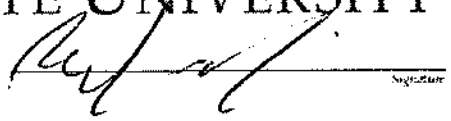
CS Capstone Requirements Document

April 19, 2019

A-Frame Live Stream Portal

Prepared for

Oregon State University

Behnam Saeedi  4/19/2019

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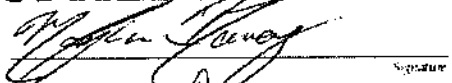
Meghan Mowery  4/19/2019

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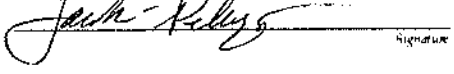
Sarahi Pelayo  4/19/19

Abstract

A-Frame Live Stream Portal is a project that will be used to bring families closer together, even when adversity keeps them apart. This report covers the different components of this project, including hardware and software. The first half of this report describes the concepts involved in the Requirements Document. This includes a description of the purpose, overview, and definitions used. The second half of the report describes the project itself, detailing the finer points of the project. The purpose of this report is to give our sponsor a full description of what the project entails, and confirm that it meets their needs. Our desire is to create a project that is simple, efficient, and cost-effective.

CONTENTS

Section	Origional	New
1.3.1	Document overview	Rewording
3.1	Functional requirements	Rewording
3.4	Mentioned English and Farsi	No words on viewer page, only English for admin page
3.6	Mentioned developer mode	Removed developer mode
3.13	Packaging, handling...	Rewording
4	Gantt chart was included	Removed Gantt chart

1 INTRODUCTION

1.1 Document purpose

The purpose of this report is to describe in detail the work to be done on the project, and the specific functions that will need to be implemented as requested by the sponsor.

1.2 Document scope

This document will cover all aspects of the project, including the hardware and software development. The report also includes a gantt chart to show our expected completion of different aspects of the project.

1.3 Document overview

1.3.1 System context

The finished A-Frame Live Stream Portal will be able to livestream video from at least 3 camera devices, one of which must be 360 degree video, at 480p and 30 fps. The system shall also stream audio in conjunction with the video stream. Users will connect to a web portal where they are able to select on a map which device they will view the the livestream from. The site owner shall also be able to modify the map and the locations of the cameras.

The system has two major parts, the streaming devices, and the server hosting the web portal. The streaming devices shall capture videos of the wedding and each will individually stream that data to the server through their own internet connection. The server shall allow users to connect to the map of the venue and select a device to view the wedding from. The server will then send the video coming from the selected camera to the user along with the audio.

1.3.2 System functions

The function of the cameras shall be to record the wedding live. Two of these cameras will be in a regular mode, while the other has 360 degree capabilities. This way, the family can have a more realistic view of the ceremony. The web portal shall be used to access the cameras. The web portal shall display the location of the cameras to the family, and they will have the option to select a camera to use. The sponsor will have the ability to edit the locations of the cameras on the web portal, as well as update the map of the venue. The sponsor will also be able to add and remove cameras as desired.

1.3.3 User characteristics

The system has 2 types of users, admins and viewers. Admins are the users who will set up the devices and have the ability to edit the map and location of devices on the web portal. Viewers will need to log in with an access token and will then be able to select a device on a map of the venue, admins will also be able to see this page. When either a viewer or an admin clicks on a device they shall be taken to a new page with the livestream from the device they chose.

1.4 Definitions

Fps	Frames Per Second
Jpeg	Joint Photographic Experts Group (image file format)
Png	Portable Network Graphics (image file format)
Web Portal	A website that displays information from multiple external sources
Access Token	Randomly generated sequence of characters used for authentication

2 References

3 System requirements

3.1 Functional requirements

This system is being developed to allow the relatives of our sponsors to experience our sponsors' wedding from outside of the country. Two cameras shall stream normal video from two locations to the web portal a third camera shall also stream 360 degree video to the web portal. In addition to the three cameras, audio will also be streamed with the video. The web portal shall run properly without crashing even when devices are added or removed.

3.2 Usability requirements

Each streaming device will have their own internet connection so that they can stream their video feed independently of one another. The web portal will broadcast the video with a maximum of one minute delay. Changing the battery of the devices will be quick and easy to do.

3.3 Performance requirements

The cameras will have at least 480p at 30fps stream quality with the maximum latency of one minute. Each camera with a fully charged battery will last at least the average time of a wedding ceremony.

3.4 System interface

The system will have an attractive website with an intuitive interface which will allow those tuning in to explore the venue using a complete map by clicking on the device icons. The website's map will have the physical location of the devices as clickable icons linking to a separate page where users are able to view the stream. The map's edit mode shall mainly use symbols for adding, removing, and updating the location of cameras. Words on the website will be kept to a minimum and are only present in admin mode.

3.5 System operations

The web portal will have a log-in page, where the user will enter a code given to them by the sponsor. Both users and admins will log in using access tokens, if we have enough time to implement it admins may instead log in using a username and password. Visitors can select an image (one representing either the normal or 360 view camera) to view that devices stream. The admin can also add and remove cameras, as well as update the web portal's map. The cameras can be powered on and off, and have independent WiFi connections meaning if one fails the system can continue uninterrupted. The cameras will need to be connected to WiFi at the venue.

