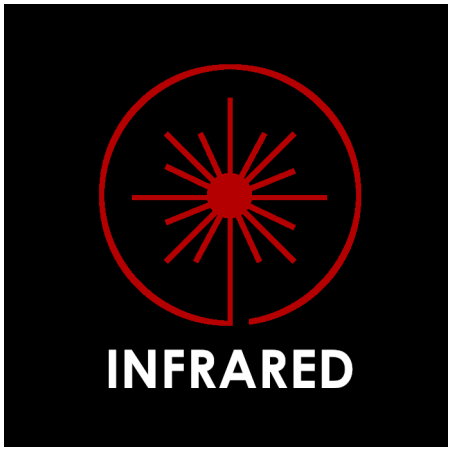
Department of Computer Science & Engineering
The University of Texas at Arlington



Project Charter
CSE 4317: Senior Design II
Spring 2020

Team Infrared
Infrared Arena

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Revision History

Revision	Date	Author(s)	Description
0.1	09.15.2019	LP	document creation
1.0	09.30.2019	EA, JB, JMY, DV, LP	complete draft ver 1
2.0	12.10.2019	EA, JB, JMY, DV, LP	complete draft ver 2
3.0	05.02.2020	EA, JB, JMY, DV, LP	complete draft ver 3
4.0	05.12.2020	EA, JB, JMY, DV, LP	final draft

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1 Vision

One growing phenomenon Americans have seen within the last decade, is the rise of eSports and popularity of multiplayer video games. However, on the other side, we find classic entertainment games such as laser tag falling behind. While technology has allowed game mechanics to improve and enhance game equipment and the player experience, laser tag is ultimately location-based and not accessible everywhere. With the advancement of technology, more often than not, we find players sitting at home for hours, communicating with others through a screen. There is a need to reconnect people not only with the outside world, but with each other personally. There needs to be a game with greater accessibility, that would allow people to go out and play with each other, while continuing to be active. In the creation of this kind of mobile game, users will be able to relive entertainment classics in an exciting new way. Children and adults would be able to enjoy a friendly game with their community at any location using Wifi or data connection on their mobile devices.

2 Mission

Our team is focused on building an application that will enable users to play laser tag through their mobile devices, anytime, anywhere. Players will not have to worry about traveling to an indoor or outdoor facility or borrow equipment for a price each time. The laser gun equipment will be a one time purchase, and the application itself will be free to download on the Google Play Store. Users will be able to connect their mobile devices to the laser gun through Bluetooth to play the game. Whether it's inside or out, users will have the ability to transform their current location into a playing field. This will encourage users to go out and meet their friends, make a team, and wage war against each other without any hassle.

3 Success Criteria

Upon completion of the application, we expect the following success indicators to be observed:

- API latency optimized to around 1 second response time.
- User experiences 1-2% average crash rate.
- Smooth compatibility between hardware and software.
- Access geolocation from users' mobile devices and update onto a minimap.
- Minimap will display user's and user's friendlies' location and direction.
- Users are able to access the same game using any Wifi or data connection.
- Little to no issues interfacing with networks.

After delivery of end product at least 90% of end users surveyed will agree that:

- Interface is intuitive to interact with.
- Battery life performance/consumption is satisfactory.
- The game is more fun than traditional laser tag.

4 Background

Our sponsor for this project is Shawn Gieser. Gieser is our professor for our Senior Design course. Gieser has given us this project in hopes that we can create a next generation laser tag app. Systems similar to what Gieser has in mind do already exist, but our goal is to improve upon the products that are currently on the market. Our goal is to create an app that can be used in conjunction with laser tag hardware to host serious competitive laser tag matches.

Laser tag is often viewed as a service that is provided by laser tag centers. These laser tag centers are convenient because the player does not have to bring their own hardware (emitter, vest, etc), and they feature dedicated spaces designed for playing laser tag. However, laser tag centers have their fair share of problems. Patrons of laser tag centers must wait in long lines to get into a game, pay for each game they play, and often can't choose who they play with. Anyone who wanted to play a serious game with just their friends would need to call in advance and then pay to have the space rented out.

