



Group 25

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Computer Engineering
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Electrical Engineering

QwikBox

Live Video Capture and Upload Device

Roles and System Diagram

Jonathan Kerbelis
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App Development --- Additional Software
Pi Development --- Additional Software
Electrical Lead --- PCB Design

Purpose of the Qwikbox

- ▶ Video and Analytics company 'QwikCut' hires cameramen to record sporting events
 - ▶ These cameramen have to wait until after a full day of games to go home and upload video
- ▶ The QwikBox will quickly encode, store and upload the video to a remote server.
- ▶ This will happen in real time, and the video will be available less than a minute after being recorded
- ▶ The Qwikbox will encode the video to the H.265 format
 - ▶ This makes a smaller file size with the same high video quality
- ▶ Will need to have both Wi-Fi and cellular network capabilities

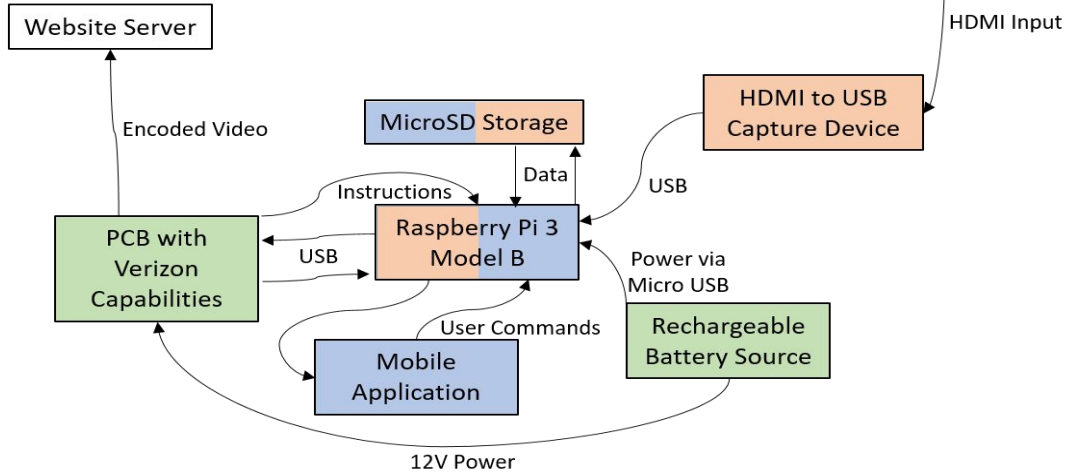
Agenda

- ▶ System Overview
- ▶ Battery
- ▶ Streaming Video Input
- ▶ Raspberry Pi 3
- ▶ Mobile Application
- ▶ PCB and Verizon Network
- ▶ Remote Server
- ▶ Integration and Testing
- ▶ Budget / Difficulties / Schedule

Requirements

1	The Qwikbox system must take a video stream and produce a video file from it
2	The Qwikbox system must encode the video files with the h.265 format
3	The Qwikbox must be resistant to common summer weather, including moderate to high heat.
4	The entire video capture and encoding process must take less than five minutes
5	The Qwikbox must have Ethernet, Wi-Fi and Cellular capabilities
6	The Qwikbox must be able to stream HD (1080p) video
7	The Qwikbox must have the capabilities to receive Bluetooth instructions from a mobile device

