

UCF SENIOR DESIGN 1
Divide and Conquer

Smart Surveillance Hub



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Initial Project Document and Group Identification

Divide and Conquer

Group 15

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1. Introduction

Project Narrative

Privacy and security are a standard in today's society, and the ability to keep yourself and your family safe should be accessible and affordable. According to the FBI's Uniform Crime Reporting (UCR) Program, the number of burglaries has decreased 48.5 percent from 2010 to 2019. We believe the decrease in burglaries is directly related to the increase in IoT devices. With such an increase in IoT devices, there's been a vast growth in the number of cost-effective ways to secure your home. A visible camera displayed in the open will most likely scare off a burglar who realizes they are being recorded.

Security companies tend to fully integrate homes with alarms and sensors, building a very complex system. Also, these types of systems usually won't alert you until an intruder has broken into your home and set off the alarm. By the time an intruder has entered the home, it might be too late to respond accordingly. If you were alerted before the burglar entered your home, you might have time to call the police, hide somewhere, possibly scare the intruder off, or even get ready to defend yourself accordingly.

It used to be nearly impossible to have your home secured without spending a massive amount of money on unwanted features. Nowadays, having a security company install a fully-integrated system comes with an extremely high cost, and it usually includes a contract that consists of installation fees and continuous subscriptions. For example, ADT has a similar product with more features, but it also has an extensive contract and installation fee. The system they provide doesn't allow you to use your own personal IP camera, so you have to spend extra money on their marked-up cameras. If you aren't interested in extra features that don't fit your needs or you don't want to be locked into a contract, you really just need an IP camera to solve your problem.

Objective

Security Smart Hub's primary focus is to provide a high-quality, affordable, and flexible product. It will be connected through wifi to a hub that streams real-time video that you'll have access to through a clear unpixelated LCD display. Whenever the IP camera detects any human presence on your property, you will be alerted through the LCD display that's attached to the hub. The hub and display will be located inside your

home, and the IP camera will send the video to the central hub to be processed. We will use facial recognition to determine if somebody is on or around your property. The different types of cameras that can be configured for use will be incredibly flexible. It will be configurable to run on the smart hub as long as it's an IP camera. This is extremely useful if you want to replace your active camera with another one due to malfunction or you simply want to upgrade to a higher quality IP camera.

Many IP cameras today only come with an app and no onsite video viewing method, meaning that if someone is not staring directly at their phone as a burglar attempts to break into their home then they will have no knowledge. With the smart hub the home owner will be notified the moment anyone comes into view of their camera via a led flashing as well as a loud noise coming from the hub. The owner can then view the hub and understand the situation. Another feature of this device is onsite storage as well, another issue with the IP cameras such as Ring, is they do not offer continuous recording storage. They offer cloud storage but it comes at a monthly subscription cost. With the Smart Hub they will be able to have their data stored onsite and be able to cycle through a month of recording to make sure no matter what happens they know their home will be protected.

By utilizing low-cost yet effective IoT devices, we will provide an affordable way of keeping a close eye on your property. Since fully integrated security systems are so expensive, we plan to save you money, whether you're a lower-class, middle-class, or upper-class individual. Surveillance Smart Hub is perfect for you if you'd like to have live footage of your property sent to you in real-time. Our product will be affordable, flexible, and simple yet very effective.

2. Constraints

For now the main constraint for this project is going to be price. In order to develop a smart hub that is cheap and affordable it would be more beneficial to design and manufacture our own touch screen led screen. Since time is an issue and there are many other aspects of the project we are designing, we decided to buy a touch screen that currently works. If this project were to be marketed a cheaper touch screen led would have to be found in order to reduce the price as much as possible and make it as marketable as possible.

Another constraint is the need to figure out how every single camera works and creating a universal hub that works for every camera. Each camera has its own design and might not be universal to what we are creating. This is especially true since our target micro controller we will use is an 8GB Raspberry Pi4 B model. More software may need to be developed in order to become a universal hub for any camera.