A laser tag app allow players to have their own private matches with their friends. No waiting in lines, and after a one-time purchase of hardware, the player could never have to spend any more money on laser tag. Some current laser tag sets require players to connect to a WiFi access point thus limiting everyone to the range of that access point. Our app will eliminate this problem by having all players connect to a server hosted in the cloud. As long as players have some sort of connection to the internet, they will be able to participate in games from practically any distance. Most laser tag games are aimed at children and lack features that would make matches more competitive. Our app is targeting a slightly older audience that would strategize during laser tag matches.

5 Related Work

"Laser Ops Pro" is a laser tag solution developed by Nerf. The game features gun shaped emitters which are sold at prices ranging from $29.99 to $49.99. There is a downloadable app that can be used with the emitters. The kit comes with wristbands so users can strap their phones to their arm while playing.The app allows users host or join multiplayer matches, however it does not feature a map of the play area and users are not able to communicate through the app. [5]

Father.io is an indie developed AR app that requires use of an emitter called an interceptor. A single interceptor is $39 and clips on to the front of the user‘s phone. The interceptor features 6 sensors through which a user can be tagged. The app features a map through where players can see team mate locations. Players can choose between 4 different classes each with their own unique stats and abilities. The main drawback of the product is that on the companies website there are dozens of reviews by customers who waited for years and never received their interceptor nor refunds. [3]

Recoil Laser Tag is a commercially produced laser tag set that requires the use of an app. The starter set is current;y priced at $48.90 on amazon. The set comes with 2 emitters and a WiFi access point. Players must use the app and connect to the access point in order to play the game, limiting the playing field to 250 ft. The access point must be in the center of the battlefield so players have to concern themselves with finding a safe place to leave it. Each emitter has sensors on the end so players are aiming at each other‘s emitter. The app for this game does not feature a map of the play area, and lacks robust match customization. [2]

Armogear has a series of laser tag sets call "Laser Battle". 2 emitters and 2 vests can be bought for $75. The set has no interactive app. The guns and vests both run on AAA batteries that only last for 2 hours of game play. This system is limited by the price per set and the need for batteries for the vests in addition to the emitter. [1]

Laser X is a popular creator of home laser tag sets. The sets can range in price from $15 to $50. The sets feature both guns and vests that run on AAA batteries. Users can only able to pick from up to 2 teams. In order to play different game modes, players need to purchase a peripheral called a gaming

tower which can cost $30-$40. There is no interactive app and users can not customize the rules of matches. [4]

6 System Overview

Our system will improve the discontinued RECOIL system, featuring an laser emitter that resembles a gun, that will have an expanding slot for the user‘s phone to sit in while playing. The smartphone will connect to the emitter through Bluetooth. The emitter will have multiple sensors on it‘s front and sides that will be used to register tags. In essence users will only be aiming to tag each other‘s emitter, rather than vests (as seen in typical laser tag).

In order to host or join matches the user‘s smartphone must connect to the cloud via an internet connection. This internet connection will be acquired either through Wifi or data on the user’s device, unlike the RECOIL system that requires all players to connect to a shared Wifi Hub that provided with their equipment. During matches the user‘s emitter will communicate tagging data through the Bluetooth connection to the user‘s smartphone. This tagging data will be sent from the smartphone to out cloud server via the internet. The cloud server will process this data and make changes to the current to the game state. Updates to the game state will to communicated to any participating user‘s smartphone over the internet. Updates to the game state will be reflected in the app for the users to view. These updates can include changes in user location, team score, match timer, and more.