Initial System Design



Personnel Responsibility Legend



Harold
Frech



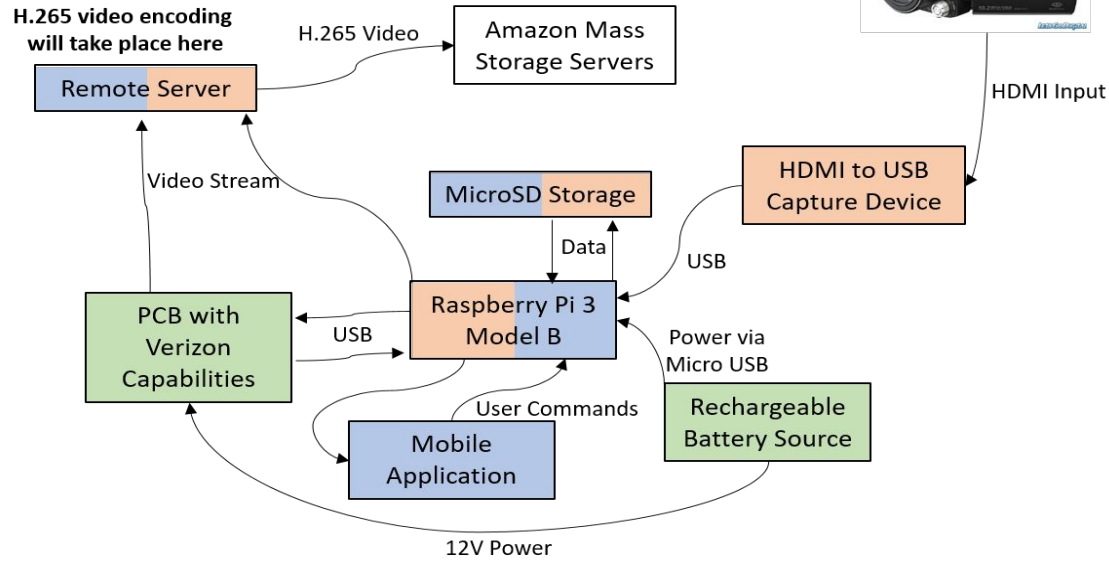
Jonathan
Kerbelis



Eric
Downey

But this design causes some issues...

Current System Design



Personnel Responsibility Legend



Harold
Frech



Jonathan
Kerbelis



Eric
Downey

Design Components

- ▶ Large battery
 - ▶ The Qwikbox needs to last all day at the field
- ▶ Raspberry Pi 3 as the central computing device
 - ▶ Cost efficient device that has a large amount of support
- ▶ HDMI to USB capture device
 - ▶ For getting the video stream from the camera to the Raspberry Pi
- ▶ PCB with Verizon Skywire modem attached
 - ▶ Provides a means to upload video through the Verizon cellular network
- ▶ Mobile app that will serve as a control interface for the user
 - ▶ Connected through bluetooth, provides the user with controls
- ▶ Remote Amazon server
 - ▶ This will encode the video to h.265 and store the final video files

Portable Battery Packs

Name	Battery Type	Size	Cost	Outputs
Mophie Powerstation	Lithium Ion	4000 mAh	\$20	One 2.1A USB
Intocircuit Portable Battery Pack	Li-Polymer	26000 mAh	\$65	One 2.1A USB One 12V DC Charging
GETIHU Portable Power Bank	Lithium Ion	10000 mAh	\$40	One 2.1A USB One 1 A USB

Intocircuit Portable Battery

Intocircuit's 26,000mA model

- ▶ Price: \$65.00
- ▶ Li-Polymer battery
- ▶ Numerous power level outputs
- ▶ Fast charging ready
- ▶ Best cost vs performance ratio
- ▶ Can power QwikBox for a the whole day and more



HDMI to USB 3.0 Dongle

Converts HDMI input to USB 3.0 output

- ▶ Price: \$140.00
- ▶ Captures full 1080p HD video
- ▶ Video conversion done through hardware
- ▶ No drivers necessary for functionality
- ▶ Powered via USB 3.0 port
- ▶ 300-350MB/s throughput and it is compatible with USB 2.0



HDMI to USB Capture Device

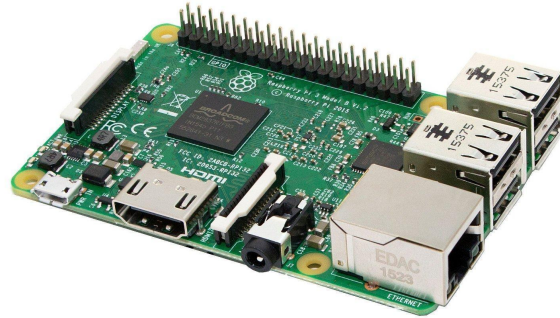
- ▶ Converts the HDMI stream to a USB interface
- ▶ This USB input stream is fed into the Raspberry Pi
- ▶ The input stream is detected like any USB webcam or camera and can be directed elsewhere from the Raspberry Pi through software tools



Streaming

- ▶ The input stream will be captured using software packages “Motion” and “FFMPEG”
- ▶ Motion is used to stream video to a URL or IP Address
- ▶ FFMPEG is used for the necessary video encoding
- ▶ The config files were altered to set the correct resolution (1280x720 or 1920x1200) and frame rate (30 fps)
- ▶ As of today, the stream is able to be viewed on any computer on the same network as the Qwikbox
- ▶ The next step is to stream it over the internet to a specific URL

