

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
THE UNIVERSITY OF TEXAS AT ARLINGTON

PROJECT CHARTER
CSE 4316: SENIOR DESIGN I
FALL 2019



XxPEW³xX
LASERS: COMBAT EVOLVED

DIPTIN DAHAL
KATARINA GOMEZ
PHU LY
JASON AUTRY
TAUSIF ZAMAN

REVISION HISTORY

| Revision | Date | Author(s) | Description |
|----------|------------|--------------------|---|
| 0.1 | 10.01.2018 | SG | document creation |
| 0.2 | 09.29.2019 | DD, JA, KG, PL, TZ | complete first draft |
| 0.3 | 11.15.2019 | PL | complete first revision and updates to the current of the project |
| 0.4 | 11.15.2019 | DD, JA, TZ, PL | modify to fit sponsors' reflection |
| 1.0 | 05.14.2020 | TZ | Final Version |

CONTENTS

| | |
|---|-----------|
| 1 Vision | 6 |
| 2 Mission | 6 |
| 3 Success Criteria | 6 |
| 4 Background | 7 |
| 5 Related Work | 7 |
| 6 System Overview | 8 |
| 7 Roles & Responsibilities | 8 |
| 8 Cost Proposal | 10 |
| 8.1 Preliminary Budget | 11 |
| 8.2 Current & Pending Support | 11 |
| 9 Facilities & Equipment | 11 |
| 10 Assumptions | 12 |
| 11 Constraints | 12 |
| 12 Risks | 13 |
| 13 Documentation & Reporting | 13 |
| 13.1 Major Documentation Deliverables | 13 |
| 13.1.1 Project Charter | 13 |
| 13.1.2 System Requirements Specification | 13 |
| 13.1.3 Architectural Design Specification | 13 |
| 13.1.4 Detailed Design Specification | 13 |
| 13.2 Recurring Sprint Items | 13 |
| 13.2.1 Product Backlog | 13 |
| 13.2.2 Sprint Planning | 14 |
| 13.2.3 Sprint Goal | 14 |
| 13.2.4 Sprint Backlog | 14 |
| 13.2.5 Task Breakdown | 14 |
| 13.2.6 Sprint Burn Down Charts | 14 |
| 13.2.7 Sprint Retrospective | 14 |
| 13.2.8 Individual Status Reports | 14 |
| 13.2.9 Engineering Notebooks | 15 |
| 13.3 Closeout Materials | 15 |
| 13.3.1 System Prototype | 15 |
| 13.3.2 Project Poster | 15 |
| 13.3.3 Web Page | 16 |
| 13.3.4 Demo Video | 16 |
| 13.3.5 Source Code | 16 |

| | | |
|---------|-------------------------------------|----|
| 13.3.6 | Source Code Documentation | 16 |
| 13.3.7 | Hardware Schematics | 16 |
| 13.3.8 | CAD files | 16 |
| 13.3.9 | Installation Scripts | 16 |
| 13.3.10 | User Manual | 16 |

LIST OF FIGURES

| | | |
|---|--|----|
| 1 | Basic layout of System Overview | 9 |
| 2 | Example of The first Sprint Down Chart | 15 |

1 VISION

Our team believes that a regular game of laser tag is outdated by the standards of the technology we have during this age. Our vision is create a more immersive laser tag game experience. In a traditional game of laser tag a player is only able to use their sight to be respond to they game, so they miss out on several other potential information which could easily make the game more engaging. The idea is to improve the existing Laser Tag System so that it can become more accessible for players and provide them with more captivating game play mechanics.

2 MISSION

Our mission is create laser tag game version without the restriction on the router base while implementing the features of a live updating map to display where team mates and possibly enemies are in the real world along with our new design for laser shooter using Infrared technology and a compatible vest. We then plan to take that a step further by expanding the game of laser tag beyond just shooting each other. To do this we will implement features with the hopes that it will further engage the player in the game.

3 SUCCESS CRITERIA

Upon completion of the prototype map system, we expect the following success indicators to be observed on the application itself implementing the new GUI software:

- Display indicator of users and their teammate at the exact location on the map.
- Display enemies indicator on the map when they are in a certain range around the user location.

