# Project Description

With the rapid expansion of the internet of things and an increasing number of devices that require access to a centralized network, processing power is coming into short supply. To remedy this, devices that utilize edge computing are increasingly important. Unlike the traditional approach, edge computing reduces the bandwidth requirement between the sensor and the central computer (known as the command center).

This design effort aims to demonstrate video analytics with edge computing techniques. “The Edge” defines effective video analytic methods, such as machine-learning based object detection, performed in the proximity of the optical instrument.

In this project, we specifically wish to utilize the Jetson Nano as an edge device for the purpose of detecting anomalies. The detection of anomalies is a very broad and generalized topic, that could be utilized in many fields and applications. In this project, we have elected to utilize the detection of anomalies in the context of a security system. To accomplish this several procedures will need to be implemented on the Jetson Nano, including but not limited to: Object Detection, Object Recognition, Recording, and Motion Tracking.

Utilizing an external camera, the Jetson Nano will be required to recognize no less than 20 common objects. When the Jetson Nano cannot successfully recognize one of these objects it will be classified as an anomaly. This anomalous item will be either photographed or video recorded for one minute. Furthermore, as audio/visual alarm will be activated to alert a user that an anomaly has been detected. This recording will be saved to a removable storage device. If object moves, the Jetson Nano will control a camera gimbal to track the object. At all times, any object detected by the Jetson Nano will be recorded to a text/csv file. It is important to remember that this system is autonomous and will not need the input of an operator at any time.

# Technical Design

Specifically, this project is utilizing the Nvidia Jetson Nano as an edge device for the purpose of the detection of anomalies in the context of a surveillance system. The Jetson Nano is equipped with 128 CUDA cores, which supply it with its computing power.

The project will generally operate autonomously to provide insights into anomalous objects or motions of interest.  Instead of transporting raw or compressed data of the captured video signal, the prototype will compute and process these signals to then deliver a set of pre-defined parameters of interest to the command center, where the decision process will ultimately take place.

A user interface will allow users to customize the system so that desired anomalous threshold will be detected as well as giving the users some control and monitoring of the data. This effort will benchmark the differences between video analytics at the edge compared to a traditional surveillance system.

Diagram

Description automatically generated

# Bill of Materials and Cost Estimation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| # | Component Name | Short description | QTY. | Cost |
| 1 | Jetson Nano Dev Kit | NVIDIA Jetson Nano Developer Kit-B01 | 1 | $149.00 |
| 3 | PI cam | Raspberry Pi Camera Module V2 | 1 | $29.95 |
| 4 | HDMI Monitor | Full HD (1920 x 1080) HDMI monitor | 1 | $99.99 |
| 5 | HDMI Cable | HDMI Cable (6 ft) | 1 | $6.50 |
| 6 | USB Cable | USB 3.0 Male to Male Type A (1.5 ft) | 1 | $6.99 |
| 7 | USB Keyboard | Basic USB Keyboard | 1 | $10.77 |
| 8 | USB Mouse | Basic USB Mouse | 1 | $5.99 |
| 10 | 5V/4A Power Supply | Power Supply for Jetson Nano | 1 | $12.99 |
| 11 | 128gb MicroSD | SanDisk 128GB Ultra microSD | 2 | $35.30 |
| 12 | Jetson Nano Wireless Internet Adapter | Jetson Nano WiFi Adapter Dual Band Wireless USB 3.0 | 1 | $18.99 |
| 13 | Jumper Wires | Jumper Wires | 120 | $6.98 |
| 14 | Servo Motors |  | 1 | $ 15.95 |
| Subtotal | | | | $399.40 |
| Est. Tax | | | | $ 27.96 |
| **Total** | | | | **$ 427.36** |

# Schedule and Plan

## Important Upcoming Deadlines

|  |  |  |
| --- | --- | --- |
| # | Goal | Deadline |
| 1 | Basic Object Recognition and Recording | 3/6/2023 |
| 2 | Audio Visual Alarm | 3/13/2023 |
| 3 | Camera Tracking | 3/27/2023 |
| 4 | Complete Object Recognition | 4/3/2023 |
| 5 | Final Design | 4/10/2023 |
| 6 | Completion of Testing | 4/17/2023 |
| 7 | Presentation | TBD |

## Past Schedule

# Risk Assessment

## Risk 1 – Computer Processing Power

A risk of this project is failure to implement the Jetson’s full processing power. Despite having 128 CUDA cores, setting up the Jetson Nano for utilizing all these cores is difficult process.

### Solution

A good deal of care and precision must be implemented in the code to ensure that the Jetson Nano is utilized to its full capacity. This can be easily be checked in the Jetson Nano Terminal through installed tools.

## Risk 2 – Computer Memory

A final risk to consider is the possibility that a computer will not have the memory space required to perform video analytics.

### Solution

This problem can easily be overcome by incorporating extended memory into the computer, or even using external memory devices (such as an SD card or extremal hard drive).

## Risk 3 – Obsolescence

Another challenge to this project is the obsolescence of the software that is running on the Jetson Nano. The Jetson Nano architecture is based upon the Ubuntu 18.04 operating system. This operating system was released in 2018, and is currently estimated to reach the end of its support in 2028. With the passage of time, it is typical for software to become increasingly powerful, this comes at the cost of no longer being compatible with older software, particularly operating systems.

### Solution

For the longevity of this project, in may prove to be beneficial to customize the Ubuntu Operating System. This is common practice in the Linux community and is known as custom building.