The Tesla Disc

Systems Requirements Specification

Fall 2014

Team DISC:

Disc Integration Systems Consortium

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1. Introduction

1.1. Purpose

The purpose of this document is to give a description of the requirements for the "Tesla Disc" hardware and associated software. This document explains the purpose of the system and list expected functionality. This document will cover user characteristics, system design constraints, interface and interactions with other external applications, and other detailed specific requirements. This document is used by the team to verify the functionality of the hardware and software as well as being submitted for approval to the Capstone instructors.

1.2. Scope

In the current game of disc golf, players encounter regular problems such as losing their disc in between throws, not having a way to track throws, having to keep track of strokes and overall score, and having to modify their discs with lights to play night games. The Tesla Disc is a modified disc golf driver which assists players during the course of a game. The Tesla Disc has GPS and Bluetooth capabilities to help players find a lost disc, keep track of score, and provide directions and distances to baskets and tee boxes. The Tesla Disc has LEDs for night-time playing. The Tesla Disc also maps the trajectory of each throw to allow players receive feedback to track and improve throwing accuracy.

1.3. Definitions, acronyms, and abbreviations

1. Ace - A player makes their first shot, or drive, into the basket.
2. Basket – The target for catching the disc. Once a disc comes to rest in the basket, the hole is considered complete.
3. Birdie – Completing a hole one stroke under par.
4. Bogey - Completing a hole one stroke over par.
5. Course – A tract of land laid out for disc golf with preplaced tee box and basket positions.
6. Driver – A disc designed for fast, long-distance flight.
7. Hole- A piece of land including a tee box, its corresponding basket and all land and hazards that are located in between.
8. Par - The desired number of strokes that a player takes to throw their disc in the basket. Typically, in disc golf, this value is three, although variations exist.
9. Stroke - A throw of the disc. The number of strokes to lie the disc in the basket is compared against par to discover one's score for that particular hole.
10. Tee Pad - The location or designated area in which the first throw of the disc golf hole is supposed to take place from.

11. Throw - The act of advancing the disc towards the basket. This can be accomplished by many different throwing styles; Backhand, Forehand, Rollers. Each throw is a stroke and counted towards the player's score.

1.4   References

http://www.pdga.com/rules: Official rules of Disc Golf

1.5   Overview

The remainder of this document includes two sections and an appendix. The second section provides an overview of the system functionality and system interaction with other systems. This section also contains types of stakeholders and their interaction with developing the system. Additionally, this section mentions the system constraints and assumptions about the product. The third section provides the requirements specification in detailed terms and a description of the different system interfaces.

2. Overall description

2.1 Product perspective

2.1.1. Domain Model:

Disc Golf is a game where the player tries to throw the disc into the basket with the least amount of the throws possible. Disc golf courses can be difficult to navigate if a player is unfamiliar with a course, resulting in the possibility of getting lost and wasting time. The Disc Golf players are responsible for tracking their disc's flight from the time it leaves their hand until it lands to ensure they do not lose their disc or spend more time wandering around searching for it. Lastly, disc golf players are responsible for keeping track of their own score.

2.1.2. Modified Domain Model:

The Tesla Disc increases the functionality of the discs used to play the game and saves a player time. The Tesla Disc application has a map of the course for them, with the location of each basket, and provides directions to the next tee pad. The Tesla Disc tracks a player's current score as well as provides statistics from previous games they have played.
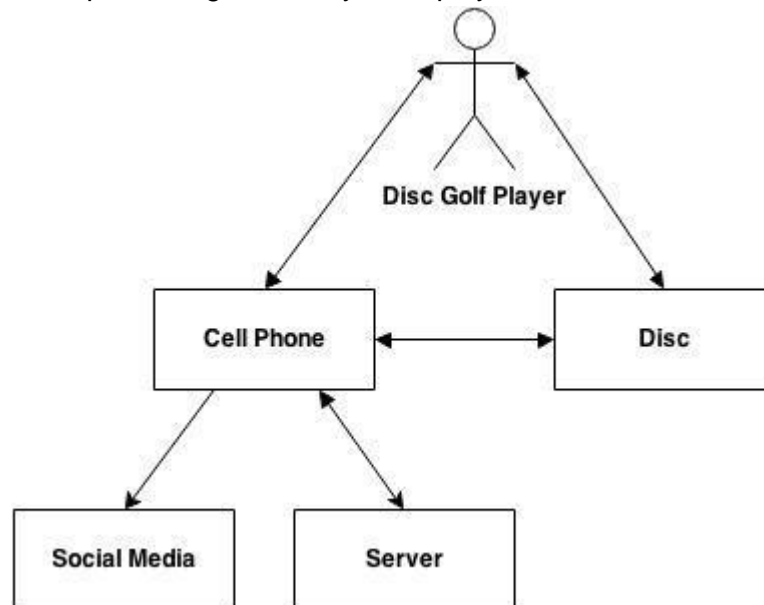
2.2 Product functions

High Priority
1. The Tesla Disc keeps track of its location and stores its location in memory.