Raspberry Pi 3 Model B



Broadcom BCM2387 chipset

- ▶ Price: \$34.99
- ▶ 1.2GHz Quad-Core ARM Cortex-A53
- ▶ 26-pin General-Purpose Input/Output (GPIO)
- ▶ Dual Core VideoCore IV® Multimedia Co-Processor
- ▶ 802.11 b/g/n Wireless LAN and Bluetooth 4.1
- ▶ 1GB LPDDR2 memory
- ▶ Micro SD storage

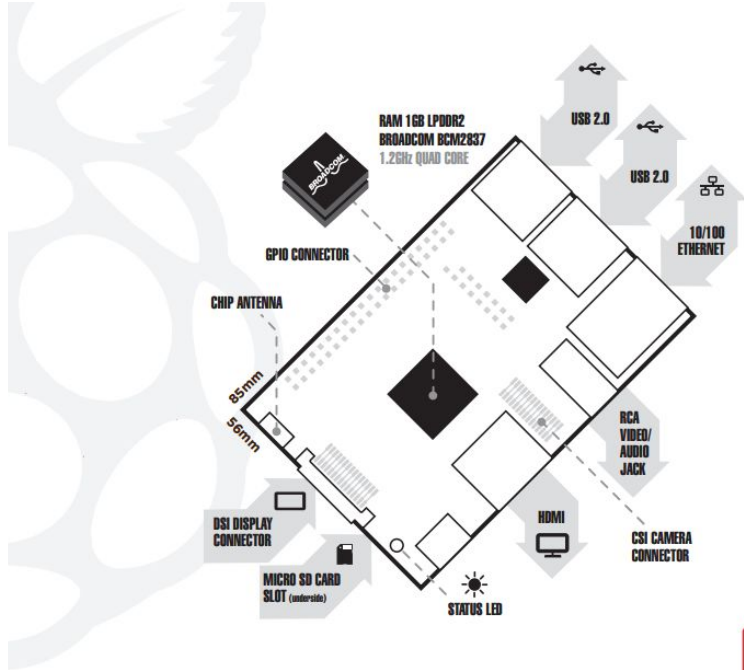
Performance of the Pi3 B

- ▶ Low cost
- ▶ Low power
- ▶ 10x faster processing
- ▶ Added connectivity

		Pi3 B
Boot	Max	0.75A
	Avg.	0.35A
Idle	Avg.	0.30A
Video playback (H.264)	Max	0.60A
	Avg.	0.33A
Stress	Max	1.34A
	Avg.	0.85A

Product	Recommended PSU current capacity	Maximum total USB peripheral current draw	Typical bare-board active current consumption
Raspberry Pi 3 Model B	2.5A	1.2A	~400mA

