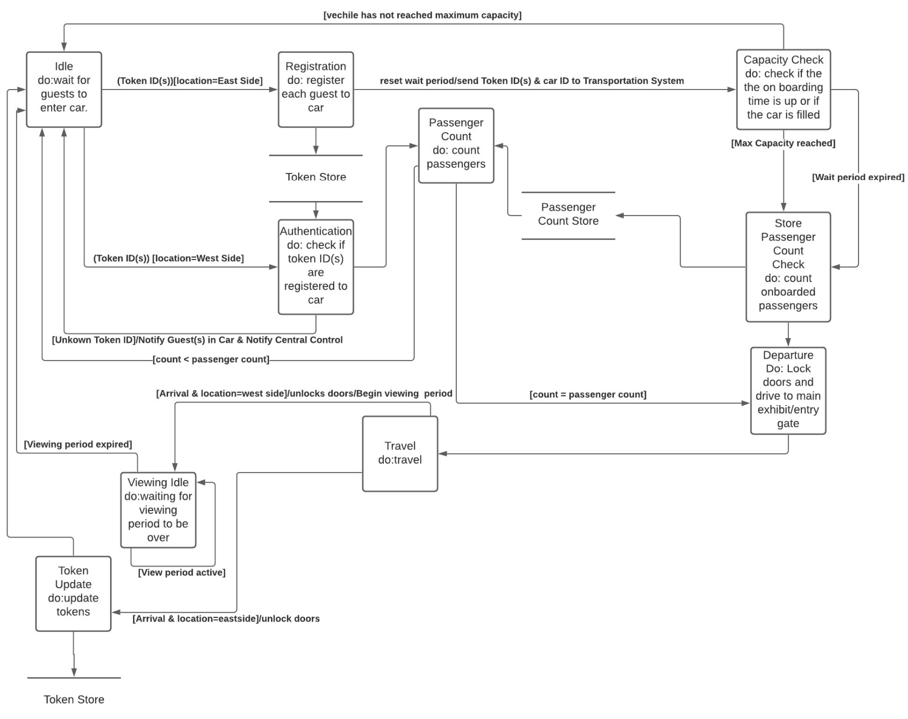

Figure 4 - Normal Vehicle Operation Control Logic 4 FEEDBACKS

When in the idle state, the system waits for the guests to enter a car. The flow of the diagram now depends on whether the car is at the east side or the west side of the key. If the car's location is on the east side of the key, it means that the guests are going from the main entrance to the main exhibit. Accordingly, these guests need to be registered into the system. So, if the car is on the east side, the registration state registers each guest to a car.

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exhibit or entry gate, the symbol / shoud be reserved for the triggering of some action, which is one of the symbols used by OMT notation

this location had to be updated somewhere before checking it here. By the Travel state maybe?

This state needs to know in which direction or path to travel, where is that information? sent as a parameter? You need to use the location parameter and then in one of these states, change it to the other location as the status of the vehicle changes.

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Now, after each registration, the wait period is reset and the token ID(s) and the car ID is sent to the Transportation system. Further, the token store in the vehicle stores the ID(s) registered to that specific car. The capacity check state checks whether the car has reached full capacity or if the waiting time has expired. If maximum capacity has not yet been reached or if the wait period has not expired, control is passed back to the idle state.

If maximum capacity has been reached or the waiting period has expired, control is passed to the store passenger count state. The store passenger count state counts the number of onboard passengers and stores that number in the passenger count store.

Control is now passed to the departure state. In this state, the doors are locked and the passengers are driven to the main exhibit. Control is now passed to the travel state, where the guests are driven through the scenic route into the main exhibit, where the location of the cars are checked. If the location is on the west side, the doors are unlocked and the passengers are dropped off into the viewing area on the west side. While the guests are at the main exhibit, control passes to the viewing idle state where the car waits for the viewing period to expire.

After the viewing period has expired, control returns back to the idle state but the cars are on the west side. If the cars are on the west side, control is passed to the authentication state where the token ID(s) registered to a car are verified with the token store. If the token ID is not registered with a car, the guest(s) are notified to go to their correct car, and control is passed back to the idle state again. At the same time, the number of passengers in that car are counted by the passenger count state, using the passenger count store.

