Spectrum Analyzer Analysis Tool

User Manual

Version 1.0

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Table of Contents

1. Introduction

This User Manual (UM) provides the information necessary for Analysts to effectively use the Spectrum Analyzer Analysis Tool(SAAT) to analyze recordings of *Radio Frequency (*RF) signal data recorded during test of electronic warfare(EW) threats.

1.1 Background

Engineers and analysts at the 402 SWEG Robbins AFB are responsible for verifying frequency and amplitude data from a video of a Spectrum Analyzer representing an Aircraft Electronic Warfare (EW) System Under Test (SUT). The test could be a calibration or a test of the EW response to threat systems.

1.2 Overview

The SAAT is designed to reduce the manual time and toil needed from an analyst or engineer to review spectrum analyzer videos containing RF signal frequency and amplitude data for EW threats. The automated analysis identifies frequency and amplitude data that exceeds observed thresholds as well as timeframe of the identified event. This is done by:

- *Utilizing a reference template image of the area on each frame that contains the graph and associated reference values, such as center frequency, db span, and*
- *Calculating values on screen based on the number of divisions and relative position of each datapoint*
- *Allowing the user to graphically:*
    - *specify the trace color on the spectrum analyzer used to capture signals and OCR data on screen*
    - *adjust the trace strength to be captured from each frame*
    - *change the naming convention visible on the spectrum analyzer of data to OCR*
    - *specify the number of divisions both vertically and horizontally to be used for scaling factors*
    - *display the processed results for visual identification of anamolies*

2. Getting Started

2.1 Installation and Set-up

Step by step installation instructions:

1. Burn zip file or contents onto a CD or DVD
2. Insert CD/DVD into tray and access on the computer
3. Copy the contents to the area you wish the system to run on
4. Run the tesseract-ocr installer tesseract-ocr-w64-setup-5.3.3.20231005.exe
5. You are now ready to run Spectrum Analyzer Tool.exe and process your Spectrum Analyzer video!!

2.2 Accessing the System

Simply return to the folder where you copied the contents of the CD/DVD and double click on Spectrum Analyzer Tool.exe

2.3 System Organization & Navigation

The system guides the user through the steps of the analysis process, according to the needs of the spectrum analyzer video processing needed. In the simplest flow, the user is processing a video for the same spectrum analyzer used in the past, where all the current preset configuration is reused. In that scenario, simply select the input video file location and output csv file location and execute the video processing.

2.4 Exiting the System

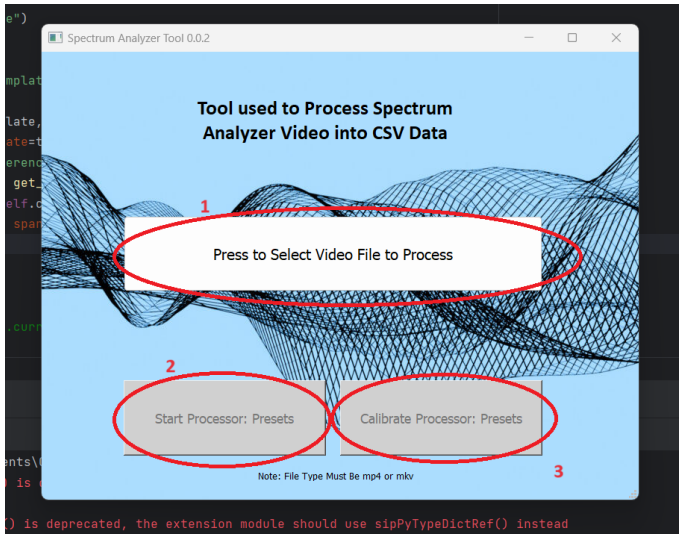
The system tray common to most windows applications contains an [X] in the upper right hand corner of the screen. simply depress this button to cancel the operation of the application.

3. Using the System

The following sub-sections provide detailed, step-by-step instructions on how to use the various functions or features of the SAAT.