3.6 System modes and states

The system will have two modes: normal and edit. The maps interface will have an edit mode that allows for the update of the venue map image using a .png or .jpeg. Because the streaming devices are independent, the edit mode will also have the options to add, remove, and reposition devices on the map which can be saved. The normal mode will be what viewers use where they can interact with the map and access streams.

3.7 Physical characteristics

The hardware shall be encased so there are no exposed wires while buttons will still remain accessible. The cameras themselves will be sturdy to reduce the risk of them falling over and breaking however weighing no more than 20lbs each. The battery will be removable. The web portal will be as simplistic as possible. This means that the web portal will have limited words, and instead use icons to represent the different functions of the system. Although the system is being developed for three cameras the system may have the option for expanding the system with more cameras. The system is not water resistant but will be rain proof.

3.8 Environmental conditions

The hardware is expected to preform well in conditions that are considered suitable for humans between 15 degrees Celsius to 25 degrees Celsius. The system shall work well in indoor conditions. Performance and quality may be affected by lighting, wind, extreme temperatures, flora, fauna, fungus, mold, sand, salt spray, dust, radiation, chemical, immersion, motion, and shock.

3.9 System security

The owner will be admin by default. Only admins will be allowed to enter edit map mode. Viewers will not be allowed to change locations, add, or remove devices on the website's map. To respect the privacy of users, streams will be private. Viewers will be able to log in with an access token to access the broadcasts. Users will agree that their private streams may be accessed by developers for troubleshooting but will not be shown to the general public.

3.10 Information management

The system will store the generated tokens used for viewers to log-in to the web portal. The audio and video recorded from the wedding will be live streamed directly to the viewers.

3.11 Policies and regulations

The system will maintain the privacy of the viewers and attendees of the wedding through the information listed in section 3.9.

3.12 System life cycle sustainment

To sustain the system, the cameras will need charged batteries, and the computers accessing the web portal will also need a reliable internet connection. In case of a camera failure or breakdown, the web portal contains an option to add or remove cameras from the system so they can be replaced if needed. Basic understanding of the web portal and the cameras will be required to maintain and utilize the system.

3.13 Packaging, handling, shipping and transportation

The cameras and microphone will be portable and easy to set up so they can be moved to and from sites as well as within the venue. The hardware of the systems shall be packages with shock absorbing material and labeled as fragile. When shipping the packaged system it shall be handled gentle as to not destroy an part.

4 VERIFICATION

The system will be considered fully operational when the web portal is operational by both the admin and the viewers, and the cameras properly record and stream the video and audio. The admin will be able to edit the display of the web portal, including the cameras, as desired. Finally, the viewers will be able to access the portal with their distributed tokens to view the ceremony.

CS Capstone Design Document

April 19, 2019

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Prepared for

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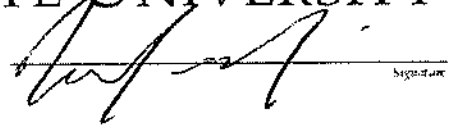
Behnam Saeedi  4/19/2019

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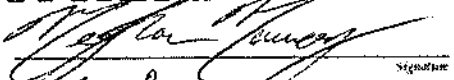
Meghan Mowery  4/19/2019

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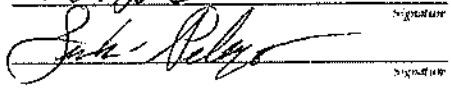
Sarahi Pelayo  4/19/19

Abstract

A-Frame Live Stream Portal is a project that will be used to bring families closer together, even when adversity keeps them apart. The main parts of this report are the introduction, design viewpoints, and design views.

CONTENTS

LIST OF FIGURES

List of Tables

Section	Original	New
1.3	Had 720p as resolution	Lowered to 480p
1.3	Microphone was originally going to be it's own separate pi	Microphones now attached to all pis
3.2	Had one microphone	Now uses three microphones
3.3.1	Referenced using a UML diagram	Removed references
3.3.2	Referenced using a UML diagram	Removed references
3.3.3	Microprocessor section	Removed section, no longer using microprocessor
3.3.3/4	Mentioned using 1 microphone	Now using 3 microphones
3.4.1	Mentioned microprocessor	Removed microprocessor reference and added a microphone per pi
3.4.1	VLC was going to be used for streaming	Picam and a node plugin were used instead
3.4.1	MJPEG was the original file format	HLS is what was used
3.4.2	360 video camera was going to be purchased	The raspberry pi camera module with a 360 degree lens attachment was used
3.4.3	Section talking about microprocessor	Removed section
3.4.3/4	Microphone design was using one microphone and a microprocessor to merge audio	New design has a microphone on every pi creating a stream with audio
3.4.4/5	Section references the ad hoc network	Revisions regarding the ad hoc network
Figures	Old pictures of prototypes	New pictures of the current appearance of the website

1 Introduction

1.1 Purpose

The purpose of this document is to describe the different physical aspects of this project. By describing the aspect of the project in detail, it will be easier to formulate a plan to complete the project. This includes describing the design concerns, views, and viewpoints of this project.