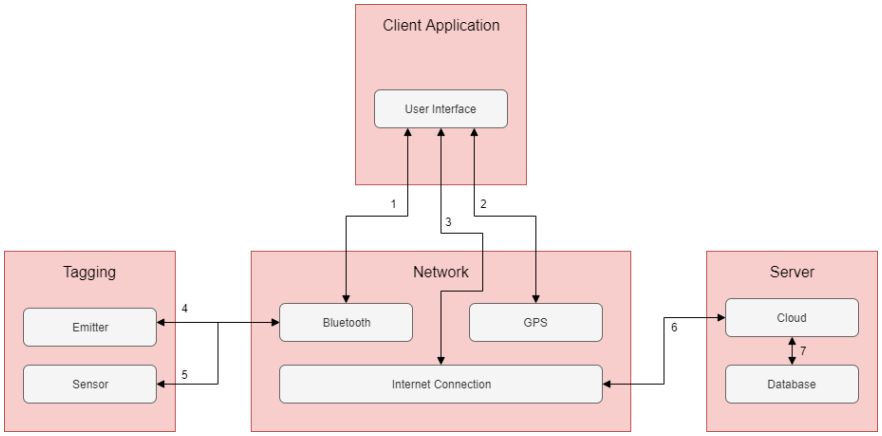

Figure 1: A simple data flow diagram

ID	Description
1	User device connects application to hardware by connecting to Bluetooth
2	User device receiving location data from GPS service
3	Data sent to cloud for processing
4	Emitter sends back information
5	Sensors sends back information
6	Data sent to cloud for storage
7	Information in database managed by cloud

Table 1: Dataflow Descriptions

7 Roles & Responsibilities

The stakeholders for the Laser Tag game will consist of the project team and sponsor. Dr. Shawn Gieser will supervise our project and be the sponsor that the team reports to for requirements and questions. The team members are

- Edgar Acevedo
- Justine Batongmalaki
- Linda Phanvilay
- Danny Vu
- Jean-Marcel Yacho

Currently, Justine Batongmalaki will be the product owner and Linda Phanvilay is the scrum master. The team has a very flexible structure and everyone decides equally on the responsibilities. Though the role of product owner and scrum master may change periodically throughout each sprint depending on the teams decision, Batongmalaki and Phanvilay are co-team leads for the project. Vu and Batongmalaki have a focus on the hardware implementation of the product. Acevedo, Phanvilay, and Yacho have a focus on the app development of the project. Each team member chooses their tasks at the beginning of each sprint and continue those tasks onto the next sprint if it was left incomplete. Phanvilay updates the Trello for tracking sprint tasks and project progress. Batongmalaki and Phanvilay take meeting notes during team meetings. Team meetings in the Fall occur on Fridays and team meetings in the Spring occur on Mondays and Wednesdays. Presentation slides are created by Phanvilay. Before each presentation day, the team meets one hour before the scheduled class time to practice,and slides are distributed equally for each presentation. Team members are expected to updated all documentation as changes are needed.

8 Cost Proposal

Infrared Arena is a laser tag game that is relatively low costs primarily to free software, cheap cloud services and laser tag equipment that is allocated within the budget.

8.1 Preliminary Budget

Components	Cost
RECOIL equipment	$250
Cloud services	$5
Software	Free
Batteries	$15
Total	$270

8.2 Current & Pending Support

The funding source for the project is the default $800 given to the Senior Design team from the CSE department.

9 Facilities & Equipment

The makerspace we will utilize is the CSE Senior Design Lab located in the Engineering Research Building at the University of Texas at Arlington to design, implement, and test our application for Infrared Arena. Testing grounds will be conducted on campus around the Engineering Research Building and Nedderman Hall and will require informing the the University of Texas at Arlington Police Department of when testing can be conducted due to the misconception of laser tag being a threat due to the design of the gun. These testing grounds will be used to test both indoor and outdoor gameplay quality. The team will use the Central Library and University Center at UTA to conduct meetings and discuss about the project in the event that the lab is unavailable. All equipment that is ordered for the team will be kept in a locked box in the CSE Senior Design Lab.

However, due to the ongoing situation of COVID-19 and Stay-At-Home order from mid-March to April 30, testing may not be facilitated as planned on campus grounds mentioned in the previous paragraph. There is a possibility that field testing may not be done by the team, but system development and individual testing will continue.

