

CySER - Carnivore A

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Background

The Air Force has identified cyber security as a primary concern to national security. Cyber warfare is constantly evolving and there is a lack of new officers coming into the Air Force with a cyber security foundation. The CySER program wants cadets to understand and be able to encrypt live video data as it would be done by a real drone the Air Force uses.

Requirements

- The weight does not exceed the payload of the drone of <800g.
- The budget remains less than \$1000 but with a goal of \$500.
- Fit within a 200mm x 200mm x 200mm volume.
- The camera can rotate with a range of 0-90 degrees.



Design Process

Throughout our design and manufacturing process, we encountered some issues:

- Wi-Fi Direct was not available on the Raspberry Pi 4 Model B.
- Internet connection created a larger latency.
- The encrypting and decrypting process was initially only done on one device.

Camera Controls

The camera has two views: forward and down. This satisfies the predefined requirement of a 0-90 degree range for the camera. It also creates a more user friendly code by allowing the desired view to be chosen rather than the specific angle value.

Manufacturing

The manufacturing plan was to focus on purchasing widely available parts that only required minor modifications to keep the overall cost down and manufacturing time as low as possible.

Connection

The Raspberry Pi and laptop are connected through a shared Wi-Fi network and Secure Shell Protocol (SSH). This requires knowledge of the Pi's IP address as well as the SSH password to connect.

Encryption & Data Transfer

The process of encryption and data transfer is shown in Figure 1. The video data is collected and encrypted on the Raspberry Pi. The Pi transmits the data over a Wi-Fi network to the laptop, where it is decrypted and displayed. The level of encryption may be adjusted based on download speeds.

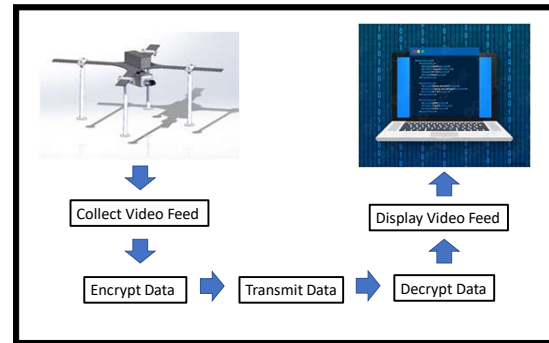


Figure 1. The process of encryption and data transfer

Test Results

With each level of encryption, there will be a difference in latency times do to each option requiring more or less processing power. In order to determine the effects of the change in encryption level, a stop watch was placed in front of the camera and an additional camera was placed to see both the stopwatch and video output on the server, then the difference was calculated as being the latency. The average of ten tests for each are below.

| Encryption | Latency (ms) |
|------------|--------------|
| None | 430 |
| DES | 610 |
| 3DES | 640 |
| AES-128 | 870 |
| AES-196 | 600 |
| AES-256 | 510 |

| Final Specifications | |
|--------------------------|--------------|
| Weight | 717 g |
| Cost | \$268 |
| Size | 156x82x89 mm |
| Angle of Camera Rotation | 0-90 deg |
| Latency | 510-890 ms |

Figure 3. The specifications of the final product.

Figure 2. The measured latency of each encryption.

Findings

The system successfully transmitted encrypted live video feed wirelessly. However, the connection was dependent on an Internet connected Wi-Fi network. This caused the latency of transmission to exceed the latency goal of 300 ms defined by the requirements.

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