1.2 Scope

This document will cover all aspects of the project, including the hardware and software development. This document also includes various images related to the system's user interface and design.

1.3 Context

A-frame live stream portal is a project that will utilize various technologies to allow the stakeholder's family to view the stakeholder's wedding live. The project consists of three cameras, two regular view and one 360 view which will be live streaming the wedding at 480p and 30fps. Each raspberry pi will have a microphone attached which will provide audio for the stream coming from that pi. Finally, the web portal that will be created will be used by both the stakeholder and the stakeholder's family. The stakeholder will have access to an admin page where they can move, add, or delete

cameras and microphones as well as change the displayed venue map. The users will be able to select any of the available cameras on the map to view the wedding ceremony. This way the family of the stakeholder will be able to experience the wedding as if they were there themselves.

References

[1] [online] A-Frame. Available at: https://aframe.io/ [Accessed 2 Nov. 2018].

[2] Hills, Mark (December 2017). trx: Realtime audio over IP. [online] Available at: http://www.pogo.org.uk/ mark/trx/ [Accessed 27 Nov. 2018]

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[4] Pinola, M. (2018). Features and Uses of an Ad Hoc Wireless Network. [online] Lifewire. Available at: https://www.lifewire.com/what-is-an-ad-hoc-wireless-network-2377409 [Accessed 28 Nov. 2018].

2 Glossary

Access Token/Login Key	Sequence of characters used for authentication
A-Frame	The web framework that will be used for 360 video
CSS	Cascading Style Sheet
Fps	Frames Per Second
Jpeg	Joint Photographic Experts Group (image file format)
Mbps	Mega bits per second
Mjpeg	Motion Joint Photographic Experts Group 720p & Progressive video format with 720 horizontal line
Png	Portable Network Graphics (image file format)
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
USB	Universal Serial Bus
UI	User interface
Server	The computer hosting the website and receiving the video
Web Portal	A website that displays information from multiple external sources
Wi-fi	Wireless Fidelity

3 Body

3.1 Identified design stakeholders

The stakeholders for this project are Behnam and Jenna Saeedi.

3.2 Identified design concerns

This project will require both a user interface (UI) and technological implementation. The web portal will have two different interfaces, admin and user, and will be simple and easy to understand. The technologies used for this project will be two video cameras, one 360 degree video camera, three microphones, and multiple raspberry pis.

3.3 Selected design viewpoints

3.3.1 Normal Video

The video needs to be live streamed from the wedding to the stakeholder's family. This video will ideally stream at 1080p and 30fps with a minimum of 480p, still with 30fps. The stream can be interacted with by the stakeholder's family. The camera will need to last the entire wedding ceremony.

3.3.2 360 Video

The 360 video needs to be live streamed from the wedding to the stakeholder's family. This video will ideally stream at 1080p and 30fps, and can be interacted with by the stakeholder's family. The camera will need to have a strong enough battery so it can last the entire wedding ceremony.

3.3.3 Microphone

To get the full experience of the wedding for the family of the client along with streaming video there will be audio to accompany it. The systems design includes three cameras and three microphones. Because each raspberry pi will have it's own microphone attached, each stream will have it's own audio feed. A subsystem is a camera or microphone connected to a microprocessor. The goal of the microphones are to record and stream audio so it can be projected over the each video broadcast coming from the other raspberry pis.

3.3.4 Web Server Architecture

The web server architecture must be designed so all the video and audio streams from the four subsystems can be sent to a web server. The network design must allow for subsystem independence, meaning that if one of the cameras fails the others must remain unaffected.

3.3.5 Desktop UI

The user interface needs to be designed in a way that is simple to use for both the client and the end user. A custom website will be designed. The website's UI will be tailored with input from the client. The design will go through a feedback process where a prototype will be presented to the client, and the client will leave feedback as they see fit. After the client's feedback the prototype will be updated and shown to the client again. The web page will require users to login to view the venue map, and be able to select a device from a camera to watch the wedding. Users will also need to be able to return back to the venue map and select a different device. There will also be an admin view from which the client can add, move, and remove cameras, as well as upload a new venue map.

3.3.6 Mobile UI

In addition to working on desktop, the website will also need to be usable on mobile devices. All functionality available in the desktop UI must be available for mobile.

3.4 Design views

3.4.1 Normal Video

Video in normal view will contain two subsystems consisting of a raspberry pi camera module and microphone. The module with be connected to the raspberry pi's camera port using a ribbon cable. For video streaming, the design will

need a video media player. Picam will be used to record the stream and a node app will act as the server for the stream because it has several options to customize the stream so it can meet the requirements of a minimum of 480p with 30fps. The video will be in HLS format and adjusted to a reasonable bit rate at will depend on the strength of the venue's Wi-Fi.

3.4.2 360 Video

The 360 video stream will be done with a basic raspberry pi camera module and an additional attachment that is used for streaming 360 video on iPhone, the user will connect the pi and operate it the same way they would operate the regular videos on the raspberry pi. The video will then be streamed to the website using A-Frame. The team chose to upload the video directly to the website instead of going through another format such as YouTube or Facebook.