If the current number of guests is equal to the previous number of guests and all the current unique token ID(s) match the previous unique token ID(s), control is passed to the departure state, where the doors are locked and the passengers are driven to the main entrance.

Control is again passed back to the travel state, where the guests are driven back to the main entrance along the scenic route.

After the traveling time has finished, the car's location is checked and if it is on the east side, control is passed to the token update state. The doors are unlocked and the tokens are taken from the guests by park staff and after checking with the token store, these tokens are updated and will no longer be used for that day. After that has been accomplished, the car returns back to the idle state and waits for a new set of guests to start another cycle.

3.2.1.2 Emergency Vehicle Operations:

In emergency operations, the functionality can be expressed with five distinct states: Idle, Capacity Check, Departure, Travel and Parking, laid out in Figure 5. The control flow begins at the idle state and ends at the parking state. As you can see, in an emergency situation, authentication is not required because people need to be taken out of the main exhibit as quickly as possible.

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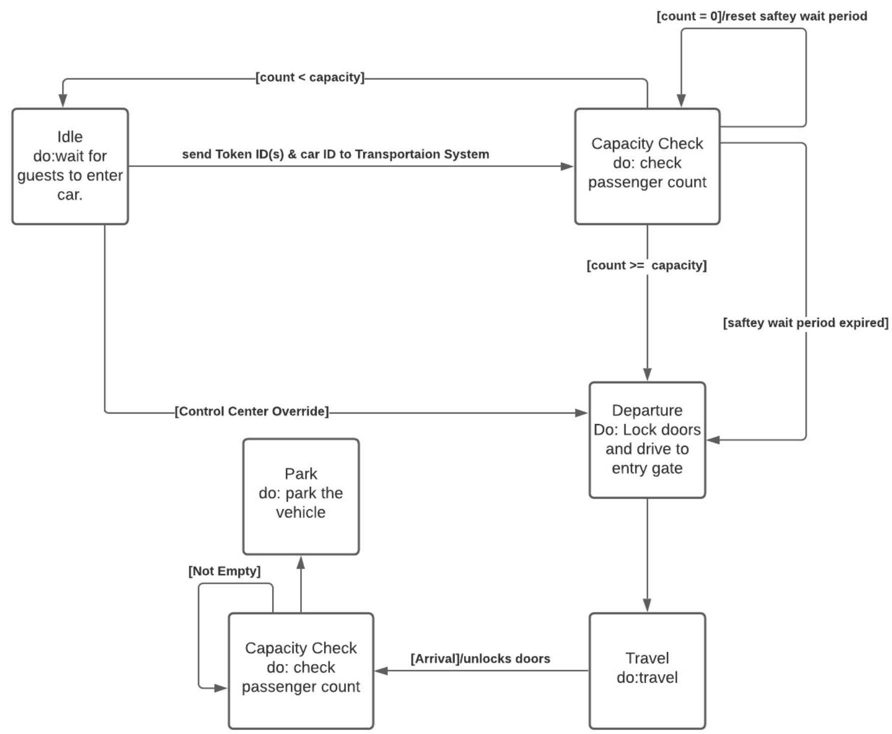

Figure 5 - Emergency Vehicle Operation Control Logic

When in the idle state, the system waits for guest(s) to enter a car. The token ID(s) of the guests and the Car ID is sent to the transportation system.

Control is now passed to the capacity check state where the number of passengers are counted. If the current capacity is zero, the safety wait period is reset and control is passed back to the capacity check state again. If the current capacity is less than the maximum capacity, control is passed to the idle state again. If the current capacity is greater than or equal to the

Commented [15]: This activity is a loop inside the state, right? Or you need to loop back into this state, the transition will be labeled by one more passenger entered and in the state is where you check the count. You want to leave when the count = capacity. I don't think I quite understand this state, those details would be good to have, or we can discuss them in the workshop on Tuesday.

In this diagram, the Park state is a final state and it should trigger an event to make the vehicle return to its normal mode of operation. So this state gets marked as the final state by placing a transition from it to the solid black circle enclosed in another circle.

