CARI Project

# Image Linkage Application: User Guide

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**This software is currently available for police use.** Contact csi@leedsbeckett.ac.uk for details on obtaining the Image Linkage Application.

**The CARI Project**

The CARI Project is a large-scale collaboration between West Yorkshire Police and the Cybercrime and Security Innovation Centre (CSI Centre) at Leeds Beckett University. The CARI Project aims to improve and incorporate an evidence-based approach into the policing of digital forensics and cybercrime investigations. An extensive needs assessment of UK policing and cybercrime and digital evidence was conducted to understand the current situation, and to identify needs across the force. The CARI Project also involved implementing a training and research programme that has impacted the capability of the digital forensics and cyber units within West Yorkshire Police to engage in research. This needs assessment and research training led to the development of a set of research proposals, which were scored and selected. Subsequently, academics and police staff co-produced 9 research and development workstreams: a framework for seizure, preservation and preservation of cloud evidence; automated forensic analysis; image linkage for victim identification and framework for image fingerprint management; automated grooming detection; frontline officer awareness development and decision support mobile app; assessment of methods of cyber training; an evaluation of the role of the Digital Media Investigator within WYP; and characteristics of victims of cybercrime. Each of these projects were designed to address needs within law enforcement and outputs include evidence-based procedures, new capabilities such as software/algorithms, and actionable intelligence.

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LEEDS BECKETT UNIVERSITY

WEST YORKSHIRE POLICE

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## User Manual for Image Linkage Application

The Image Linkage application is a product from the partnership between Leeds Beckett University and West Yorkshire Police. The app enables users to extract the sensor fingerprints of imaging devices (e.g. digital cameras or mobile phones with cameras) using test reference pictures that were captured from the imaging device. These camera fingerprints are automatically stored in the default location. Users can load pictures to match against the stored camera fingerprints and obtain results that can be exported as a spreadsheet and stored in the default location. Note that the results obtained from the application can be used for intelligence purposes to aid investigations.

The following subsections describe how to operate the Image Linkage App by creating, selecting SPN (Sensor Pattern Noise) camera fingerprints and matching pictures to the camera fingerprints. The process flow is shown in Appendix A, where the steps for adding a new camera fingerprint and matching pictures to the camera fingerprint are displayed. The output of the matching process is a table in the app and a spreadsheet report can be generated to export the results. Figure 1 shows the Image Linkage application when it is launched.

