# Team B6 - EyeSPy

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## **Use Case**

 A Camping Perimeter Security System to monitor surroundings

 Current solutions are costly, internet dependent, and not suited for wilderness use cases

 ECE Areas: Signals & Systems, Hardware Systems, Software Systems



Trip Wire Based Security System



Trail Camera Security System

#### Requirement #1

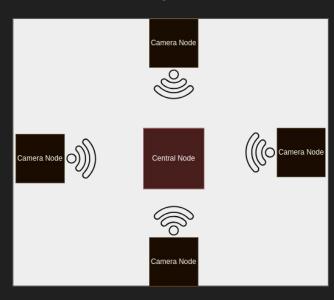
## **Continuous Streaming from All Cameras**

#### **Motivation**

Security systems must monitor all camera streams simultaneously

### **Sub Requirements**

- Stream 240p 10Hz streams from 6 cameras
- Drive a 720p 60Hz display
- Less than 10% dropped frames



#### Requirement #2

#### **Portable Camera Nodes**

#### **Motivation**

Outdoor scenarios require an easy setup and quick teardown process

## **Sub Requirements**

- Wireless communication between camera and receiver
- 24 hours on battery power
- Plug-and-Play operation

#### **Requirement #3**

## **Reduced Costs Compared to Alternatives**

#### **Motivation**

Existing systems are **expensive** and are **incompatible** for campsite surveillance

## **Sub Requirements**

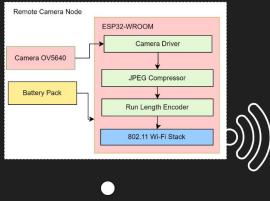
- Cost of prototype camera node < \$50</li>
- Cost of prototype receiver node < \$100</li>
- Use only Open Source Toolchains

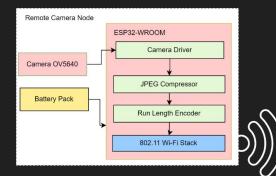
## **Technical Challenges**

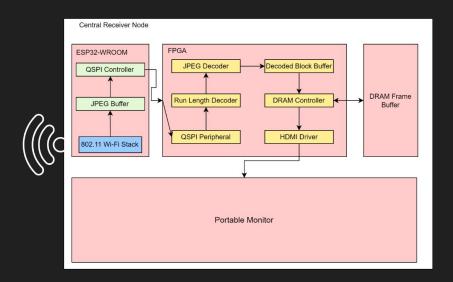
How do we...

- Compute frame compression fast enough
- **Stream** enough data over the wireless connection
- Decompress all the incoming frames fast enough
- Optimize performance to minimize power consumption

# **Solution Approach**



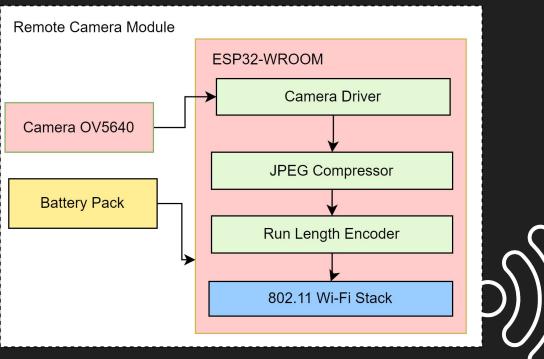






## **The Camera Node**

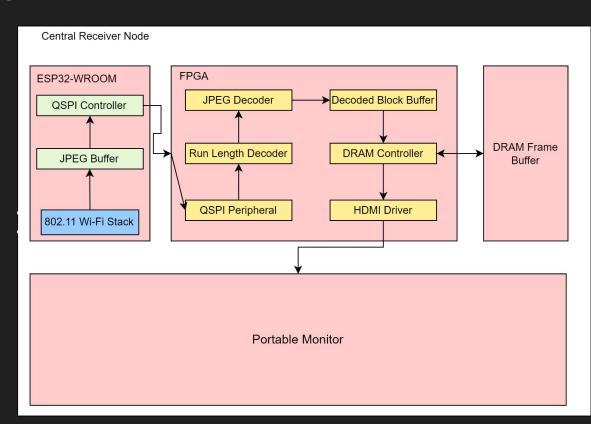
- 5MP OV5640 Camera
- LiPo Battery Pack
- Wireless ESP32
- Custom software stack for fast JPEG compression