Time can also come into play when developing this project, the hardware design and prototyping is going to take a bit of time and that is going to be needed to test the software. Many parts of this project need to be built in different pieces tested and combined after all have been tested.

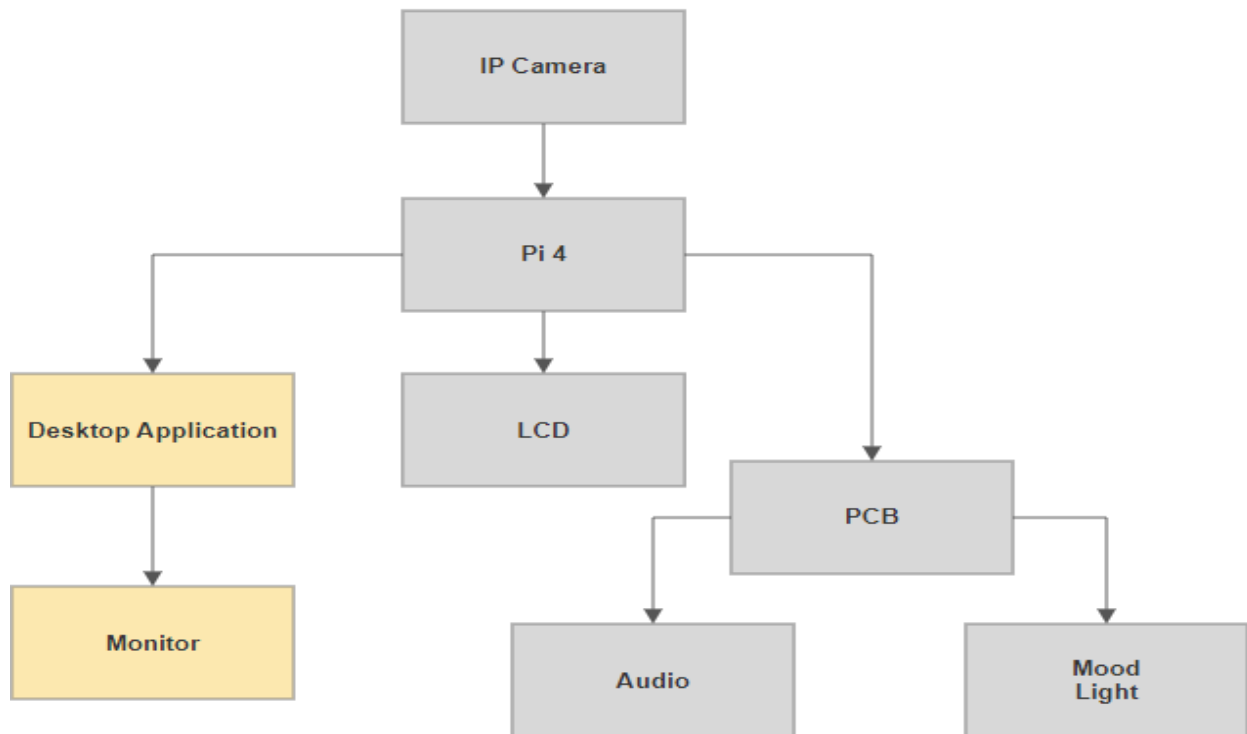
3. Specifications

Specification Number	Specification Description
1	Users will have access to a Desktop and/or Mobile application to interact and view the data sent by the IP camera.
2	Smart hub's desktop application will be able to interface with any generic IP camera within the same network.
3	An IP camera will send a continuous video feed (24/7) to the smart hub.
4	A micro-controller that is able to run the desktop application that will act as a "hub". It will utilize A.I. to detect different objects and that information will be relayed to the notification PCB.
5	The smart hub must be able to connect and display to a monitor using HDMI to display the desktop application.
6	The camera and the smart hub will be able to communicate with each other over a Wi-Fi network.
7	Parent desktop application will be able to display the live streamed video feed on a monitor that will connect via HDMI. This application will also save recorded video feed onto a storage device.