Within 6 months of developing the database for our application, we expect the following success indicator to be observe on the application and the database itself :

- User can access to the game using only their preferred nickname .
- User nickname will displayed in our database web base.

Within the same period, we also expect to observe the following success indicator from our gun device on the application :

- The application will recognize the gun as a device that is connected to the game.
- The application will receive the first fired signal with the device and first direct hit on the vest .

Within 12 months after the prototype delivery date, we expect the following success indicators to be observed:

- Porting of the application on to the mobile Android platform.
- Display of Complete UI Cycle from Opening to Game Finished on mobile device.
- Display User completed registered Profile on Mobile Application.
- Users will be able to create lobby, find other players, invites other player into the same lobby on the mobile application.
- Display of the final scores computed on the end game scene on the mobile application.
- The system will notify on hit or on missed from the connected device to the mobile application of both the shooter and the victim.
- Notification of enemies within the player's zone.

4 BACKGROUND

Many ways to play laser tag exist. For example, at the local arcade Alley Cats, you can participate in a game of laser tag. There the arcade will supply you with a gun and vest combo to play the game but, you can only play in the designated arena and there is no map so you don't know where your allies are during the game. The cons of this is the lack of information and knowledge about your teammate where-about which players mostly end up to be very frustrated. Another option is you buy your own gun which would allow you to play anywhere you want and some include a type of map feature but the outcome of this is those devices have the restriction of requiring the players to be within a specific range around an included router to track the player's position.

Those missing components are not the downside of the game play since laser tag itself is the game that family and friends would enjoy playing together. However, as technology grow beyond the eyes of humanity, we wanted to improve and bring the game play further to the point that players could overcome those missing components, we will achieved this by providing various of supports to ensure their game play will be come more and more realistic.

We are excited for what is ahead and how we can make our customers to experience a laser tag game that will blows their minds. We want to allow customers or players to innovate new tactics, new ways to play the game. To reach our goals, we plan to remove as many of the restrictions as possible. Being able to freely move around in a game is one of the key to win the game, which it made its way to the top of the restriction list. We will first eliminate the range restriction on how far could one players could connect to the other players. By doing this practice, we will also enable a better teamwork within a game play through an overall mapping system that will support player of their teammate where about. We will also increasing the the interactivity between players of the game as much as we can through the promising communication system with automatic notification system. We believe that by applying these features, we will able to give our best support to our players and we eventually create a new trend for the traditional laser tag.

5 RELATED WORK

A. *Nerf Laser Ops*

This is a commercially available alternative to traditional laser tag. Players get to face off in head-to-head live-action laser battles right out of the box with this Nerf Laser Ops Pro blasters [1]. Each Blaster features light and sound effects, unlimited ammo, quick-reload button, and indicators for health, ammo, and teams. Each Laser Ops Pro Nerf toy blasters fires a single-shot IR beam up to 225 feet (68 meters). This system tackles the problem of being restricted to an area by allowing to hit any target with a 68m radius. While this is a solution for mobility, this limits the players only to that 68m radius. We plan to make a product where the player can decide what the playing radius will be.

B. *Xtreme Augmented Reality Blaster*

Players get into the game with the AR Blaster. Players have to add a compatible smartphone to AR Blaster and play games in augmented reality [2]. The AR Blaster fits most 4 in. to 6 in. smartphones and requires internet access and the installation of the AR Blaster app. Play games in real or virtual mode and experience a world of game-play that's incredibly immersive. Play games in real or virtual mode

C. *LaserX*

Laser X is a Real- Life Gaming Experience. Players get to make their own 'Laser Tag Arena' [3]. The set includes 2 Laser X Morph Blasters with Receiver Vests to equip 2 Laser X plays. In Game Target Mode, use your Laser X Morph Blaster to test your speed and accuracy with 3 built-in games. Full color lighting

effects let you keep track of shots and hits. The interactive voice coach gives tips feedback during the game. This is a more traditional approach but it does have a notification system which we also want to implement.

D. *Laser X Fusion Complete*

Another Laser X product which emulates the '*Laser Tag Arena*' [3]. This uses two types of adapters: long and wide range to amplify the signal of the laser rays. This does allow the players to shoot further but it still limits the players within a set radius.