In general, that initial state that has been called idle in all the diagrams, needs to be identified as the initial one in the diagram, that is done with a solid black circle. Then you show which is the event that starts this diagram. This is more relevant in the emergenc mode, so that the "emergency event" (however you call it) is the one that labels the transition from the solid black circle to the first state in the emergency cycle.

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maximum capacity or the safety waiting period has expired, control is passed to the departure state. In an emergency situation, the control center overrides the state of capacity check to pass the control from the idle to the departure state.

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In the departure state, the doors are locked and in the travel state, the guests are driven back to the main entrance, where the doors are unlocked and the guests are let out.

Control is passed to the capacity check state, where the number of passengers are counted. If the number is zero, control is passed to the parking state, in which the car is parked at the parking lot by the main entrance. If the number is greater than zero, control is passed back again to the capacity check state until the number is zero.

3.2.2 Token

The token system oversees and coordinates the components associated with the token subsystem. Its functionality can be expressed with three distinct states: Idle, Message Management and Token Management, laid out in Figure 6. The control flow always begins and returns to the idle state.

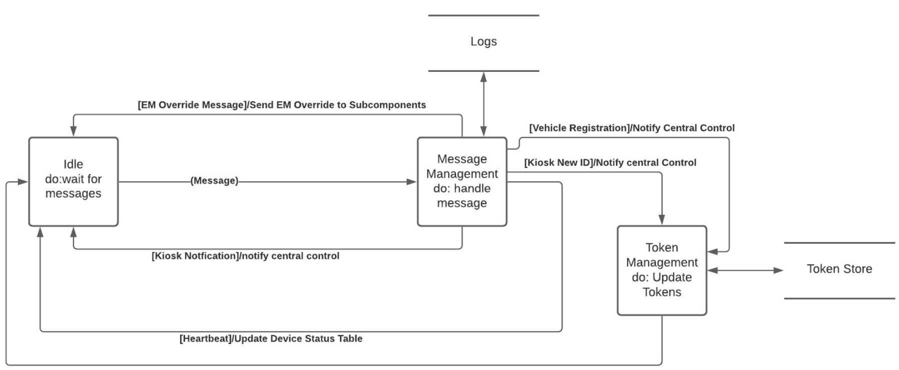

Figure 6 - Token System Control Logic

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In the idle state, the system waits for messages and sends that message to the message management state. The message management state handles different types of messages. If the message is an emergency override message, the token system sends an emergency override to its subcomponents. If the message is a Kiosk notification, central control is notified. If the message is a heartbeat, the device status table is updated. Control is passed to the idle state again.

If the message is a vehicle registration or a new kiosk ID, central control is notified and control is passed to the token management state. The token management state updates the tokens using the token store and the system returns to the idle state again.The token system has two subcomponents: RFID bracelets and token kiosks.

3.2.2.1 RFID bracelets

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The bracelet waits for messages from the token system and updates the display message to the guests. The bracelet also sends heartbeat messages to the token system.

3.2.2.2 Token Kiosks

The functionality of the token kiosk component can be expressed with four distinct states: Idle, Authentication, Programming, and Dispense Token, laid out in Figure 7. The control flow begins and ends at the idle state.