Pi3 B Pin Mapping



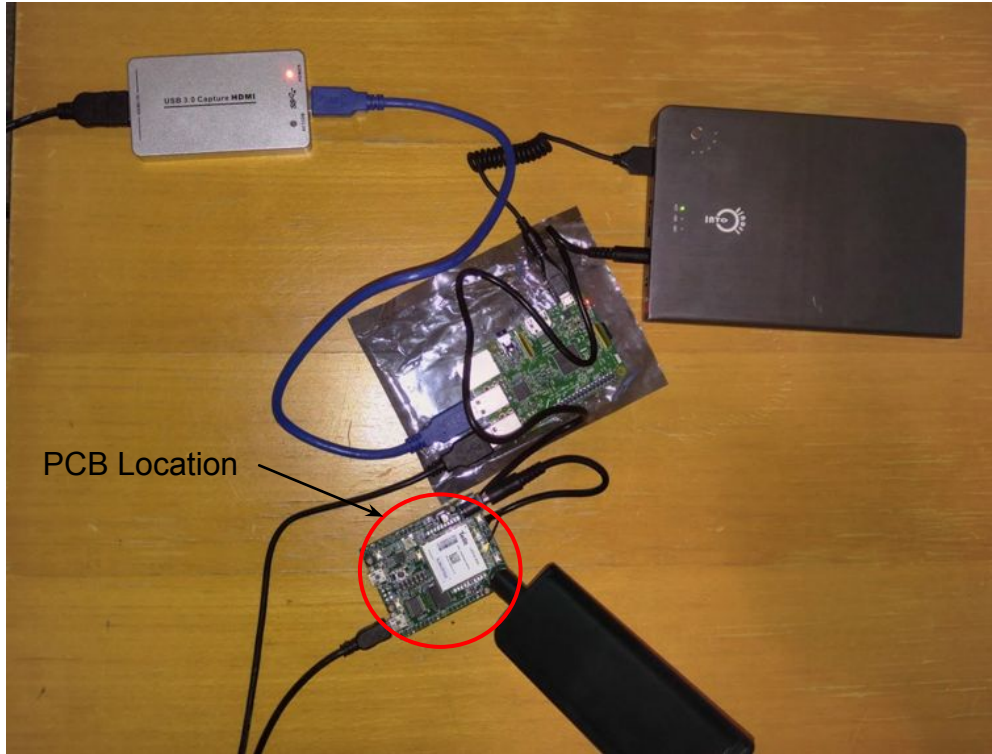
Raspberry Pi 3 GPIO Pin Layout

NAME		NAME	
1	3.3v DC Power	2	DC Power 5v
3	GPIO 2 (SDA1, I ² C)	4	DC Power 5v
5	GPIO 3 (SCL1, I ² C)	6	Ground
7	GPIO 4 (GPIO_GCLK)	8	(TXD0) GPIO 14
9	Ground	10	(RXD0) GPIO 15
11	GPIO 17 (GPIO_GEN0)	12	(GPIO_GEN1) GPIO 18
13	GPIO 27 (GPIO_GEN2)	14	Ground
15	GPIO 22 (GPIO_GEN3)	16	(GPIO_GEN4) GPIO 23
17	3.3v DC Power	18	(GPIO_GEN5) GPIO 24
19	GPIO 10 (SPI_MOSI)	20	Ground
21	GPIO 9 (SPI_MISO)	22	(GPIO_GEN6) GPIO 25
23	GPIO 11 (SPI_CLK)	24	(GPIO_GEN7) GPIO 8
25	Ground	26	(GPIO_GEN8) GPIO 7
27	ID_SD (I ² C ID EEPROM)	28	(I ² C ID EEPROM) ID_SC
29	GPIO 5	30	Ground
31	GPIO 6	32	GPIO 12
33	GPIO 13	34	Ground
35	GPIO 19	36	GPIO 16
37	GPIO 26	38	GPIO 20
39	Ground	40	GPIO 21

KEY

Power
Ground
UART
I ² C
SPI
GPIO

Making the Connections

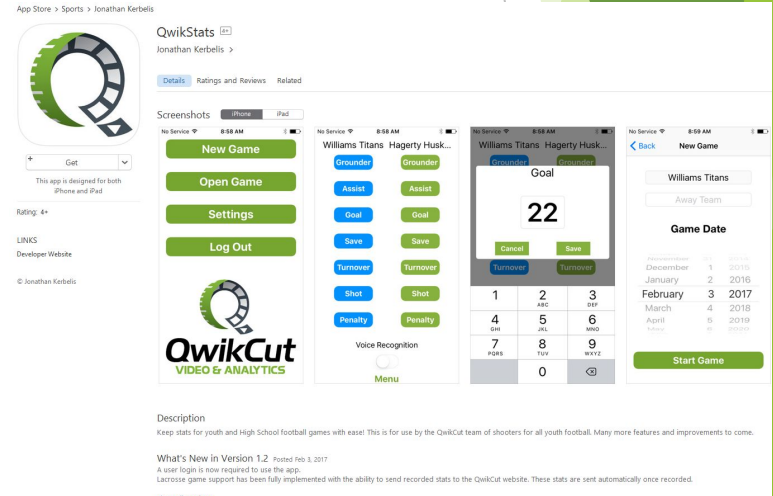


Mobile Application

- ▶ Will be available for both Android and iOS
- ▶ App is already on both Google Play and App Store, just need to add functionality
- ▶ Acts as a 'Remote Control' for the Qwikbox



Keep stats for youth and High School football games with ease! This is for use by the QwikCut team of shooters for all youth football. Many more features and improvements to come.