8	A PCB that will receive data from the hub and notify the user with audio on the object the IP camera detects. This PCB will also change the mood light depending on the level of security concern.
9	LCD that will be configured to the 3d printed case that will be able to run the desktop application as an alternative to using a monitor.
10	Lighting that will utilize the results of the A.I. detection to act as a security threat 'mood light'. Depending on the level of security threat, the light will switch colors. (Red = threat, Yellow = warning, Blue = no threat)

4. Block Diagram

This hardware diagram illustrates the connections between subsystems that form the single product. The IP camera will be the the main collector for audio and Video, this data will then be transmitted over a wifi network, and communicated to a Raspberry Pi 4 microcontroller. The microcontroller will then connect to an LCD screen and PCB board of our design. The PCB board will serve as a RGB controller and sound board for when a person is detected or when the camera is benign controlled. There will also be additional ports to connect our hub to external devices such as monitors for viewing purposes.

Hardware Block Diagram:



Responsibilities

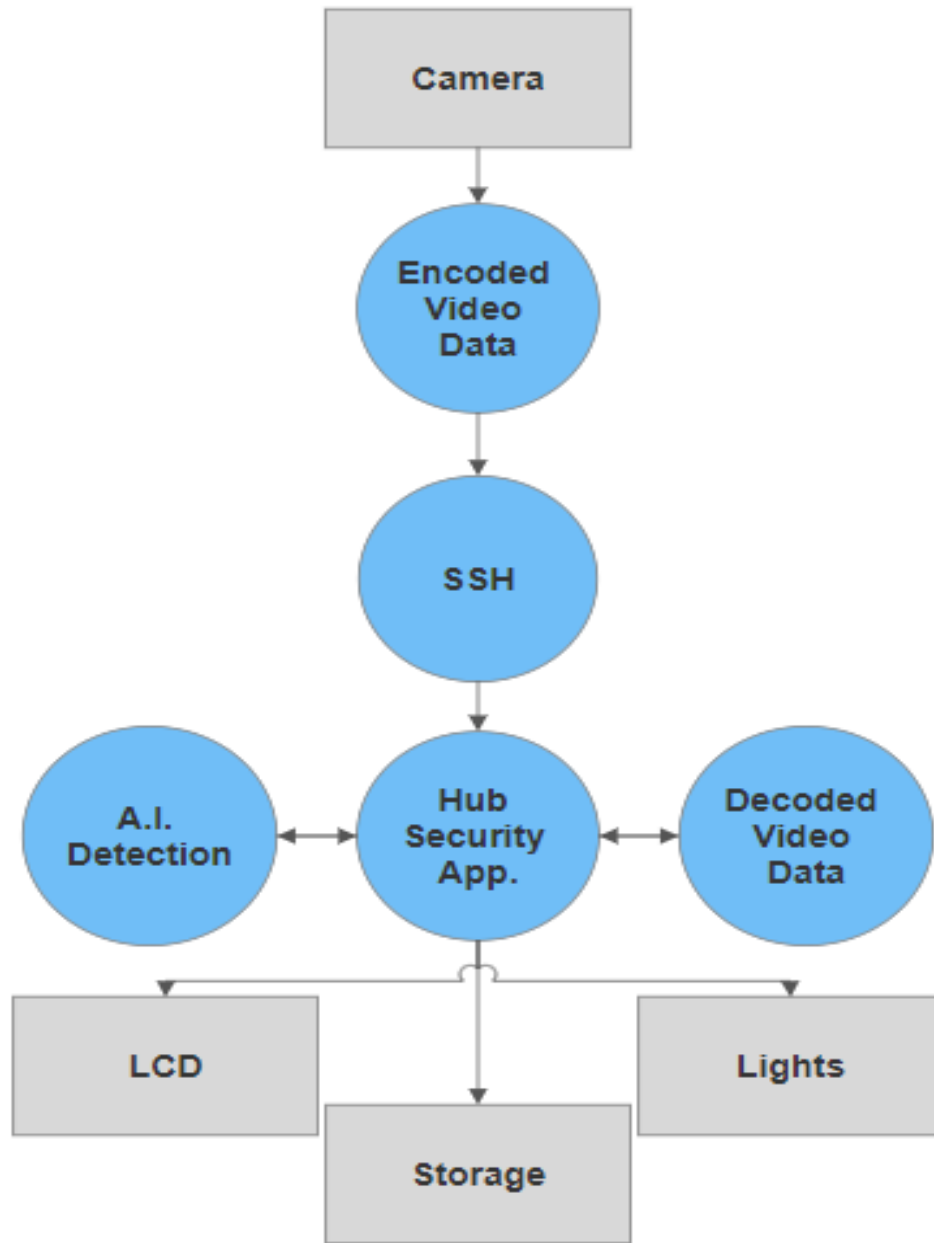
Electrical Component	Joshua & Kenneth
Software Component	Matt & Korey
Other	Everyone