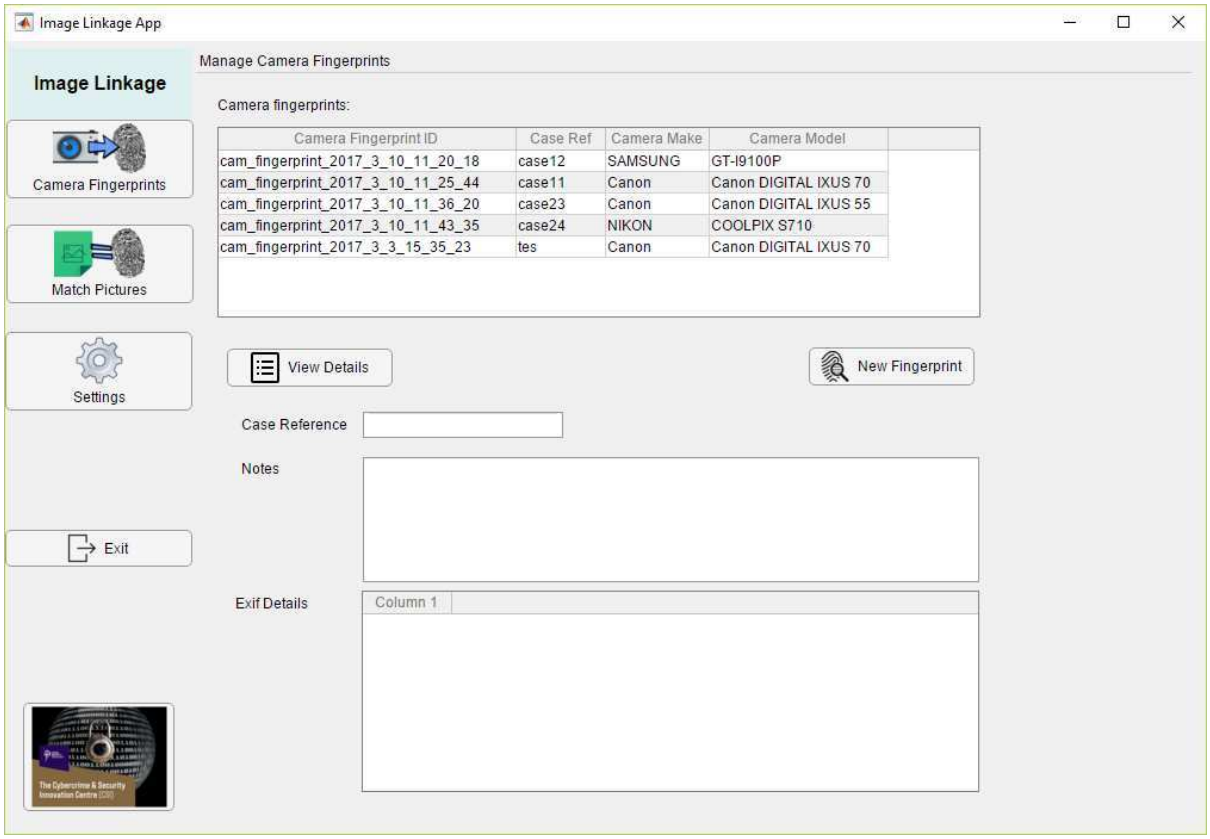



Figure 1: Opening page of Image Linkage Application

The menu for the app is on the left and allows the user to select the following features of the app:

- Manage camera fingerprints
- Match pictures to camera fingerprints
- View settings page
- Exit the app

## Manage Camera Fingerprints

The management of the camera sensor fingerprints, shown in Figure 2, is performed by adding new fingerprints or viewing the details of the camera fingerprints. The camera fingerprints table displays the list of camera fingerprints ID along with the case reference, camera make and model.