2. The Tesla Disc wirelessly communicates with an Android device.
3. The Tesla Disc application is able to load course data from the server
4. The Tesla Disc application displays where the disc has landed
5. The Tesla Disc application displays tentative strokes and score of the game.

Medium Priority
1. The Tesla Disc application receives data from the Tesla Disc and plots its trajectory onto its corresponding location on the disc golf course's map via the phone display.
   a. If the exact trajectory can not be mapped, the Tesla Disc application will use a best-fit algorithm for mapping disc flight.
2. The Tesla Disc application displays distance from the disc golf player to the basket on the disc golf player's smartphone.
3. The Tesla Disc application provides directions from a disc golf basket to the next tee box on the disc golf player's smartphone.
4. The Tesla Disc application sends game statistics, strokes and scores to a remote server to be stored.
5. The Tesla Disc has LED's and lights up when prompted to by the disc golf player for night play.

Low Priority
1. The Tesla Disc application displays other users' and friends' most current game statistics.
2. Game play data can be uploaded from the disc golf player's smartphone and shared via social media.
3. The Tesla Disc will have a solar film to supplement battery charge during play.

2.3 User characteristics

Representative	Jeff Meyer
Description	The disc golf player has extensive experience playing disc golf
Type	The disc golf player has technical expertise with the sport of disc golf
Responsibilities	The disc golf player is responsible for playing a game of disc golf with the modified Tesla Disc
Success Criteria	The disc golf player defines success as a simple and reliable operation of Tesla Disc, including transmission of information from the disc to the smartphone.
Involvement	The disc golf player relays feedback about ease of operation

	and general functionality of the Tesla Disc and smartphone application.
Deliverables	None
Comments/Issues	None

2.4 Design Constraints

2.4.1.   System Capabilities requirements:

1. The disc has to be able to operate in an outdoor environment with the potential of being submerged in water.
2. The code for the application must be written in Java to ensure it works with the Android KitKat 4.4.

2.5 Assumptions and dependencies

1. Additional circuitry can be added to the disc without adversely affecting the flight of the disc.
2. The circuitry inside the disc can be secured sufficiently to maintain operation after various impacts it will be subject to..

3. Specific requirements

Marketing Requirements	Engineering Requirements		Justification
1, 2, 6	1.	Components should be economically feasible and small enough to fit in the outside rim of the plastic disc without sticking out and be mounted in such a way to keep the integrity of the balance of the disc.	Disc golfers will not use a disc that does not feel the same and fly as well as the current discs on the market, nor will they want to pay more than $100 for a single disc.
3, 4, 6, 8, 10	2.	We will need a Bluetooth module that is economically feasible. The Bluetooth needs to be low power and have an effective range of 50 feet.	We are limited in the battery weight we are able to put on the disc which limits the amp hour capacity. This will require a Bluetooth that is low power. Additionally the "Find My Disc Mode" will need a pairing range of at least 50 feet because generally the user can track down a disc to within a 50 foot radius, at which point the "Find My Disc Mode" will point the user in the right direction.
5	3.	The disc's component compartments will have shock absorbing filler material.	The disc is made to be thrown and impact the ground and trees; the electronic components must be able to survive the impacts.
7	4.	The disc's component compartments will be watertight.	The disc has a reasonable chance of being completely submerged in water during gameplay. The electronics must not be damaged.
1, 2	5.	The circuitry added to the disc golf does not affect the aerodynamics and balance of the disc.	Disc golfers will not use a disc that does not fly as well as the current discs on the market.
8	6.	The disc circuitry will be capable of determining flight start/stop locations.	Disc needs to be able to distinguish new throws to update the score correctly.
10	7.	Application will be capable of two-way communication with web server	Application needs to be able to store current game data and retrieve previous game data
9	8.	Game data should be packaged and sent to a remote server such that it can be retrieved and viewed by the application at a later time.	Players are interested in viewing performance in past games.

Marketing Requirements:
1. Hardware added to the disc should not affect the aerodynamics and balance of the disc.
2. Hardware added to the disc should fit inside the rim of the disc without obstructing the original disc rim in order to maintain normal user grip on disc.
3. Bluetooth connection capability should be at least 50 feet to ensure the user can conveniently use the Find My Disc feature, because generally the user can get within a 50 foot radius of where the disc landed.
4. Disc should be able to function for at least two hours on a single charge.
5. Device must be able to withstand impacts with the ground and trees.
6. The system should have low cost.
7. Disc has to be waterproof.
8. Disc should be capable of tracking individual throws and game score.
9. Application should allow user to review past games and publish desired game to social media.
10. Disc to smartphone communication must be reliable throughout a standard course