3.4.3 Microphone

The best design approach selected will be to have a microphone connected to each raspberry pi. The independence of the mentioned design choices meets the need for safeguarding from total system failure as a result from one competent or subsystem failure. A USB microphone will be used on each raspberry pi 3 to record the audio used for each stream. USB microphones have easy interfaces meaning that it can be inserted into any USB port. The audio will be streamed with picam, which captures both audio and video from the attached pi.

3.4.4 Web Server Architecture

Each of the microprocessors need to have a built-in wifi module to be able to connect to the internet. The network will consists of three subsystems, two normal video, and one 360. Each microprocessor will send captured video and audio to the web server directly using the venue internet. The raspberry pi from a will have the IP address of the venues router then the router will port forward to the pi. The video will be port forwarded from each of raspberry pi to the router then sent over to the OSU server.

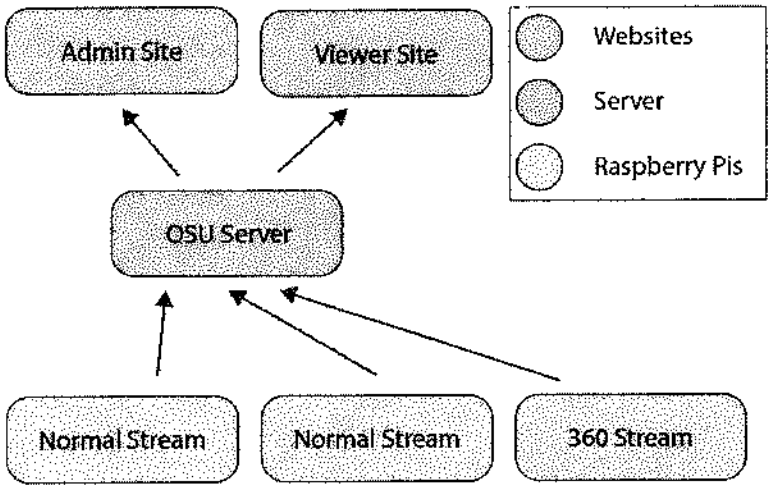

Fig. 1. System Architecture

3.4.5 Desktop UI

Figure 2 is the login page of the system's website. Users will be given a login key which they will input. When the user's enter the correct key they will be taken to the main page, Figure 3. The main page is where users will be able to select which stream they want to watch. The main page also has an admin view shown in Figure 4. The client will be able to get to admin view by logging in with a separate login key for the admin login. The buttons will open menus that will allow the client to perform the labeled action (ex: add a device, remove a device, etc). In both admin and normal user mode clicking on a camera will redirect the user to that camera's stream viewable in Figure 5. The video page will be the same for both normal and 360 video.