Description

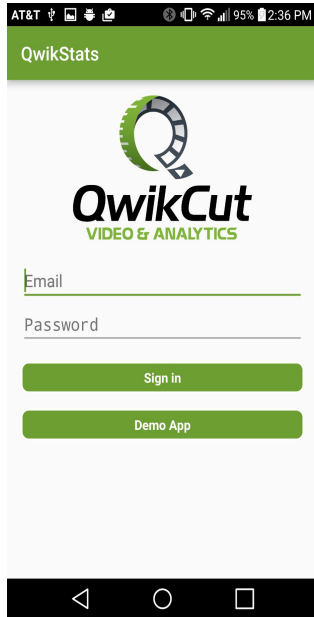
Keep stats for youth and High School football games with ease! This is for use by the QwikCut team of shooters for all youth football. Many more features and improvements to come.

What's New in Version 1.2

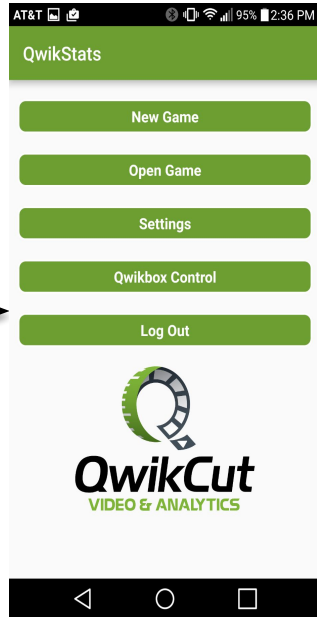
Posted Feb. 3, 2017
A user login is now required to use the app.
Lacrosse game support has been fully implemented with the ability to send recorded stats to the QwikCut website. These stats are sent automatically once recorded.

Mobile Application Flow

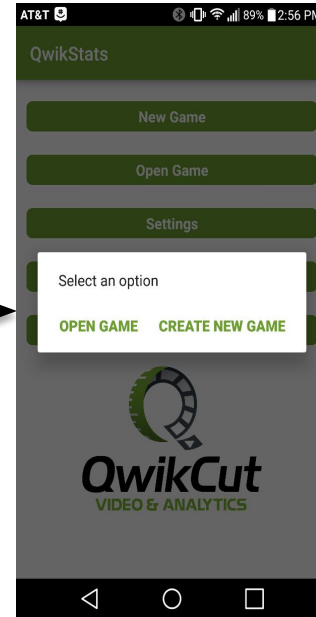
User opens app and logs in



User selects "QwikBox Control"



User has option to create new game or open a past game



Mobile Application Flow (cont.)

Enter Game Information

QwikStats

Enter the Game Information

UCF

USF

Football

Varsity

February

9

2017

CANCEL OK

Create New Game

Open Game

QwikStats

New Game

Open Game

Select a Game to Open

UCF vs. USF
February 9, 2017

DELETE GAME OPEN GAME

QwikCut
VIDEO & ANALYTICS

Select game from list of past games

QwikBox interface where users can control the recording

QwikStats

USF vs. UCF

Bluetooth Status: Connected

Bluetooth Connection



- ▶ The mobile application will communicate with the Raspberry Pi through a Bluetooth interface
- ▶ The Raspberry Pi 3 comes with built-in Bluetooth hardware, but it is not able to connect to a mobile phone without additional configuration
- ▶ To ensure a connection each time the Raspberry Pi is booted, a simple bluetooth service was developed to start each time the Pi is booted
- ▶ This will allow a mobile phone to connect with the QwikBox as soon as it's powered on

Bluetooth Connection (cont.)



- ▶ To start the video stream, the mobile app will have to kick off a shell script
 - ▶ In order to do this, the app will need to have access to the Raspberry Pi's shell through a bluetooth interface
- ▶ Serial data received from a phone is in the form of text, so this alone accomplishes nothing
- ▶ A python program was developed to serve two main purposes
- ▶ Read in serial data coming from the bluetooth module and transfer it to a terminal process
- ▶ Transfer the terminal readout back to the bluetooth module
 - ▶ This way the mobile app has access to the Raspberry Pi's shell and can start the necessary scripts at the press of a button

Skywire™ 4G LTE Embedded Modem

Telit E910SVG chipset

- ▶ Price: \$129.99
- ▶ 20-pin connections
- ▶ Will be implemented into PCB
- ▶ Features 4G LTE speeds on Verizon's Wireless network