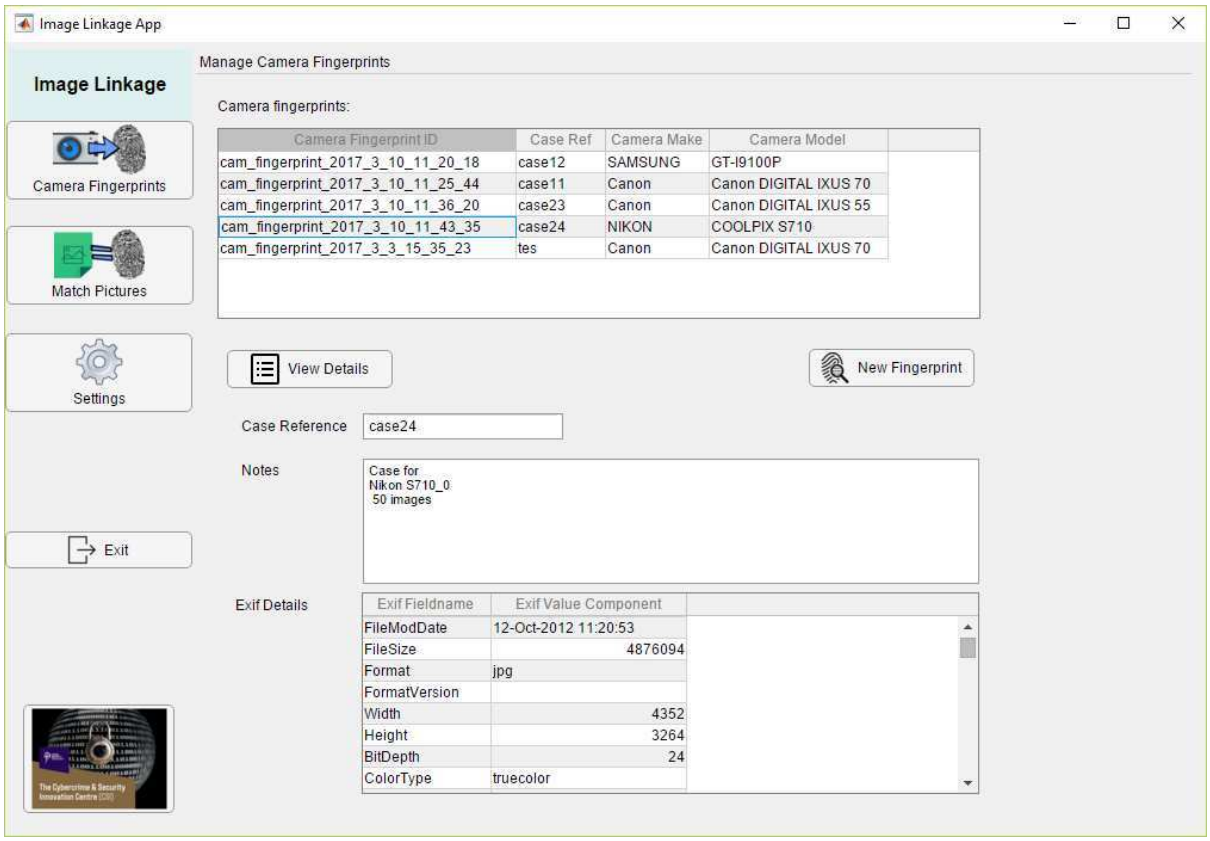



Figure 2: View details of camera fingerprint

The user can view the details associated with a particular camera fingerprint by either clicking on the *'View Details'* button or selecting a cell in the camera fingerprints table. The case reference and any notes added when creating the camera fingerprint are displayed as well as the EXIF details (metadata) associated with the test pictures.

Clicking on the '*New Fingerprint*' button, shown in Figure 3, will display the fields to allow the user to generate a new SPN camera fingerprint. The user can select the test pictures folder, where the test reference pictures for the camera are stored. The reference ID related to the case can be inserted in the *'Case Reference'* text box. Any notes that the user wants to collate to the camera fingerprint can be added in the '*Notes*' text box. Examples of notes can be Exhibit number or details related to the case and camera. Click on the '*Generate Fingerprint*' button to create the camera fingerprint. Each camera fingerprint is given a unique ID by using the time stamp when they were created. When the camera fingerprint is created, it will be saved in the default folder and added to the camera fingerprints table in the user interface. Note that all the test pictures are cropped to 512 x 512 pixels in this prototype version of the application.