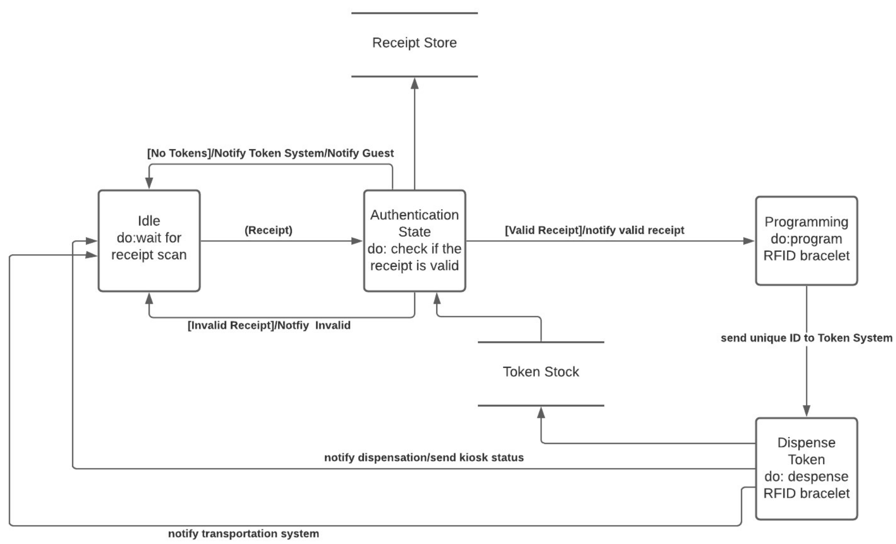

Figure 7 - Token Kiosks Control Logic

When in the idle state, after a receipt has been received, control is passed to the authentication state. The receipt is checked for validity using the receipt store, and if the receipt is invalid, the token system is notified, the kiosk displays an invalid receipt message and control is passed back to the idle state.

Now, this system has multiple token kiosks. If the token kiosk being accessed by the guest gives a no tokens display, the token system and the guest are notified. If the receipt is valid, control is passed to the programming state, where the RFID bracelet is programmed, the unique ID of the RFID bracelet is sent to the token system and control is passed to the dispense token state.

In the dispense token state, a token kiosk accesses the token stock and since the kiosk has tokens to give, the kiosk status is sent to the token system, the guests are notified of the

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This is an action triggered by this transition, so it is denoted as: /send uniqueID to Token subSystem

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dispensation and the transportation system is notified. Control is passed back to the idle state again.

3.2.3 Security

The security system oversees and coordinates the components associated with the security subsystem. Its functionality can be expressed with two distinct states: Idle and Message Management, laid out in Figure 8. The control flow always begins and returns to the idle state.

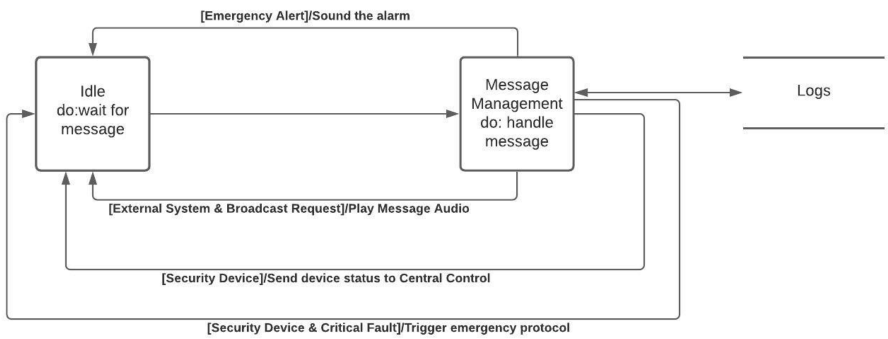

Figure 8 - Security System Control Logic

In the idle state, the security system waits for messages and sends the messages to the message management state. The message management state, depending on the message: 1) sounds an alarm in the case of an emergency alert, 2) plays a message audio if an external system and broadcast request message has been received, 3) sends device status to central control if a security device message has been received and 4) triggers an emergency control if a security device sends a critical fault to the security system. Every time a message is processed, a log of those events is recorded inside the subsystem.

The security system has five subcomponents: electric fence sensors, speakers, security camera and the T. rex tracking device.

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Apr 18, 11:29 AM
Not clear what all the conditions mean, the type of message maybe?

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Commented [22]: Only this one was described here, what about the other three?

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3.2.3.1 Electric fence sensors

The electric fence sensors constantly monitor voltage at the fence and send that information to the security system.

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3.2.4 Central Control

The central control communicates with all other subsystems to operate the SGC. Specifically, central control handles subsystem messages, emergency management and protected and non-protected requests.

3.2.4.1 Subsystem message handling

The subsystem messages update the central controller with updated status or alerts from the subsystems. In the idle state, central control waits for subsystem messages and sends that to the message management state, which depending on the message: 1) updates the subsystem status table if a heartbeat message has been received and 2) updates the subsystem table if a subsystem message has been received 3) enters the emergency management state in the event of a component failure. This logical diagram is shown in figure 9.