E. *RECOIL: FPS Brought to Life*

This is another commercially available form of an alternative to traditional laser tag [4]. This is an state-of-the-art Laser Tag Starter Set, GPS enabled Multi-Player Smartphone Game. This system reinvents the traditional laser tag system by allowing the game to be played outside of an specific room. Players can take the laser weapons and the '*WIFI Game Hub*' anywhere and start a game. This does limit players to the boundaries of the WIFI router. That is the biggest limitation of this product and it is something we look to deal with in our product.

6 SYSTEM OVERVIEW

The laser tag project consists of hardware (gun, vest) and an app which connects with these hardware and the central server which will in real-time store and communicate scores information. App will consists of all the game features like map, communication with other players etc. and it will also communicate with the gun and vest through Bluetooth to keep track of scores on hits. The implemented database (server) will be the Firebase Server with support of Unity Network Manager Engine, which will provide real-time data transfer feature to the application.

This game will be initiated using the app, which will then be connected to the gun. When the user starts the game, all the hardware will be turned on. Initial check will be performed on the hardware and when ready it will notify user. The hardware will communicate with app using Bluetooth connection, and the local data will be stored on the phone. The stored data will then be transmitted to the server (database), and real-time calculations will be performed based on data. The application will also receive data from the server, which will be displayed in the application.

7 ROLES & RESPONSIBILITIES

There are 3 majors stakeholders for this particular project. They each identified as Users, Developers and Sponsors. We, xXPew³Xx, are the main developers for this project. Our sponsor is the visionaries and also the one that selected xXPew³Xx as the developer for this project. Lastly, Users are the future main interactive players and also our customers for the project.

Originally, the sponsor is the project owner and it will remain the same until changes are made. However, the status of scrum master occurred only after the project was given to xXPew³Xx by the sponsor. xXPew³Xx will now remain the scrum master up until the project delivery day as of May 10, 2020. The project owner may not change the status of scrum master until the deliver day unless condition are made between current scrum master and the project owner. Otherwise, scrum master status is not subject to change during the development process. Following this is the responsibilities of each individual stake holders.

Establishing the stakeholders and the responsibilities :

xXPew³Xx- The Developer

The team consist of five students from the University of Texas at Arlington. We each have different

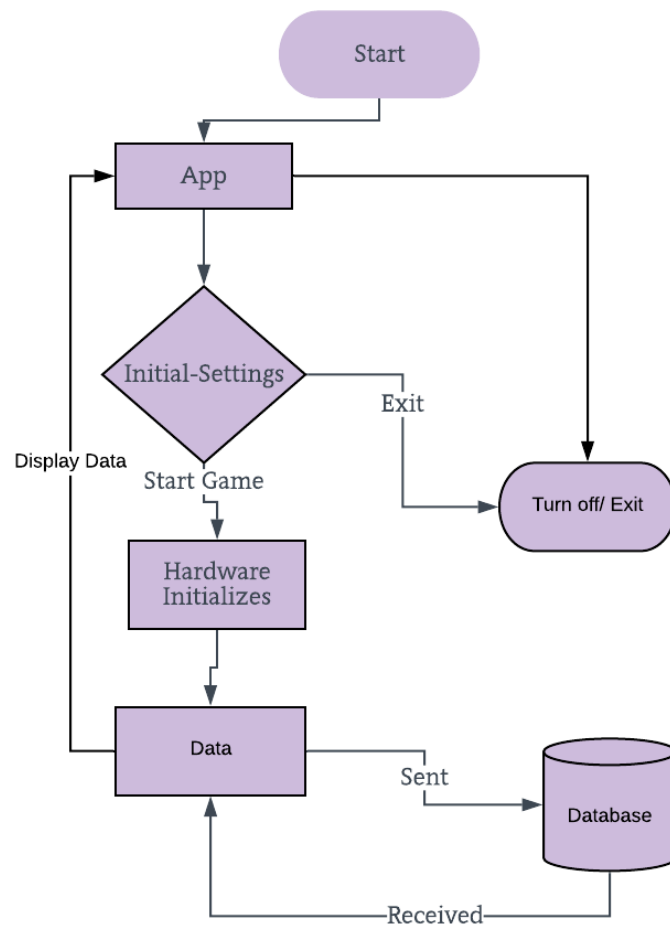


Figure 1: Basic layout of System Overview

background but eventually, we joined under one team and shared the same vision for the project.
Our Members:

- **Leader:** Diptin Dahal - Computer Engineer - Hardware Specialist & The main point of contact from the sponsor.
Area of Responsibility: Hardware Design and Development.
- Katarina Gomez - Computer Engineer - Hardware Specialist & Graphic Designer.
Area of Responsibility: Hardware Support and Hardware Communication.
- Jason Autry - Computer Scientist - Software & Project Developer.
Area of Responsibility: Software System Supports and User Interface Design.
- Tausif Zaman - Computer Scientist - Software & Project Developer.
Area of Responsibility: Software System Architecture and Control.
- Phu Ly - Software Engineer - Software Developer, Secretary & The point of contact from the customer side.
Area of Responsibility: Software System Supports and Interactive Database.

The Sponsor

Our current sponsor is Professor Shawn Gieser at the University of Texas at Arlington. The responsibilities of a sponsor included providing general ideas and requirements of the original projects for the developer team, request and approve on any features or components of the application if necessary during the development process.

The Users

Users are not interacting with the project until the deployment of the Beta version of the product. However, the role of users are critical but yet, it is optional to them. We expect users to interact with the application and provide feed backs and engage with the development team via all possible way of contacts so that we understand and strive for the improvement of the product.

8 COST PROPOSAL

Our approximate budget for the project currently is estimated at \$305.00. Our main expenses will go towards creating our prototype for our Laser Tag gun + vest combo. We will need to create 2 versions of our prototype in order to test the system player vs player. Our prototype will consist of a micro-controller with Bluetooth functionality, in order to connect to our phone without needing to rely on local WiFi. The prototype will also be implemented with an IR emitter to function with the game.

8.1 PRELIMINARY BUDGET

| Product | Cost | Purpose |
|----------------------------------|-------------------|--|
| Unity | \$0.0 | Editor for game's coding and UI |
| App Assets | \$60.00 | Assets for the game |
| Hard Case Hardware Bag | \$30 + tax | Used for safely storing the developed hardware |
| Arduino Grove - Infrared Emitter | \$4.50 + tax X 2 | Transmit signals, data or commands to the receiver |
| Arduino Uno Case | \$9.90 + tax X 2 | Case to hold Arduino |
| External Battery Pack | \$20.00 + tax X 2 | Power Arduino |
| Micro USB cable | \$6.00 + tax X 2 | Connection to battery pack |
| Arduino 33 BLE Sense | \$29.50 + tax X 2 | Micro-controller with Bluetooth connectivity, built in sensors |
| 3D Printed Gun | \$20.00 X 2 | 3D printed gun to hold Micro-controller for hardware element of game |
| -ABS Filament | \$.05/gram | Filament Option |
| -NinjaFlex | \$.15/gram | Filament Option |
| Materials for Vest | \$20.00 X 2 | Materials to construct vest with built in IR sensor |
| Solder Materials | \$20.00 | Materials needed for any soldering work |

8.2 CURRENT & PENDING SUPPORT

| Source | Support |
|-----------------------|---------|
| CSE Department at UTA | \$800 |

9 FACILITIES & EQUIPMENT

Facilities

Any cubical space we are assigned to will be used to house our hardware, and equipment while we are designing and developing the project. This space can also be used as a space to have team meetings, and for team members to visit while coding software as well. The team cubical will be where we keep

our prototypes as we development, store them, and could also be used as a work space to solder and store said soldering equipment during the span of the project. In order to test the software and hardware elements of the project, we intend to use campus grounds to see how the software and hardware will behave in a spacious environment, and additionally at range. In order to accomplish this, we plan to contact campus police, and any other authorities we might need at the time of testing, so that we will be testing within the regulations and with permission from the university.