Other Parts

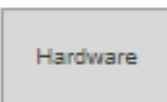
Custom 3d Printed Case

Block Status:

All blocks are currently being *researched* for the most economically efficient parts.



Key:



5. Project budget and financing

For the financing of this project everything will come out of pocket by the group members. These parts are items that *could* be used, but are subject to change. We are currently researching the most economically efficient parts for their respective capabilities in our block diagram, so the price is most likely to change.

Item	Price	Quantity
Resistors, Capacitors, Other small electrical components kit	TBA	1
LED capacitive touch screen	\$140.00	1
IP camera	\$39.99 - \$60.00	1
LEDs	TBA	1
Raspberry Pi 4 8gb Model B	\$75	1
Mini HDMI to HDMI converter	\$5.99	1
USB Type-C	\$9.99	1
3d printed case	TBA	1
Total	\$435.60 - \$470.60	

6. Milestone

Number	Task	Start	End
1	Think tank - Ideas	01-17	01-24
2	Narrow down options, design parameters and select a project.	01-24	01-13
3	Initial Document - Device and Conquer	01-31	02-03
4	DC1	02-04	
5	Review and discuss our project with Lei Wei	02-07	
6	Investigate IP protocol networking	02-07	02-10
7	Obtain an off-shelf generic IP camera	02-10	02-14
8	60 page Senior Design draft	02-14	03-25
9	Explore options for software development	02-17	02-24
10	Determine and choose final parts for PCB	02-24	02-30
11	Assignment of standards	02-28	03-11
12	Test and configure software compatibility between the Pi4 and the IP camera.	03-01	03-10
13	Design the PCB and have it made	03-10	03-21
14	Acquire additional finalized parts	03-10	03-27
15	100 page Senior Design report	03-28	04-08
	SENIOR DESIGN 2		
16	Test software to hardware configuration	04-09	04-30
17	Develop software for the Smart Notifier	05-01	05-10
18	Develop software for the Hub application	05-11	05-30
19	Design a 3d printed case	06-01	06-10
20	Print the case	06-11	06-15
21	Stress test the finalized product before final assembly	06-16	06-20
22	Assemble the Smart Hub	06-20	06-22

7. **Stretch Goals**

- Cloud storage capability

Storing data that was recorded from the cameras in the hub and transferring all the recordings to the cloud would be a great addition to the system and allow for a greater product. Time is the main constraint when dealing with this task.
- Mobile application

Developing a mobile application that will be able to stream current camera footage. Also being able to see the recordings on the cloud storage. This would be able to access outside of the local network of the IP camera and hub.
- Backup battery

A backup battery in the hub would allow the hub to be more mobile for the customer to carry around and still be able to have access from a non-stationary location.
- Developing our own IP camera