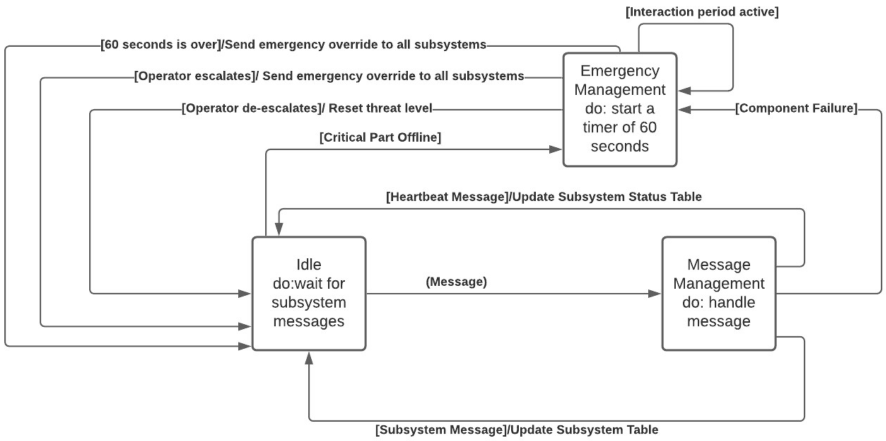

Figure 9 - Subsystem Message Handling Control Logic

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3.2.4.2 Emergency management

Also, in figure 9, emergency situations are handled. If the central controller receives failure messages from the subsystems, or if it has not received a heartbeat update from a component for ten seconds, then the central controller will notify the park operators that a device failure has occurred and the central controller gives them sixty seconds to respond to the event. If the operator can review the camera footage and ensure that the dinosaur is still within the confines of the enclosure, then they can choose to de-escalate the event and cancel the count down. If they determine that there is imminent danger to the health of the park guests, they can send the emergency overrides to all of the subsystems. If no operator handles the event within the sixty second period, then the system will automatically send the emergency overrides, assuming that the park staff is incapacitated.

3.2.4.3 Request handling

The request handling section handles any commands requested by the park operators. Most of these requests would trigger messages to the subsystems. The request handling functionality can be expressed with three distinct states: Idle, Request handling and Authentication, laid out in Figure 10. The control flow always begins and returns to the idle state.

In the idle state, central control waits for a request and sends that request to the request handling state. If the request is a protected request, control is passed to the authentication state, where the entered password is checked against a password store. If the password is correct, the request is executed and control is passed to the idle state. If the password is incorrect or the password entering time has expired, there is a failure notification and control is passed back to the idle state. If the request is a non-protected request, a password is not required. The request is executed and the control is passed back to the idle state.

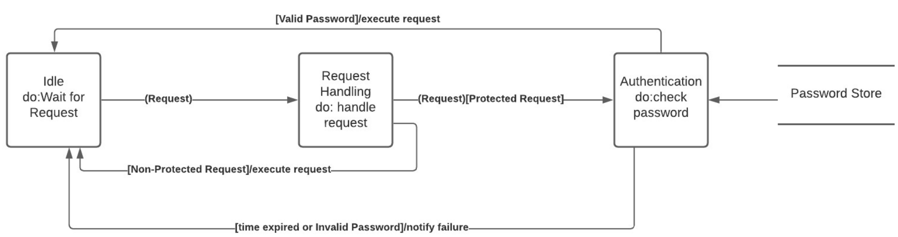

Figure 10 - Request Handling Control Logic

4 Design Constraints

The system has limitations that are enforced on it by the constraints of the system. Some of these constraints are caused by ethical concerns, some by nature, some by engineering and physical space, and others by the demands of the guests.

Commented [26]: Are these the operator escalates and de-escalates conditions indicated in the diagram? They probably should be events, rather than conditions. You use the [ ] for a condition, and no symbol means an event. These are more appropriate as events.

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Commented [27]: Don't quite understand this diagram. Please explain on the next workshop. Not sure the best way is to have it separate from the rest of the control center.

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4.1 Operating Schedule

The park schedule is constrained by the park's need for daylight and occasional maintenance. Because the dinosaur is only visible during the day and we do not want to disrupt its sleep schedule with night lights, the park schedule will be limited from sunrise to sunset. Since the park will need routine maintenance and occasional software updates, the park will only be open from Monday to Saturday. On Sunday, park staff can conduct any necessary maintenance.