Equipment

For the laser shooter part of our hardware we wish to design and print a toy gun shell to house the IR emitter. This device can be printed in the UTA Fab Lab at a cost for materials. The materials cost is included in our cost projection above. While working on the implementation of our Micro-controller with our IR emitter and other components, we will mostly likely need access to soldering equipment. Soldering materials are included in our cost projection, such as solder and wires, however the soldering iron would be accessed from the MakerSpace, as well as any other tools, such as laser cutters, etc. Additionally if we are to construct our own vests to hold the micro-controller and IR sensor, team member Katarina is willing to contribute her personal sewing machine to use. Personal laptops will be used for any of the software designing and coding.

10 ASSUMPTIONS

- Our consumers or customers will be only Android Users
- Our database will not be broken on overloading of players
- Customers' mobile phones are capable of accessing into the Wifi
- Customers' mobile phones are capable of running the basic implementation of the app
- Customers' mobile phones will have no issues to install the game application
- We will have work space where we can build and test out gun hardware
- The Google maps API will work with how we plan to implement our map
- Required hardware components will fall within our given budgets

11 CONSTRAINTS

- Final prototype demonstration must be completed by May 1st, 2020
- Total development costs must not exceed \$800
- Talk to specific University of Arlington departments to get permission to move toy weapons on campus
- Acquiring development skills for building all the software applications
- Need to zero in on the scope for this project since the project has a huge pool of features that can be added but that makes it easy lose vision on what is important to the sponsor
- Find time for group meetings when all of the members are free to work together
- Coordination between hardware and software teams

12 RISKS

| Risk description | Probability | Loss (days) | Exposure (days) |
|---|-------------|-------------|-----------------|
| Availability of infrared sender and receivers | 0.10 | 14 | 1.4 |
| Cellphone service unavailable | 0.05 | 14 | .7 |
| Google API not fitting our needs | 0.2 | 21 | 4.2 |
| No work station available to work on gun | 0.3 | 7 | 2.1 |
| Hardware pieces not available | 0.01 | 35 | .35 |

Table 1: Overview of highest exposure project risks

13 DOCUMENTATION & REPORTING

13.1 MAJOR DOCUMENTATION DELIVERABLES

13.1.1 PROJECT CHARTER

Based on the given time of delivery, xXPew³Xx decided that we will make at most 4 major updates on the project charter from the starting day of the project until the day of deliveries. However, xXPew³Xx is planning to only make changes that is necessary and relatable to the project and the charter will also be maintain at the end of every sprint. Major updates on this type of document will be submit at the beginning of the project and every 3 months period only after any significant changes was made. Eventually, Project charter will be deliver on they day of project deliver May, 10 2020.

13.1.2 SYSTEM REQUIREMENTS SPECIFICATION

xXPew³Xx plans to initiate on the System Requirement Specification, SRS, once we submit the initial version of the project charter. The first draft of this documentation will be deliver in about two week after it initial day. The SRS will also be maintained and updated at the end of every sprint. Changes are only made if necessary regarding to sponsors inputs or any offset that made by xXPew³Xx's team member; However, there will be only two SRS version and the last version will be submit on the day of the project delivery May, 10 2020.

13.1.3 ARCHITECTURAL DESIGN SPECIFICATION

The Architectural Design Specification, ADS, will be discuss among the team after the submission of the first Project Charter. However, The first draft of the ADS will be deliver in 3 weeks after the submission of the SRS. Any significant changes of this type of documents will be update maintain regularly every month. The delivery day of this ADS will be the same as the delivery of the project May, 10 2020.

13.1.4 DETAILED DESIGN SPECIFICATION

xXPew³Xx documented every single meeting and planning since the first team meeting and we are planning to keep the momentum going forward. The initial document of the Detailed Design Specification may come later in the Spring but the final delivery of this type of document is May, 10 2020. This document will be initiate as the team moving toward the architecture process of the application. Updates will be following a monthly schedules once the team started to design the application.

13.2 RECURRING SPRINT ITEMS

13.2.1 PRODUCT BACKLOG

Each product backlog will be decided at the end of the sprint and the beginning of the next sprint. The team will decide the prioritized of each item based on the significant of the it. We will define each

item by either core objectives or add-on features. Based on those conclusion, each item will be add into the backlog from SRS for each indicated sprint. xXPew³Xx runs our own document server with daily updates to prevent any miscommunication. All major documents are being shared with each members from the first meeting and any updates will be notify via our communication server.