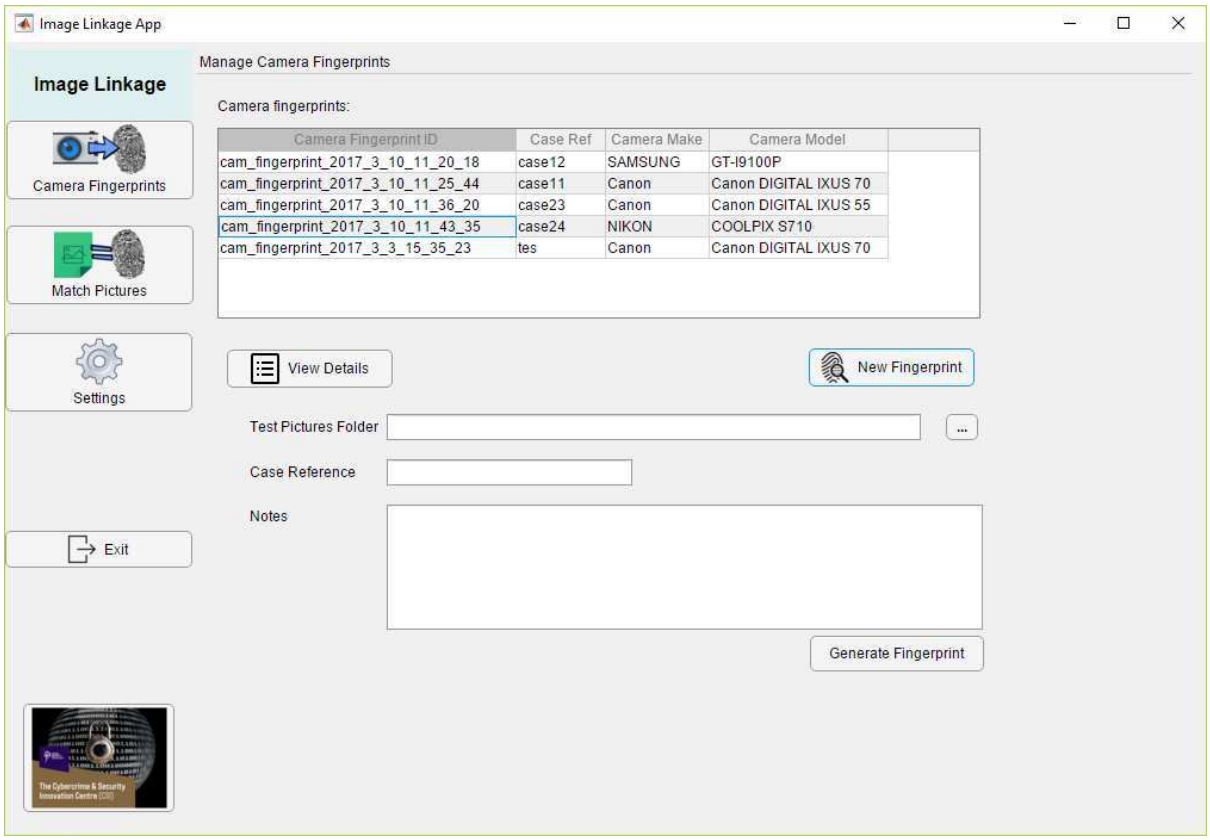



Figure 3: Generate new camera fingerprint

## Match Pictures

The user can match digital pictures against the camera fingerprints listed in the table, which has an added column on the left, displayed in Figure 4, for selecting the required camera fingerprints for the matching process. All the rows of the table are selected as default and there is a (de)select all button under the '*Select*' column in the camera fingerprints table. The user can also (de)select individual camera fingerprints by checking or unchecking the row in the '*Select*' column.

After selecting the camera fingerprints, click on the '*Match Pictures*' button to open the load pictures dialog for the source identification process. A progress bar box is displayed while the matching is performed between the pictures loaded and all the camera fingerprints selected and the results are displayed in the results table.

The results table displays the filename of the picture loaded in the first column and the outcome of the matching process in the second column. If a match is found between a picture and a camera fingerprint, the word ***Matched*** is displayed on that corresponding row. If no match is found, then the cell in left empty. The matching camera fingerprint ID is displayed in the third column, with the matching correlation score shown in the fourth column of the results table.