Fig. 2. Login Page

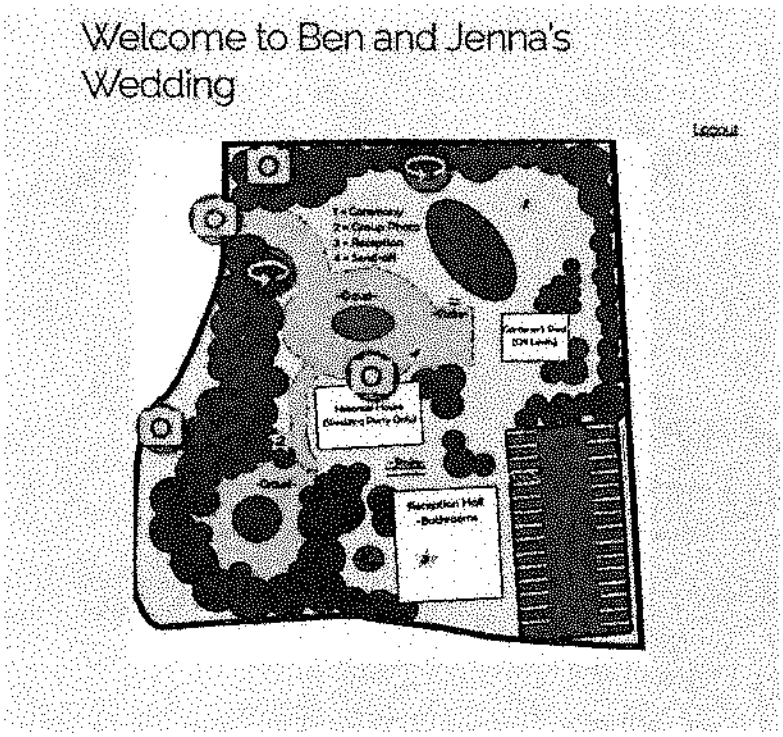

Fig. 3. User View

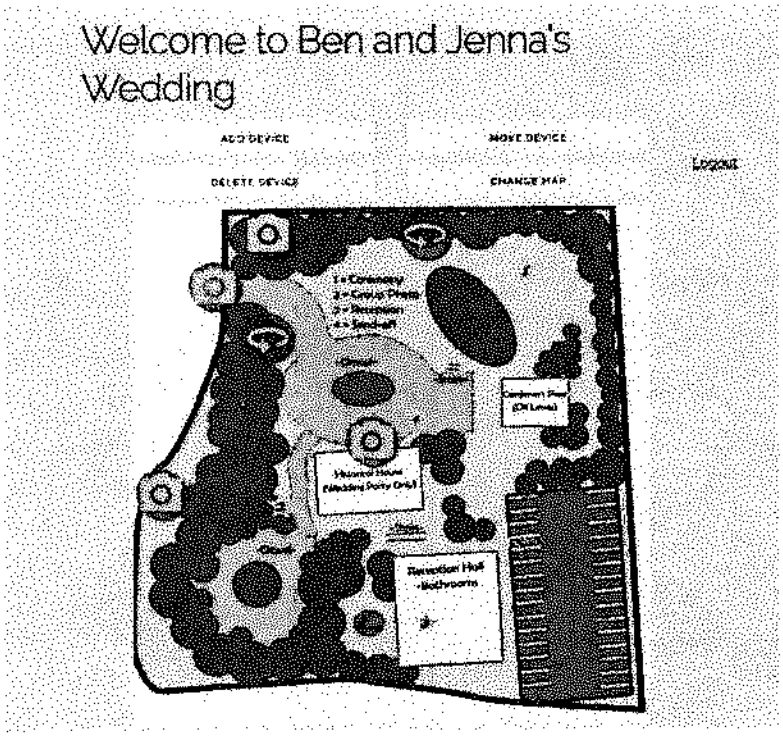

Fig. 4. Admin View

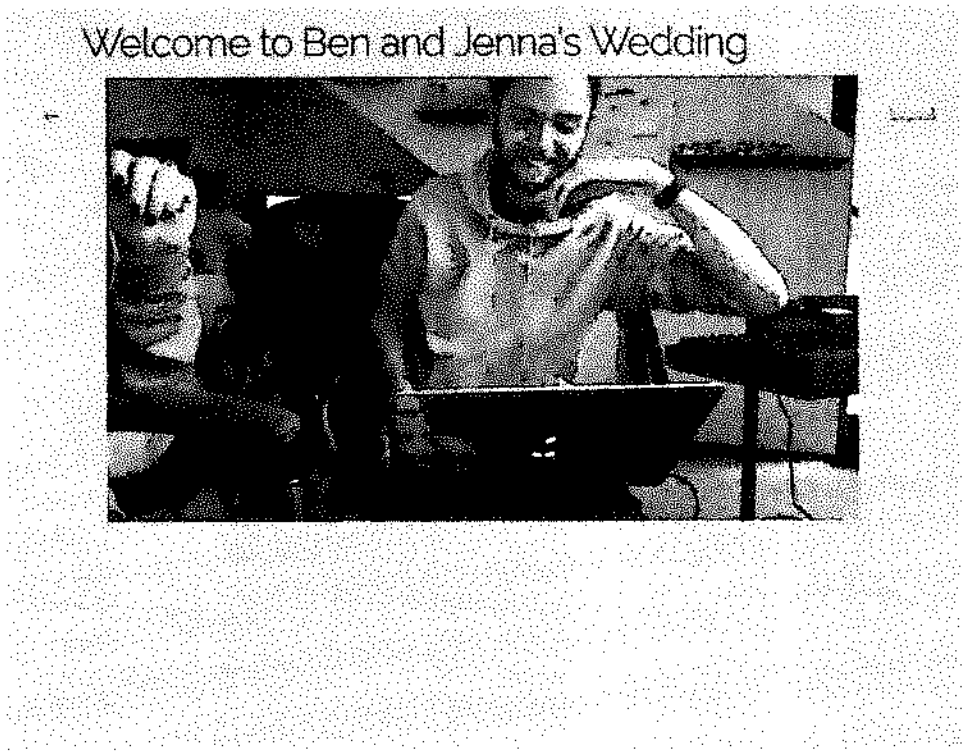

Fig. 5. Video Page

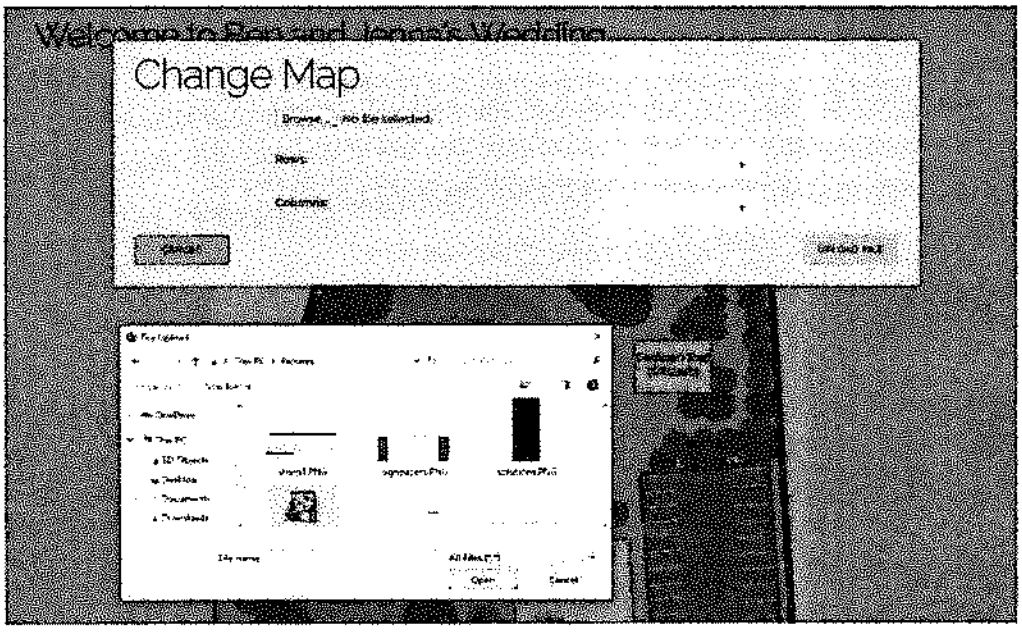

Fig. 6. Change Map Image