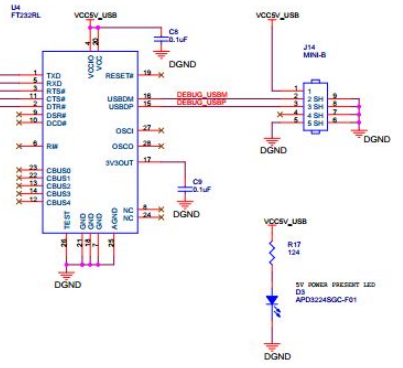
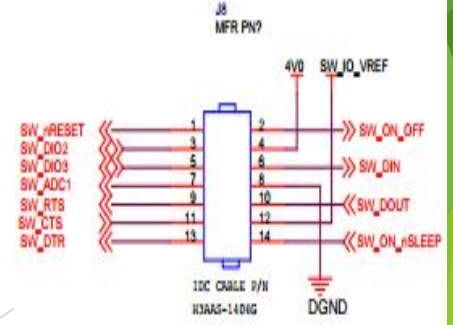
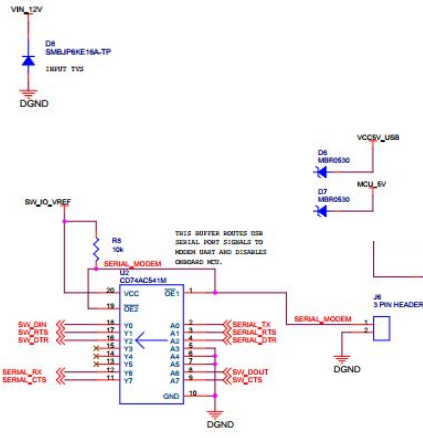
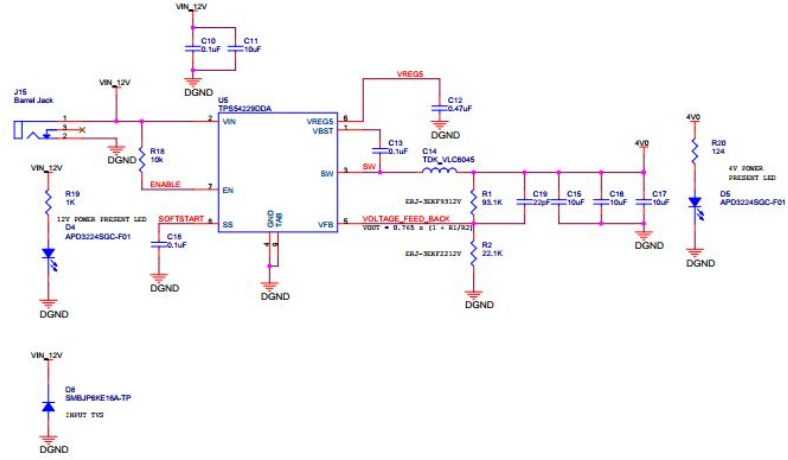
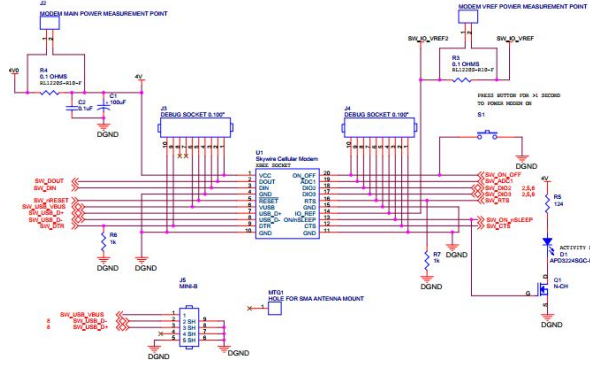
Skywire™ Development Kit

A fully integrated modem set

- ▶ Price: \$210.00
- ▶ Barrel Power Port (Compatible)
- ▶ Antenna is FCC approved
- ▶ Testing the server communications