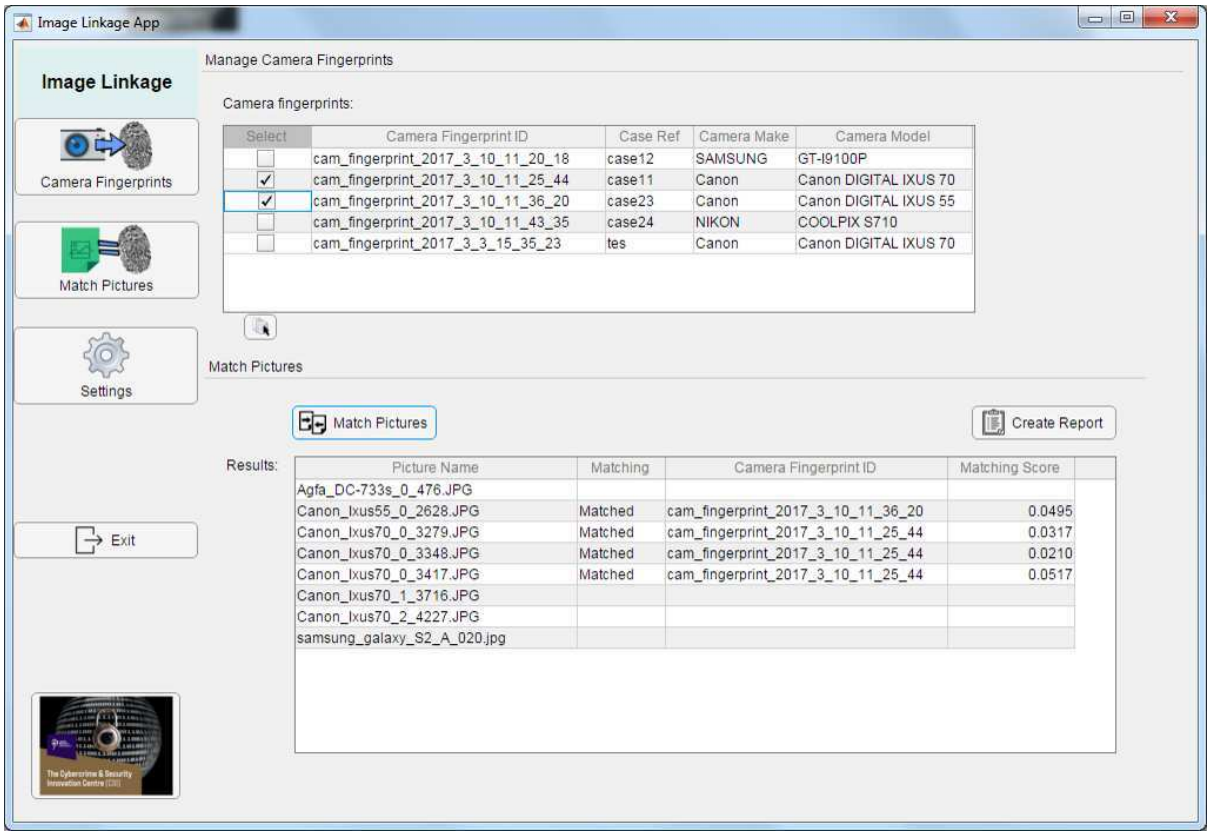
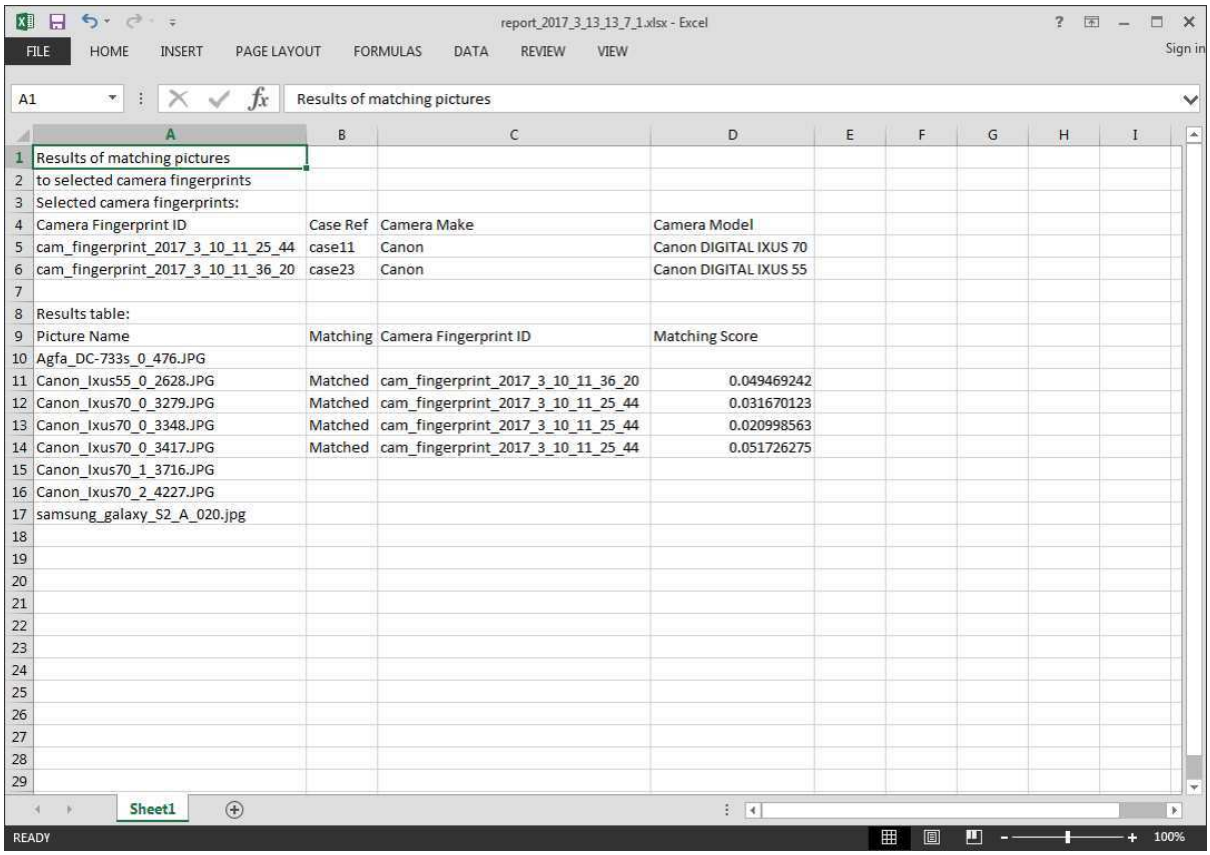