3.1 Spectrum Analyzer Analysis Tool

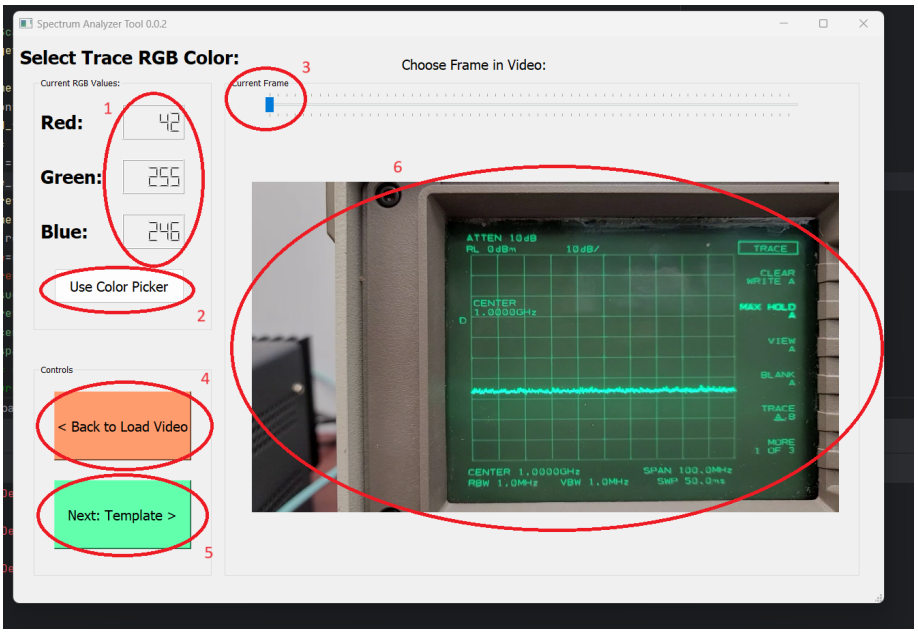
3.1.1 System Start



At system start the System Start window will pop up starting the process of configuring the system for execution. Three key points on the screen to understand, depending on the execution scenario you need:

1. You must locate and select the video for the system to process
2. If this video utilizes the same spectrum analyzer and video setup as the last run, you can bypass calibration steps and process the video faster
3. If calibration and configuration of the system is necessary proceed to the trace calibration screen

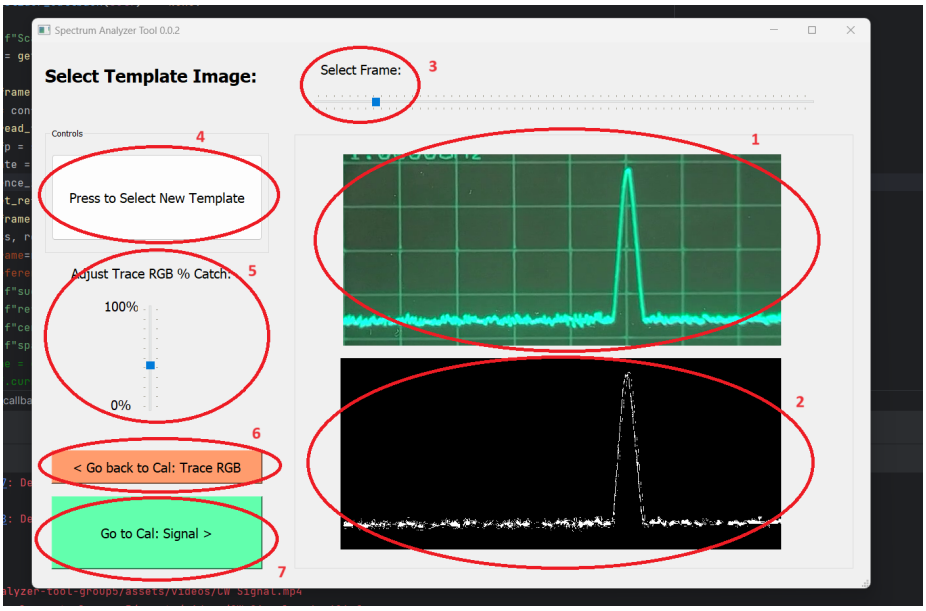
3.1.2 Trace Calibration



Following the selection of the video and determining the need to calibrate the RGB value of the data trace on screen to pull, the user selects the “Calibrate Processor: Presets(3)” on the start screen which immediately pulls the first frame of the video and displays to the user. The user will either input the required trace RGB color of the graph on the spectrum analyzer or use the color picker to pick the color from the screen. If the first frame is not a good representation you can adjust the picture to a frame where the image is of better quality. For reference, on the Trace Calibration screen you have the following selections:

1. RGB color manual entry – the value is represented for each component in the decimal range of 0-255. Values outside of this range will produce an error
2. Use the color picker option to easily select the trace color on screen rather than entering a discrete set of RGB values
3. Frame selection allows you to select another frame to select the trace color from a higher quality image
4. If the video selected is not correct, simply select to go back to the initial video selection screen
5. When the trace color selection is satisfactory, move to the template calibration
6. Frame image display