The equipment used will be free software licenses, a cloud service and laser tag guns/gear. The Unity software is free and will be used to create our laser tag application. The team will be using version . We will need to acquire a cloud server to hold our data by purchasing them from Digital Ocean. The laser gun hardware set will be from the Recoil Laser Tag Kit which consists of two laser tag guns, two phone mounts, and one WiFi hub. The team will purchase additional kits and sensor receivers from Recoil as seen necessary to further develop the multiplayer environment. The laser tag gun contains the laser emitter and the sensor. The application will be tested using the team members' personal Android phones and Android tablets. The phone mount will implement a portrait mode and the phone will be attached the laser tag gun to create a fully functional game setup.

Figure 2: RECOIL equipment we will be using

10 Assumptions

- Testing conditions available
- There won't be any compatibility issues between hardware and software
- All players will be able to connect to the same server using wifi or data connection
- Domain will be available to host our software online
- User's ages will be 12 years old or higher

- The max diameter of the playing field is 1 mile

11 CONSTRAINTS

- Final prototype demonstration must be completed by May 1st, 2020 [Demo day]
- Orange tip on gun required to indicate to police the laser gun is not a real gun
- Team lacks experience in hardware development and cloud services
- Total development costs must not exceed $800
- All developers need to use Unity Version 2019.2
- Application is only available using Android

12 Risks

Risk description	Probability	Loss (days)	Exposure (days)
Outdoor testing needs to be coordinated with police department	0.80	10	8
Lack of extensive experience using a cloud service	0.60	20	12
Software does not connect with hardware system	0.40	20	8
Scheduling conflict with team members	0.20	6	3
Internet connection not available in playing area for demonstration	0.10	5	0.5
Coronavirus and quarantine	0.80	40	32

Table 2: Overview of highest exposure project risks

13 Documentation & Reporting

13.1 Major Documentation Deliverables

13.1.1 Project Charter

The Project Charter will be maintained throughout our project and will updated every 1-2 weeks during the period of our sprints if there are any changes or inclusions we need to make. The initial version of this document was delivered on September 30, 2019 and the final version will be delivered on May 15th, 2020.

13.1.2 System Requirements Specification

This document will be updated whenever any changes appear in the functions or designs of the project. The initial version of this document was delivered on October 21, 2019 and the final version will be delivered in May 15, 2020.

13.1.3 Architectural Design Specification

The document will be updated when necessary changes come up after performing research and testing during our project implementation. The initial version was delivered on November 11, 2019 and the final version will be delivered in May 15, 2020.

13.1.4 Detailed Design Specification

The document will be updated less frequently than the other deliverables. Updates will be made when there are changes to the design of our project. The initial version was delivered on March 2nd, 2020 and the final version will be delivered in May 15, 2020.

13.2 Recurring Sprint Items

13.2.1 Product Backlog

Items will be added to the backlog from the SRS based on the prioritization of the items and their dependability with other items. The decision of the items added will be decided by a group discussion. We will be using Trello to maintain and share with everyone the items on the backlog during our sprint along with Google Drive for meeting notes.

13.2.2 Sprint Planning

Each sprint will be planned in a team meeting every 2 weeks. We will decide the tasks that need to be completed by the next sprint and assign a task to each individual. There will be 8 sprints in total, including both semesters.

13.2.3 Sprint Goal

During each sprint, the team will discuss where we are at on the project and the sprint goals will be discussed and decided by the entire team.

13.2.4 Sprint Backlog

Items will be added to the sprint backlog by team discussion. The sprint backlog will be maintained by using the website "Trello", keeping the individuals organized and on track throughout each sprint.

13.2.5 Task Breakdown

Each individual task will be voluntarily claimed by a team member who feels that they are up to the task and each member will have relatively the same amount of hours. Each member can document the time spent on their tasks either in their notebook or update their status on Trello.

13.2.6 Sprint Burn Down Charts

Each team member will submit their time spent on their tasks to a single team member and that single member will create and generate the burn down chart.