13.2.2 SPRINT PLANNING

Every sprint planning occurred at the beginning of the sprint and each objectives being in the upcoming sprint will be driven by the direction of the previous sprint. Sprint discussion will be in details for the first scrum meet of the sprint and any scrum meet follow that will be implement and evaluate the objective of that sprint. We are planning for about 8-10 sprints depend on the time shift between one season to the next.

13.2.3 SPRINT GOAL

Each sprint goals will be discuss in weekly scrum meets. xXPew³Xx team members will decided the sprint goals among ourselves and eventually, the leader will make the ultimate decision if necessary. The first scrum meet of every sprint is mostly like the important one and sprint goals will be bring up as the first objective of the meeting. However, any meeting following that could produce its own sprint goals depend on how the process work and these updates will only occurred if necessary to support the development process. Otherwise, no sprint goals will be updated after the first scrum meet.

13.2.4 SPRINT BACKLOG

Sprint Backlog will be produced after sprint goals established within the scrum meeting. xXPew³Xx team will then based on the goals to decide the most optimized items to put on the Sprint Backlog to guarantee the high productivity of each sprint.

13.2.5 TASK BREAKDOWN

Individual task are broken up into two category. They are Hardware and Software since the project contains two part. Members that had more experiences with any of the item will be assigned to that item. An assistant member will be assigned as support to the other member if the items are difficult or heavy tasks. Each member within xXPew³Xx understand their own strength and by utilizing the communication tools, we will find ways to work together on different matters and subject to magnify the successful of the backlog items.

13.2.6 SPRINT BURN DOWN CHARTS

Sprint Burn Down Chart are provided at the starting day of the project. The chart was made in Google Sheets and are updates bi-weekly. Inputs from each day are recorded based on an honest system and these information will be stored on the same Google Sheet data to prevent any lengthy method that could convert to a bigger issues. Jason is the team specialist on this aspect of the documentation.

13.2.7 SPRINT RETROSPECTIVE

There are small scrum meet that is different than the meeting. The team meet up to discuss on what needed to be done, updates and re-evaluate on each team members to embraces and strengthening the team relationship. We also re-evaluate backlog items that occurred with in the previous meeting or any items that contain issues during their development processes.

13.2.8 INDIVIDUAL STATUS REPORTS

Team xXPew³Xx was build based on trust from each member to the others. Therefore, individual member voluntarily to give status reports on their subject to gain opinions and supports from other team

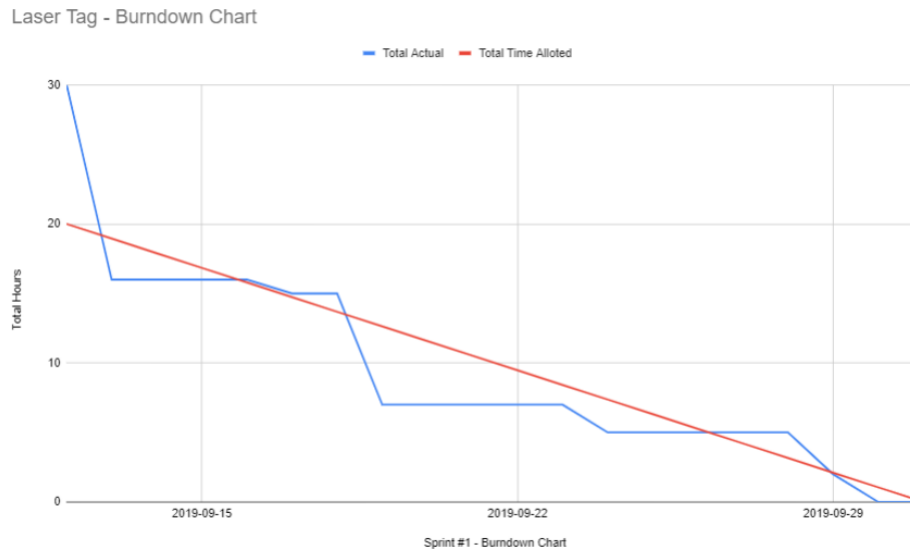


Figure 2: Example of The first Sprint Down Chart

member. This process usually occurred after the meeting and xXPew³Xx's secretary will record them into the team Document Server.