Creating our own IP camera with off the shelf devices is the ultimate stretch goal. It would allow the product to become a complete system with recording and storing as well as smart notification services. Time and complexity of this task is what makes this a stretch goal. If the hub is completed in a timely manner then this will be the first thing we try to develop.
- Adding increased functionality to control other types of IP Cameras

Cameras like PTZ cameras come with extra features to pan tilt and control zoom. Allow access to these features through our hub would give the user more control over how they would like to use their device.
- Ability to cast received data

As a higher level feature we would also like to include the ability to cast data received from the camera to give users the option to see video without a hardwired cable connected to their display.

8. Resources

[1] Federal Bureau of Investigation. (2019). *2019 Crime in the United States: Burglary*.
<https://ucr.fbi.gov/crime-in-the-u.s/2019/crime-in-the-u.s.-2019/topic-pages/burglary>

[2] ADT. (2022). *Is a Wireless Security Camera Worth the Cost?*.
<https://www.adt.com/resources/wireless-security-cameras-cost>

[3] Raspberry Pi 4 Specification, Schematic, Diagrams
<https://www.raspberrypi.com/products/raspberry-pi-4-model-b/specifications/>

[4]<https://lucasteske.medium.com/reverse-engineering-cheap-chinese-vrcam-protocol-515c37a9c954>

Displays considered

[5]https://www.amazon.com/SunFounder-Raspberry-Touchscreen-1024%C3%97600-Capacitive/dp/B07Y889J3X/ref=sr_1_1_sspa?crid=1GCWRIR1GYHGO&keywords=touch+screen+lcd&qid=1643949017&sprefix=touchscreen+lcd%2Caps%2C170&sr=8-1-spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUEzTzNGNUpSRDVPQUwmZW5jcnlwdGVkSWQ9QTAzMjQ4MzczUFhMTzdLSVQ0OTIKJmVuY3J5cHRIZEFkSWQ9QTA1Nzc0MDcyRDhCMIZZOUJVOFREJndpZGldE5hbWU9c3BfYXRmJmFjdGlvbj1jbGlja1JIZGlyZWNOJmRvTm90TG9nQ2xpY2s9dHJ1ZQ==

[6]https://www.amazon.com/dp/B01J51CXU4?axitk=b9e084d794b47684d8c57912dc75bb6c&pd_rd_w=rdGLv&pf_rd_p=81374be5-e348-4c15-938f-a311a861c514&pf_rd_r=SCWKQN14V60DNC4J6PB4&pd_rd_r=cc3846ad-842f-4569-9b98-a7740adcc87b&pd_rd_wg=oOgte&ref=dacx_dp_4281262610001_594034300449770011

Camera considered

[7]https://www.amazon.com/Amcrest-5-Megapixel-NightVision-Weatherproof-IP5M-T1179EW-28MM/dp/B083G9KT4C/ref=sr_1_1_sspa?crid=36SJVIR898Y67&keywords=ip+cameras&qid=1643951080&sprefix=ip+cameras%2Caps%2C135&sr=8-1-spons&psc=1&smid=AM1AKWRN957PC&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUFDTDNEN0g0OUtCSTUmZW5jcnlwdGVkSWQ9QTA3MzgyNTVUMU1VRDkwVUM5RIUmZW5jcnlwdGVkQWRJZD1BMDAxMzIxOTJYWU1CWVlZTjlGRTAmd2lkZ2V0TmFtZT1zcF9hdGYmYWNOaW9uPWNsaWNrUmVkaXJlY3QmZG9Ob3Rmb2dDbGljaz10cnVl

[8]https://www.amazon.com/Wireless-Security-Wansview-Detection-Compatible/dp/B07QKXM2D3/ref=sr_1_5?crid=2XWKJ037NQ2P8&keywords=ip+camera&qid=1643951179&s=electronics&sprefix=ip+camera%2Celectronics%2C131&sr=1-5