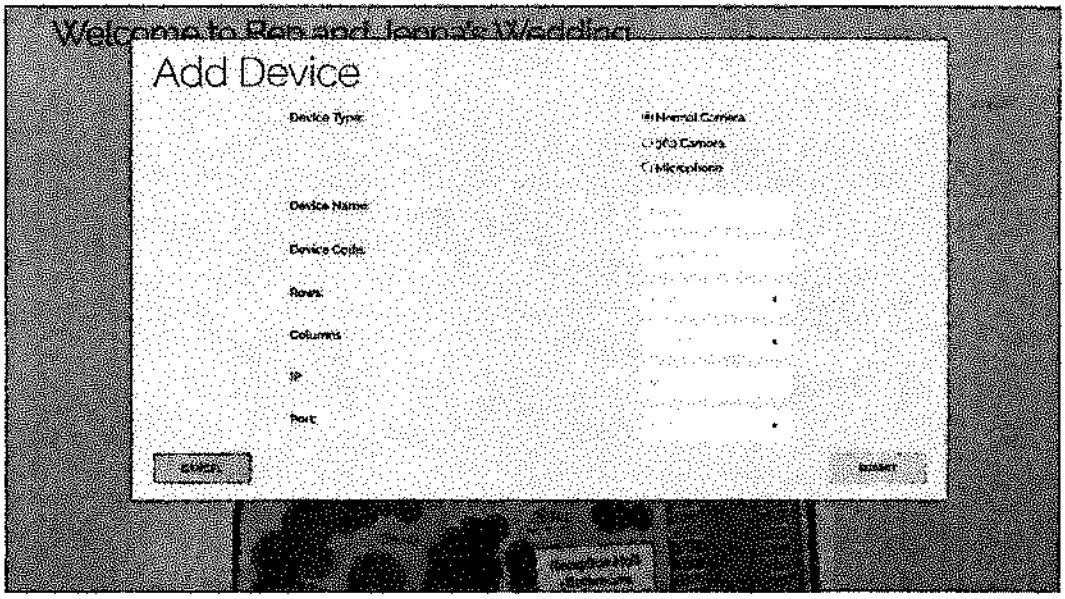

Fig. 7. Add Device

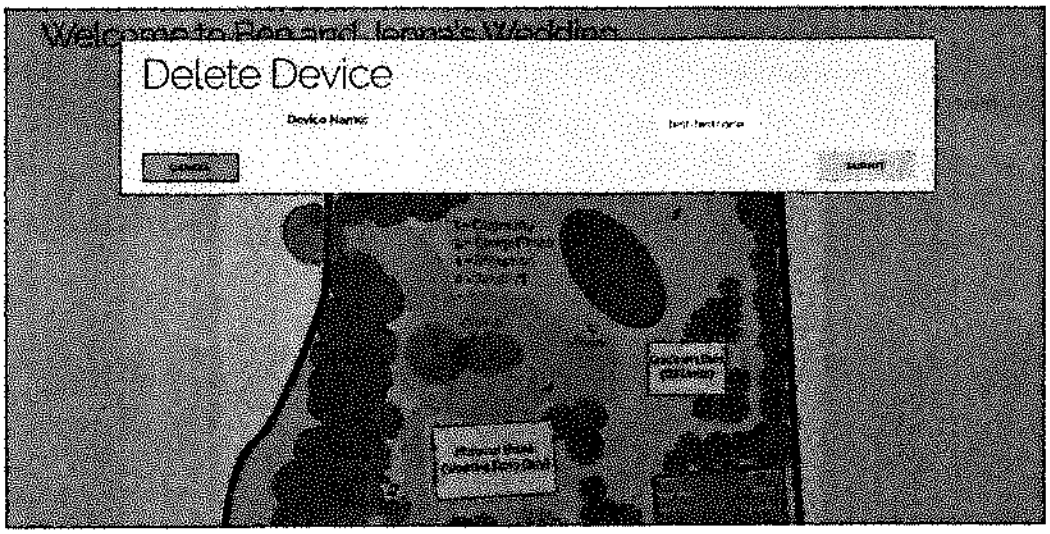

Fig. 8. Delete Device

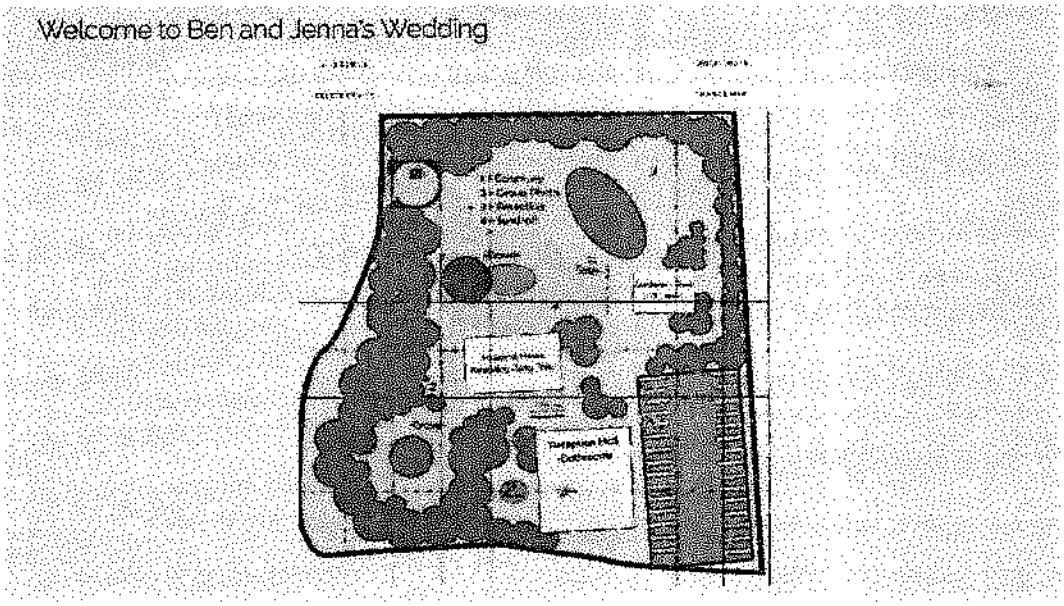

Fig. 9. Move Device

3.4.6 Mobile UI

The mobile UI will contain the same pages as the desktop UI and have all of the same functionality. The system's CSS will be written such that the user will be loading what would be the same page both on desktop and mobile, but the page's components for the mobile view will be oriented differently.