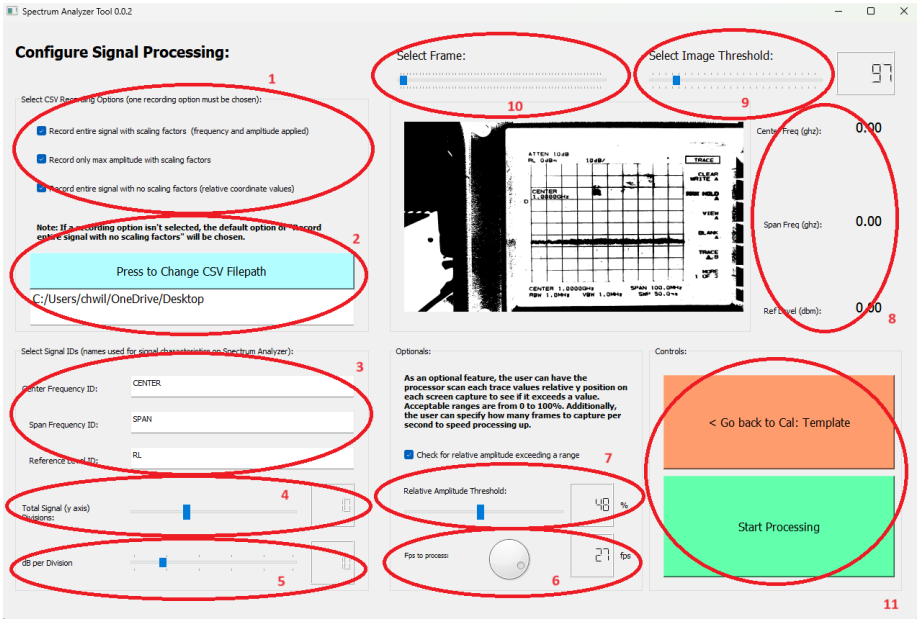
3.1.3 Template Calibration



The template configuration screen is used to select the masking image used to define the area within the video that OpenCV should process, excluding other visual artifacts that process as noise. A pre-trimmed image of the spectrum analyzer is used to mask the potential noise and the RGB %Catch slide is used to show you the resulting trace image that the tooling extracts based on that configuration. The frame slide can be used to adjust forward and back to validate the captured trace data is at the level of accuracy needed. The features on the window we use to accomplish this:

1. Current frame being reviewed and processed
2. Processed frame yielding the graph trace
3. Frame selection slide to adjust and review processing quality
4. Selection of a different cutout of the reference video to use to mask unneeded portions
5. Slider to adjust the sensitivity of the capture of RGB data on screen
6. If the RGB value selected is incorrect and resulting in a low quality of capture, go back to the last screen and update the selection
7. If the trace processing is acceptable, proceed to the signal calibration screen

3.1.4 Signal Configuration



Additional options are available to allow the user to customize the signal processing for speed, detail, or a balance of the two depending on the need of the analyst. Reviewing the options available, you may:

1. Choose between:
    a. relative positions and values of the graph data
    b. limiting to values based to max amplitude with scaling values
    c. apply OCR values to scaled data on each frame
2. Change the CSV extract location
3. Adjust the labels the OCR library will use to find data on screen
4. Set the number of divisions on the Y-axis
5. Set the number of divisions on the X-axis
6. Change the sampling from every frame to some fraction of the frames
7. Set the relative amplitude threshold
8. View the center frequency, span frequency, or ref db level captured on the frame shown
9. Adjust the image threshold for quality
10. Switch to another frame to review impact of settings
11. Choose to go back to the prior screen and adjust the values or start processing

4. Troubleshooting & Support

The full application, apart from the execution of the external Tesseract-OCR.exe, may be executed in debug mode to allow a developer to diagnose issues with the application. In addition, logging of the execution is available in the same location specified for the output csv.

4.1 Error Messages

Error messaging will display to screen and processing will halt for any errors encountered. More detailed information may be obtained in the log located in the same directory as the target csv extraction.

4.2 Development Environment Setup

In the event additional development, bug fixes, or functional additions are needed a development environment may be established via one of 2 methods:

4.2.1 Setup via Pycharm

In Pycharm, simply create a new project through pulling the project from git. Contained within the source repository is the Pycharm configuration file that identifies the relative paths and versions of all libraries and python versions. Simply follow the prompts to install the requisite libraries from the requirements.txt and python version configured for the project. You are then ready to make changes, as needed

***NOTE: additional steps required to make changes to the UI, see 4.2.3 for details

4.2.2 Manual Environment Setup

There are a number of steps to perform in order to manually configure your development environment:

- Python 3.11_64bit (recommended to utilize a virtual environment)
- Install requirements.txt from the root folder in this project directory

***NOTE: additional steps required to make changes to the UI, see 4.2.3 for details

4.2.3 UI Changes

For UI changes, activate virtual environment and/or IDE, and launch the designer with qt5-tools designer cmd from bash

- Open any .ui file, make changes, save, and rebuild the associated .py file with:
    - pyuic5 [ui_filename_here].ui -o [ui_filename_here].py

4.3 Building Executable

Once all changes are made:

- run the distribution.py file from this directory
- Executable and all artifacts will be created into dist/[current_version_and_app_name_here].zip

Commented [A1]: [Mention was removed] - what relative path should be here?

5. Appendix A: References

Source Code Repository:
https://github.com/chwillchwill/SWE7903-SpectrumAnalyzerTool-Team4.git