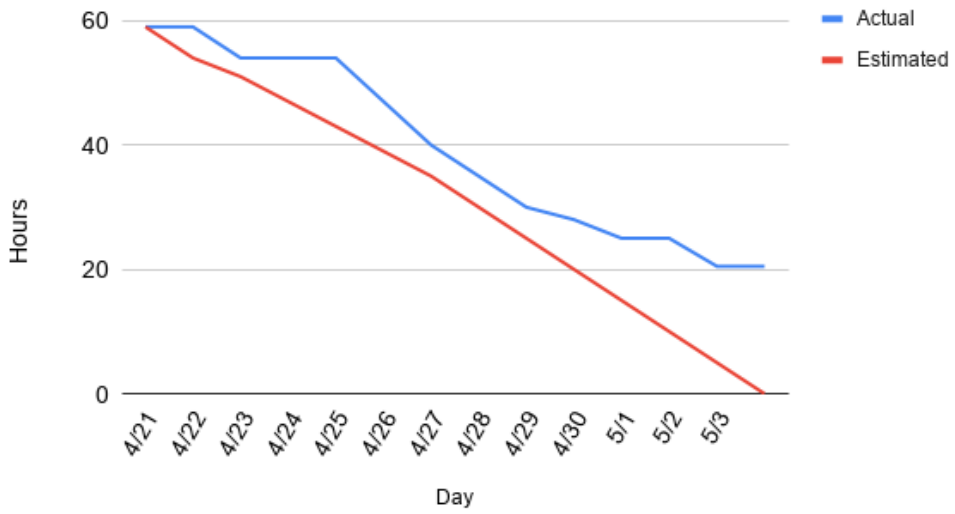

Figure 3: Sprint burn down chart from Spring 8

13.2.7 Sprint Retrospective

The sprint retrospective will be held as a meeting before the end of a sprint. We will discuss what each member has worked on and any issues they have run into. These issues will be taken seriously and the team will come up with a resolution to help the work flow of the next sprint.

13.2.8 Individual Status Reports

The Individual Status Reports will contain each members tasks, the amount of hours each task is predicted to take, how long the member has worked on the tasks, and any change in hours for a task if issues or extra information come up.

13.2.9 Engineering Notebooks

The Engineering notebook will be updated by each member at least once a week during our team meetings. Each interval will be 2 weeks long and about 1-2 pages will be completed in this time frame.

Each page will be signed by the TA.

13.3 Closeout Materials

13.3.1 System Prototype

The final prototype will consist of software that can be downloaded and installed onto smartphones, a server used to create lobbies for multiplayer connectivity, and a toy gun with a laser emitter, sensors, and a mount to hold your phone. It will be demonstrated outdoors to show the range our prototype can handle.

13.3.2 Project Poster

The poster will include our team logo, team members names, one team member equipped with one prototype, and an example of how our app looks like. The dimensions will be 4ft x 3ft. This poster will be delivered once the UI of our app is complete and we have the parts for our prototype finalized. The poster is based off of UTA's Innovation Day poster template, which includes the following information: an executive summary, background, conceptual design phase, detailed design phase, prototype & test, conclusion, and references.

13.3.3 Web Page

Our product web page will include our logo, team name, team members names, prototype hardware, documentation, example snapshots of the UI of our app, and our demo video. This will be delivered when a functioning version of our prototype is accomplished.

13.3.4 Demo Video

The demo videos will show an overview of the app and the hardware needed in order to play this game. Steps to host and join a lobby will be shown, as well as general gameplay which includes the map and pinging system. The video will be approximately 5 minutes long.

13.3.5 Source Code

The source code will be maintained with the git version control system and collaborated over GitLab between the team members over the duration of the project. The source code will be private at the moment in order to prevent competition but will be linked in the final deliverables.

13.3.6 Source Code Documentation

A README file will be available with the source code and in the project's final deliverables to explain the source code. The source code will also be well commented.

13.3.7 Installation Scripts

The software will be downloaded and installed onto smartphones from the Google Play Store just as any other android app would. For testing purposes, the app will be built and exported from Unity and then uploaded to an Android phone.

13.3.8 User Manual

A start guide will be included in the app itself in case the user doesn't understand our intuitive UI design.

REFERENCES

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