13.2.9 ENGINEERING NOTEBOOKS

Due to each discussion and team meet will have its own report that updated in the same day. Updating the Engineering Notebooks is not a difficult issue with in team xXPew³Xx. On average we update the engineering notebook twice a week depend on how many critical point that is needed to re-evaluate or discuss among the team.

13.3 CLOSEOUT MATERIALS

13.3.1 SYSTEM PROTOTYPE

The final prototype of this application will have the Map system to indicate location of players, completed registration system where post and get will be a smooth transition from the database to the mobile application, an established communication system of the hardware device with the mobile application, system master log will be produced abstractedly for each game to record and compute scores for each player and their team.

There will be a Prototype Acceptance Test if applicable under the allowances of times. If Prototype Acceptance Test is on the way, this will most likely to be a Field Acceptance Test since xXPew³Xx team is looking forward to have our application to be tested in the real-world environments; However, this will only occurred if we made proper progresses on the application itself. Decision on the test will be made upon the completion of the application and this decision will be made by the xXPew³Xx team.

13.3.2 PROJECT POSTER

Upon the deliveries day, xXPew³Xx team will have an overall project poster to demonstrate our vision, mission and significant progresses of our works. The poster will be a default tri-fold type of poster. The dimension is estimated at 48 in x 36 in.

13.3.3 WEB PAGE

xXPew³Xx team will have our vision and mission statement display on our website along with our product name and team name. We will also include any references that are significant to the application development progress. Web page will be updates in a monthly schedule .Demo video of the application may not be include for the first few updates.

13.3.4 DEMO VIDEO

Demo video will becomes away to show the progress of our product. However, depend on various circumstances the demo video may not be complete. We will try our best to get them to the sponsors as we complete the fundamental of the application. Genuinely, the demo video will have an introduction and significant works that is completed.

13.3.5 SOURCE CODE

Github will be the main version control tool for this project. Initial development will be updates and use as the team decision before splitting up in features to accomplish different objectives. After the first initital development, this code base will become the initial source code. Each member will have their own branch that accessible to the source code. Any updates will be push for review and these review will be test and check by the team in the coming scrum meet. This project will temporarily not available on any open source libraries.

13.3.6 SOURCE CODE DOCUMENTATION

As far as our understanding, unity had their own tools to generate source code documentation based on our source code. However, the gathered information is not enough to clarify on this matter. We may eventually have to use Latex as our secondary option to generate our SCD. Basic standards such as Addenda which generate documentation based on Requirements, Suggestion and Related References will be employed. This type of documentation will be available in digital form such as PDF or Latex.

13.3.7 HARDWARE SCHEMATICS

Eventually, the hardware specialists will create any necessary circuits boards and layouts for the hardware components of the project. However, those schematics and data will not available on the initial project charter. We will updates on any necessities documentations on our next major update.

13.3.8 CAD FILES

The model of the component hardware may be initially design in Tinker CAD available online but details touch up may be modify and updates via Auto CAD. This is only our temporary solution for 3D design work on our gun model. However, this is subject to change when necessary with proper recommendations from our sponsor.

13.3.9 INSTALLATION SCRIPTS

xXPew³Xx wanted to increase the Users' experiences with the game to be more relevance so we will be compiles and scripted our application and have it ready to public under Unity Android App. Users will need to install the version that is going to be available through the Unity App store or Google Store. This is our initial plan and this may subject to change depend on any regulations or changes from the team or the application service platform.

13.3.10 USER MANUAL

Prior to the delivery of our project, a user manual will be update on our web page and this will documentation will also be inform via email to the sponsor. This documentation will be available as the digital version for the Users. A hard-copy of this document will also be available on the day of delivery.

REFERENCES

- [1] Hasbro. Nerf Laser Ops Pro AlphaPoint, 2019.
- [2] JEM Accessories Inc. Xtreme Augmented Reality Blastert, 2017.
- [3] JEM Accessories Inc. Xtreme Augmented Reality Blastert, 2018.
- [4] Skyrocket Toys LLC. Recoil Laser Tag Starter Set, GPS enabled Multi-Player Smartphone Game, 2017.