UC-51

Difference Detection

Automated Defect Detection System for Modernized Display Units

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Abstract Introduction

The 402 Software Engineering Group at Robins Air Force Base sought an automated method for detecting defects in modernized display units. This project developed an application that syncs two video feeds, identifies differences lasting longer than 5 seconds, and logs them with timestamps and durations, reducing manual effort and ensuring pilot safety

Introduction

Defects in military software can lead to costly damage and loss of life. The 402 SWEG needed an efficient way to detect issues in modernized pilot display units to minimize risk and free up developer resources for design and development.

Method(s)

- Synced video feeds using OpenCV
- Detected differences with pixel-wise comparisons and thresholding
- Filtered out insignificant differences using contour area
- Logged differences with timestamps and durations
- Developed in Python, leveraging OpenCV, NumPy, and Tkinter

Algorithms(s)

- Frame Difference *(cv2.absdiff)* - calculates the absolute difference between two corresponding pixel values of two grayscale frames. Highlights areas where pixel values differ past a threshold that we set.

- Thresholding *(cv2.threshold)* - After obtaining the pixel wise difference with absolute difference, a binary thresholding operation is applied. Pixels above a certain threshold are set to white, and pixels below the threshold are set to black.

-Contour Detection *(cv2.findContours)* - contours in the binary difference image are then found. These contours are filtered to remove small, insignificant differences.

- Bounding Rectangle *(cv2.boundingRect)* - bounding rectangles are drawn around the detected contours

- Visualization *(cv2.imshow)* - displays the annotated frames as well as the binary difference image.

Company

Robins Air Force Base, located in Warner Robins, Georgia, is a pivotal installation within the United States Air Force. It serves as the home of Warner Robins Air Logistics Complex, which is one of the largest centers for air logistics and maintenance within the Air Force. This complex is critical for the overhaul, repair, and modification of a variety of aircraft and aerospace vehicles, including some of the most sophisticated in the Air Force's inventory like the C-5 Galaxy, F-15, and C-130 Hercules.

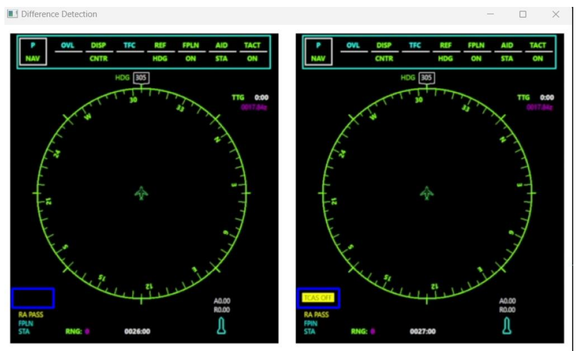
Apart from its logistics and maintenance role, Robins Air Force Base also hosts the Air Force Reserve Command headquarters, providing strategic oversight and support to the reserve components. Additionally, it supports the 78th Air Base Wing, which ensures the base's operational readiness and provides essential services for the welfare and morale of military personnel and their families residing there. The base plays a strategic role in both national defense and regional economic stability.

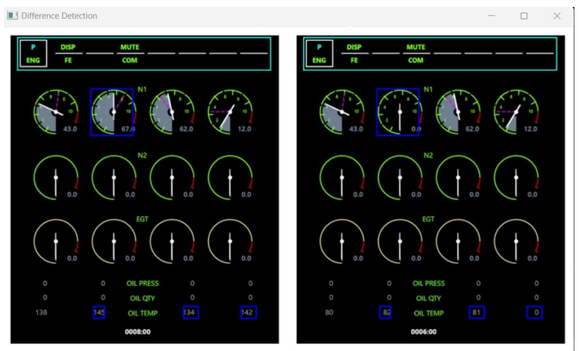
Introduction

Our job for this project was to create an application capable of discerning variances between two video feeds. Key tasks include synchronizing feeds for frame comparison, annotating disparities with bounding boxes, and identifying deviations lasting over 5 seconds. The role entails establishing confidence threshold parameters to minimize false positives, considering factors like pixel coloring and refresh rates. Additionally, we were responsible for logging identified differences with timestamps and durations.

Results

Our team was able to successfully implement and test several difference detection algorithms, with these algorithms yielding similar results in regards to efficiency and accuracy. The program runs as expected and contains each requirement as requested by the client. The program also offers adaptability for future additions and modifications, for example, while 3D Models were not required, it is something that would be necessary to integrate in the near future.





Acknowledgments

This program and its resources should be open to the public for reference, but the client, Robbins Air Force, reserves the rights to the program itself. However, the analysis techniques/algorithms used in the program, as well as basic UI structures, can be used to develop other video analysis programs. As stated before, this program can be adaptable, so its goal would be to analyze and differentiate bigger and more in-depth video feeds.

Conclusions

Overall, our team was able to successfully implement the task at hand, and build a Difference Detection program for the 402 SWEG at Robins Air Force base. This program will help reduce manual labor and time spent on video analysis. With technology advancing everyday, it is crucial for this technology to advance with society's needs as well. The program is still in the refinement and testing phase, and while not required, the ability to analyze 3D video feeds is also being prototyped.

Literature Cited

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