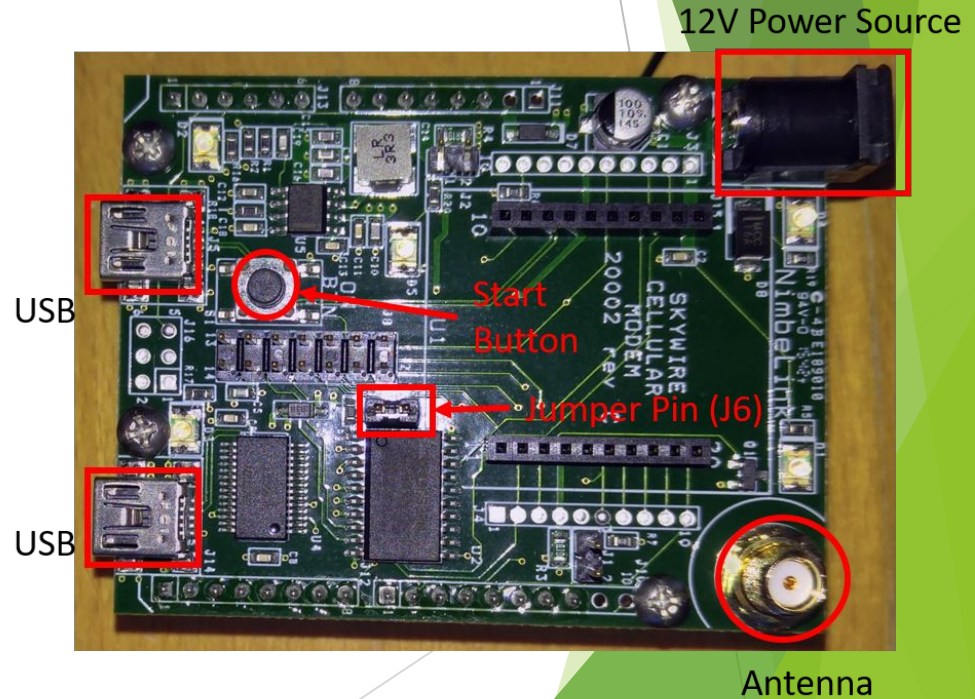


PCB Overall Schematics



PCB Design

- ▶ Modeled after development board
- ▶ Verify service provider data plan
- ▶ Handles video data from raspberry pi
- ▶ Transmits video data to server



Amazon Web Services

- ▶ Amazon is able to provide a high-end remote server
- ▶ Multiple tiers of service are available
- ▶ Fully controllable platforms

Notable companies that use Amazon Web Services:

- ▶ Spotify
- ▶ Netflix
- ▶ Slack



Why Use A Remote Server?

- ▶ Longer battery life for QwikBox system
- ▶ Faster overall start to finish time
- ▶ Reasonable pricing
- ▶ Reliable and secure

Amazon's EC2 servers will process all video encoding and uploading

Hardware Testing

- ▶ Ensure battery is charged, and all components are connected to securely to the Raspberry Pi.
 - ▶ With the Pi connected to a Wi-Fi network, attempt to load a web page
 - ▶ With Wi-Fi disconnected, attach an ethernet cable and attempt to load a web page
 - ▶ With ethernet and Wi-Fi disconnected, attempt to load a web page using the PCB with Verizon network components.
- ▶ Repeat the above steps after leaving the Qwikbox in the sun for over two hours
 - ▶ This will ensure that the Qwikbox can withstand heat from the direct sunlight that will occur at sporting events

Software Testing

- ▶ Connect all components, including the video camera. Confirm the camera's viewfinder depicts a clear picture
- ▶ From the mobile app, start the capture
 - ▶ Observe on the Raspberry Pi that the capture script is running
- ▶ From the mobile app, stop the capture
 - ▶ Check the logs on the remote server to ensure the encoding process was run
- ▶ On the final mass storage server, ensure that the recorded video clip appears and is in the H.265 format
- ▶ Download the video file and ensure it retained 1080p video quality with a frame rate of at least 30 fps

Budget

- ▶ \$1000 total project budget

Description	Quantity	Cost (\$)
PCB containing wireless communications (4G LTE / 5G)	1	400
HDMI to USB Capture Device	1	140
Raspberry Pi 3	1	35
Battery Source	1	65
Plastic Case	1	50
Micro SD Storage Device	1	15
Total		705

Difficulties

- ▶ Working with computer science team
- ▶ PCB integration with modem and Verizon network
- ▶ Amazon remote server communications
- ▶ Weather resistance protection
- ▶ Ensuring a stable HD stream from the Raspberry Pi

Progress

Project Component	Percentage of Completion
PCB Design	60%
Mobile App Development	75%
Raspberry Pi Streaming/Bluetooth Capabilities	50%
Amazon Server Development/Setup	20%
Total Project Development	52%

Questions?