4.2 Severe Weather

The park's schedule and equipment are constrained by severe weather. The park will be closed to the public during major weather events, such as a hurricane, to protect the public. However, the SGC control system will still need to operate all security and emergency features to maintain the dinosaur enclosure. This requires the use of surge protectors on all circuits, back-up power generators to run the system, and automatic reboots if the system goes offline. The communication wires between subsystems and the central control building also need to be insulated cable buried underground to protect from the weather. The electrical fence also needs to be designed in a way that it will not be adversely affected by rain. The park will remain open during normal inclement weather such as rain or mild wind. These protections help ensure that the park is fully operational at all times for the safety of the park staff and guests.

4.3 Guest Privacy

The system is required to track guests using cameras and RFID bracelets while they are at the park. To respect guest privacy, after three months, the aggregated data of the guests will be purged from the system. In that sense, the system is constrained by guest privacy to not hold guest information like name, camera footage and payment method after three months.

4.4 Guest Tracking

The system is constrained to have passenger cars, as opposed to letting guests roam on foot, so that they are accounted for while they are in transit to the exhibit, so that they can easily escape in the event of an emergency and so that their time is not wasted and they don't risk getting tired while walking to the exhibit.

4.5 Natural Habitat

Some of the construction of the island is constrained by wanting to keep the feel of a natural habitat and safari for the guests and the dinosaur. This is because the self-driving cars will only follow one predefined road to the enclosure so they do not tear up the terrain and degrade the experience for the guests.

The enclosure design also needs to look natural for the dinosaur, therefore the security cameras inside the exhibit need to be disguised as a part of the local fauna. The exhibit will need to have many lines of visibility so the guests get the best chance of viewing the T. rex, but the enclosure needs to retain a natural look and so there may still be parts of the enclosure that guests cannot see.

4.6 Car Limitations

Commented [28]: Don't remember if you mentioned the capacity of the cars.

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Due to the limited amount of space on the key, the number of cars is constrained to be ten vehicles that the system can use. For the safety of the park guests, five of these cars must be kept in reserve as spare cars in the parking lot near the enclosure to evacuate guests in the case of an enclosure failure.

4.7 Emergency Automation

Emergency management is constrained such that it cannot trigger an emergency response unless several conditions are met to prevent needless guest hysteria. In the case of a single system failure like the gate or GPS, the emergency management module will alert the control center staff, but it cannot start evacuation procedures without their approval in case it is a sensor malfunction. If however, the staff do not respond to the alert within one minute, the system can begin emergency procedures in case the staff is somehow incapacitated.

Due to the short response time required, there must always be at least two staff in the control center at a time.

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Commented [30]: again, you do need security guards.

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4.8 Automated Status Limitation

Not all systems have the capabilities to send constant heartbeat updates to the controllers, thus these systems will need to be manually checked during weekly maintenance. The announcement speakers need to be manually checked each week since they are regular speakers and can only play audio without being able to send back device health updates.

4.9 Animal Welfare

Due to the Animal Welfare Act, there exists a constraint such that the welfare of the animal must be kept in high regards.[1] The habitat will be cleaned and if for some reason the animal needs medical attention then the park will unexpectedly close down but the park will issue refunds to the affected guests. The Florida wildlife commission regulates the cleanliness and the humane treatment of wildlife. [2] Therefore, unexpected inspections may occur and the park will have to shut down temporarily to abide by state laws.

Commented [31]: You might need to reflect this state in your diagrams and how to get in and out of it.

Or verify that the diagrams work in those situations.

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5 Definition of Terms

Term	Description
SGC	Siesta Gardens Controller
B-STACK	Our software company's name
SRS	Software Requirements Specifications
RDD	Requirements Definition Document

Commented [32]: These are not definition of terms but rather meaning of the abbreviations.

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6 References

[1] “Animal Welfare Act,” *NAL*. [Online]. Available: https://www.nal.usda.gov/awic/animal-welfare-act. [Accessed: 09-Apr-2021].

[2] “FWC Overview,” *Florida Fish And Wildlife Conservation Commission*. [Online]. Available: https://myfwc.com/about/overview/. [Accessed: 09-Apr-2021].