## The Receiver Node

- Wireless ESP32
   Access Point
- QSPI Interface to Open Source FPGA
- FPGA Accelerated JPEG Decoding
- Portable Monitor to display video streams



# **Testing & Verification**

- Run Length: ensure camera nodes can run for 24 hours on battery
- Wireless Streaming: measure transmitted and received frame counts
- **Display Driving:** ensure monitor detects stable and clear HDMI input
- Performance: measure throughput of compression and decompression
- Scalability: ensure above tests pass with at least 6 camera nodes

## **Division of Labor**

- Camera Node Michael Lang
- Receiver Node ESP32 Neelansh Kaabra
- Receiver Node FPGA Varun Rajesh
- Testing and Verification All
- Deliverables All

TASK TITLE	START DATE	DUE DATE	DURATION	% OF TASK COMPLETE	WK3	JAN WK4	JAN WK5	WK1	WK2	WK3	WK4	WK1	WK3	WK1	WK2	WK3	WK4
Deliverables				33%													
Abstract	1/17/24	1/24/24	7	100%													
Website Initial Setup	1/30/24	2/3/24	3	100%													
Project Proposal Slides	1/29/24	2/4/24	5	100%													
Project Proposal Presentation	2/5/24	2/7/24	2	100%	1				10								
Design Presentation Slides	2/8/24	2/18/24	10	0%													
Design Presentation	2/19/24	2/21/24	2	0%													
Design Document	2/22/24	3/1/24	9	0%													
Ethics Assignment	3/11/24	3/13/24	2	0%									4				
Interim Demo	3/14/24	4/3/24	19	0%													
Final Presentation Slides	4/4/24	4/21/24	17	0%													
Final Presentation	4/22/24	4/24/24	2	0%													
End of Semester Deliverables	TBD	TBD	TBD	0%													
Remote Camera Node	2/5/24	4/22/24	77	0%													
Buy and Reseach Hardware	2/5/24	2/9/24	4	0%													
Tool Chain Setup	2/10/24	2/16/24	6	0%													
Write JPEG Encoder	2/17/24	2/23/24	6	0%					-								
Finish Camera Driver	3/11/24	3/18/24	7	0%													
ESP Wi-Fi setup - TX	3/19/24	3/26/24	7	0%								1					
Slack	3/27/24	4/22/24	25	0%													
Receiver Node - ESP32	2/5/24	4/22/24	77	0%													
Buy and Reseach Hardware	2/5/24	2/9/24	4	0%													
Tool Chain Setup	2/10/24	2/16/24	6	0%													
ESP Wi-Fi setup - RX	2/17/24	2/23/24	6	0%													
Write JPEG Buffer	3/11/24	3/18/24	7	0%									///				
Quad SPI Controller	3/19/24	3/26/24	7	0%													
Slack	3/27/24	4/22/24	25	0%													
Receiver Node - FPGA	2/5/24	4/22/24	77	0%													
Tool Chain Setup	2/5/24	2/9/24	4	0%													
Quad SPI Peripheral	2/10/24	2/16/24	6	0%													
JPEG Decoder	2/17/24	2/23/24	6	0%													
DRAM Controller	2/24/24	3/1/24	7	0%													
HDMI Driver	3/9/24	3/15/24	6	0%													
IP Integration - Write	3/16/24	3/22/24	6	0%													
IP Integration - Read	3/23/24	3/29/24	6	0%													
IP Integration - Full	3/30/24	4/5/24	5	0%													
Slack	4/6/24	4/22/24	16	0%													
Testing and Integration	2/23/24	4/25/24	62	0%													
JPEG Encode and Decoder test	2/23/24	3/1/24	8	0%													
Intergration with Central ESP	3/25/24	4/1/24	6	0%													
	4/1/24	4/1/24	7	0%	-												
Stability testing Testing with multiple podes	4/1/24	4/8/24	7	0%													
Testing with multiple nodes	4/8/24	4/15/24	10	0%	-												
Slack	4/15/24	4/25/24	10	U%													

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## Conclusion

- Proposed a portable security system
- Cost effective and easy-to-setup
- Includes features not commercially available
- An extensible platform for future development