Fig. 10. Mobile Login

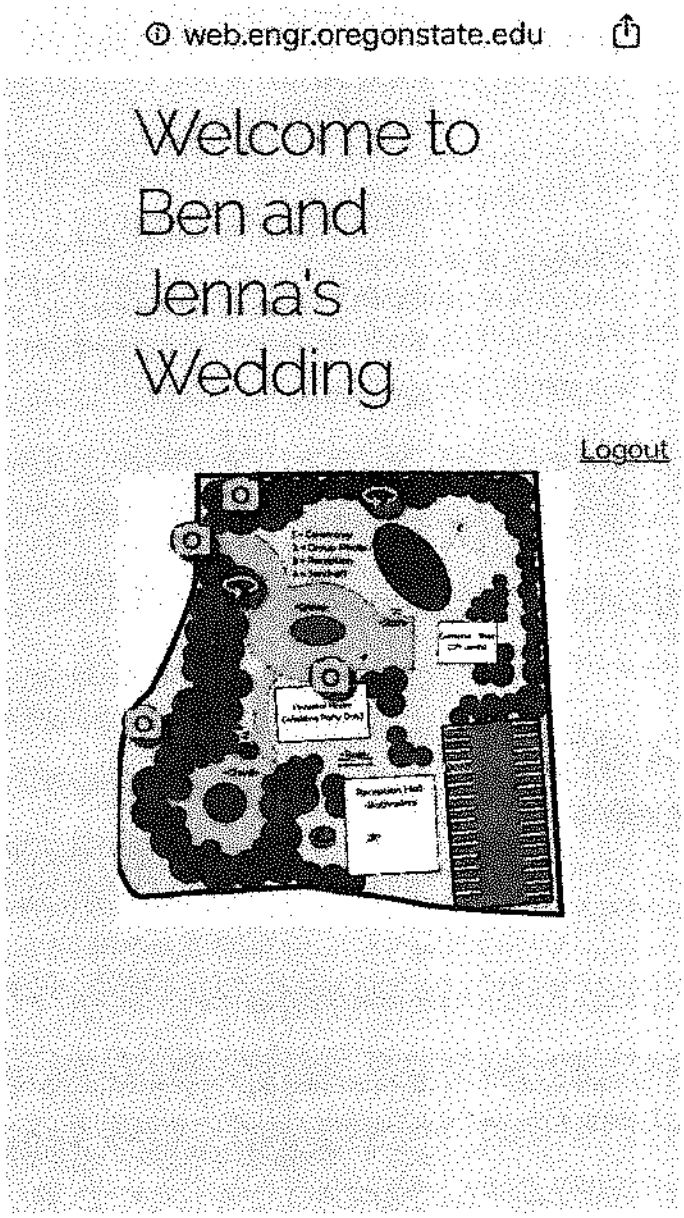

Fig. 11. Mobile User View

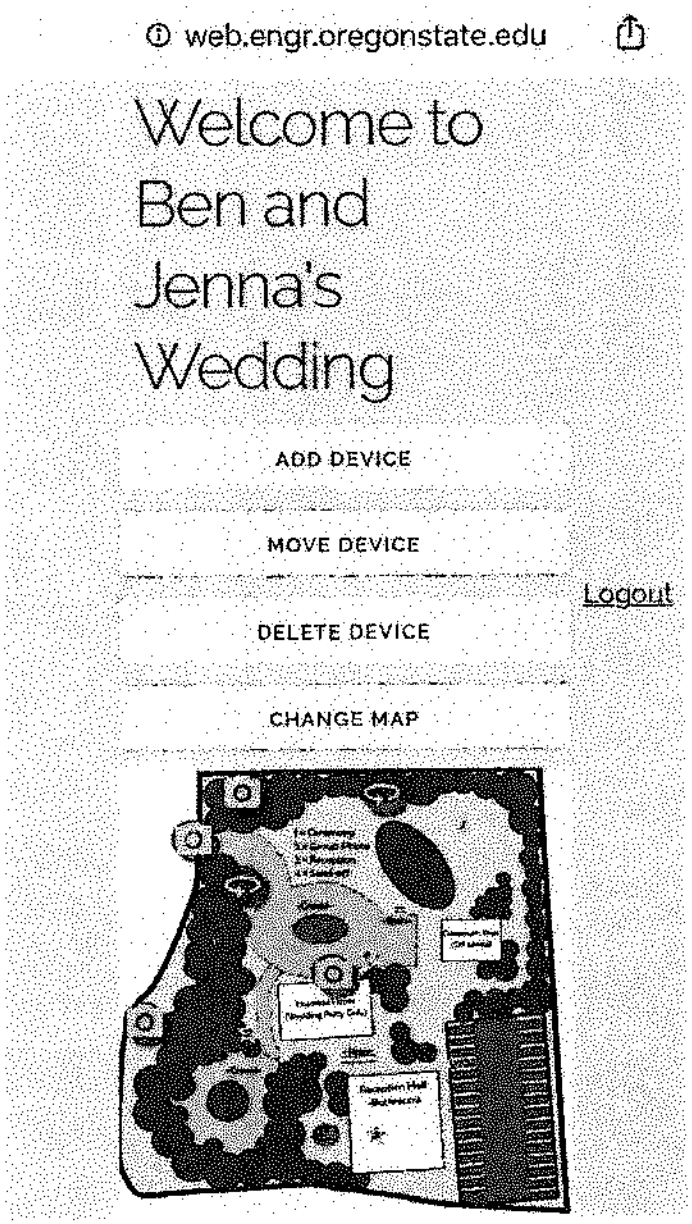

Fig. 12. Mobile Admin View

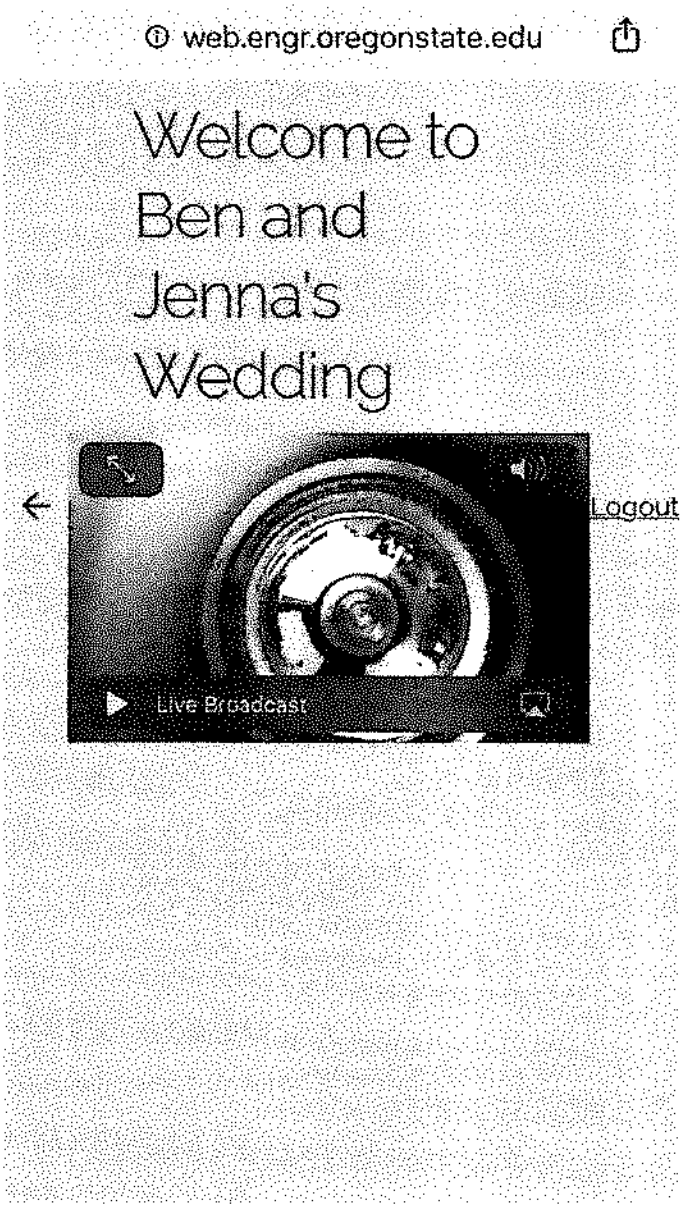

Fig. 13. Mobile Video Page