4. Use Cases

4.1. Use Cases

4.1.1. UC1: Normal gameplay

Scope: Gameplay with the Tesla Disc
Level: User goal
Primary Actor: Disc golf player
Stakeholders and Interests: Disc golf player wants to play an entire game of disc golf. Disc golf player does not want the additional features to interfere with normal flight of the disc.
Preconditions: Disc battery is fully charged. Course is all par 3. Map of disc golf course is already uploaded to the server
Success Guarantee: Map of disc throws has been generated from throwing data and saved to scenario. Player's score has been calculated based on number of throws per basket. The "Find My Disc" feature works within bluetooth range of the disc.
Main Success Scenario:
1. Player arrives at the course with Tesla Disc and supported smartphone.
2. Player activates the disc and opens DISC application on their android smartphone.
3. Disc and smartphone connect via Bluetooth.
4. Phone GPS recognizes course and loads map of the course
5. Phone displays directions to the first tee pad(or next if already started)
6. Phone displays distance and direction to next basket.
7. When player is ready to throw he first gives the disc a quick jolt to wake the microcontroller up out of sleep mode.
8. The LED will blink as an indication that the disk is ready to be thrown.
9. Player throws disc from the current tee-pad.
10.   Disc records throwing data
     i.   Acceleration sensor signals that a throw has started
     ii.   Flight navigator records throw start GPS location
     iii. Flight navigator continues poling and storing GPS location throughout disc flight.
     iv.   When disc lands, the acceleration sensor signals that throw has ended
     v.   Flight navigator records throw stop location
     vi.   Flight navigator saves throw data into a data packet.
11.   Disc sends data packet to the phone via Bluetooth upon establishing Bluetooth connection
     i.   Game manager interprets GPS locations from the data packet received from Bluetooth
     ii.   Game manager generates best fit line to approximate the disc trajectory
     iii. Game manager saves new throw data locally

      iv.   Game manager adds 1 stroke to player's score

12.   Phone display interface adds most recent trajectory to game map.

13.   Player retrieves disc.

  Steps 5-13 repeat until disc lands in basket

14.   Disc lands in basket

15.   Player walks to next tee

16.   Phone updates player's score.

      i.   Ace: -2
      ii.   Birdie: -1
      iii.   Par: 0
      iv.   Bogey: +1
      v.   Double Bogey: +2
      vi.   Triple Bogey: +3
          etc.:

17.   Player retrieves disc and moves to next tee-pad.

  Return to Step 5 until course is completed (typically 18 holes)

18.   The disc golf player's smartphone sends game play to server.

19.   The disc golf player has the option to share game details with social media.

Extensions

*. If at any time the disc and the phone lose connection:

  1. Disc saves game data locally.

  2. Disc repeatedly attempts to reconnect to smartphone.

  3. Once the smartphone and disc re-establish a connection, the disc sends data to the smartphone.

  4. *Return to Main Success Scenario.*

3a. Disc and smartphone cannot connect.

      1. Phone displays message about error.

      2. User attempts to reconnect.

      3. *(Two possible outcomes)*

          a. Disc and phone connect.

             1. Return to Main Success Scenario

          b. Disc and phone cannot connect.

             1. Phone displays message about failure

             2. *Exit Use Case.*

10a. Player retrieves disc and decides to exit game early.

      1 Phone displays message about disc leaving course.

      2 Phone flags game as incomplete.

      3 Phone saves current data to server as incomplete game.

      4. *Exit Use Case.*

10b. Player attempts to retrieve disc but cannot locate it.

      1. Player selects 'Find My Disc' from the smartphone application

      2. Phone application displays map with location of disc.

3. When disc is found, player selects 'Found it!' from the phone app.
4. *Return to Main Success Scenario*

Special Requirements: Disc battery power must last the course of the entire game
Technology and Data Variations List: Communication between phone and disc may occur via bluetooth or NFC
Frequency of Occurrence: Could be daily and continuous during an entire game
Open Issues:

   - How will the disc survive on impact with an obstacle (tree, person, hard ground impact, water, etc)?

   - How will the disc know it's landed in the basket versus on the ground below the basket?

4.1.2.   UC2: Looking at Profile

Scope: Reviewing past games
Level: User goal
Primary Actor: Disc golf player
Stakeholders and Interests: Disc golf player wants to review past game statistics on their Android phone..
Preconditions: The user has set up an account on the application. The user has also played at least one game on the account.
Success Guarantee: They can pull up their past game data, including the overall score of the game, as well as score of individual holes.The user will be able to see the trajectory of each throw for each hole.
Main Success Scenario:
1.) The user opens the Disc Application on their Android smartphone
2.) The user pushes profile button on the device's display
3.) The profile manager retrieves data from the server
4.) The user looks at the game data that he/she would like to review
5.) Once the user is done reviewing the game data, exit the Disc Application
6.) End use case

Special Requirements: Server with lowest overall cost will be used.
Technology and Data Variations List: Server used may vary
Frequency of Occurrence: Could be daily and continuous.
Open Issues:
   - How will we display the player's statistics
   - What kind of statistics will we display?