Figure 4: Match pictures with results

The user can generate a report for the matching process results by clicking the '*Create Report*' button. A spreadsheet is created, shown in Figure 5, with the details of the selected camera fingerprints for the matching process and the contents of the results table.



report_2017_3_13_13_7_1.xlsx - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW Sign in

A1 Results of matching pictures

| | A | B | C | D |
|---|---|---|---|---|
| 1 | Results of matching pictures | | | |
| 2 | to selected camera fingerprints | | | |
| 3 | Selected camera fingerprints: | | | |
| 4 | Camera Fingerprint ID | Case Ref | Camera Make | Camera Model |
| 5 | cam_fingerprint_2017_3_10_11_25_44 | case11 | Canon | Canon DIGITAL IXUS 70 |
| 6 | cam_fingerprint_2017_3_10_11_36_20 | case23 | Canon | Canon DIGITAL IXUS 55 |
| 7 | | | | |
| 8 | Results table: | | | |
| 9 | Picture Name | Matching | Camera Fingerprint ID | Matching Score |
| 10 | Agfa_DC-733s_0_476.JPG | | | |
| 11 | Canon_Ixus55_0_2628.JPG | Matched | cam_fingerprint_2017_3_10_11_36_20 | 0.049469242 |
| 12 | Canon_Ixus70_0_3279.JPG | Matched | cam_fingerprint_2017_3_10_11_25_44 | 0.031670123 |
| 13 | Canon_Ixus70_0_3348.JPG | Matched | cam_fingerprint_2017_3_10_11_25_44 | 0.020998563 |
| 14 | Canon_Ixus70_0_3417.JPG | Matched | cam_fingerprint_2017_3_10_11_25_44 | 0.051726275 |
| 15 | Canon_Ixus70_1_3716.JPG | | | |
| 16 | Canon_Ixus70_2_4227.JPG | | | |
| 17 | samsung_galaxy_S2_A_020.jpg | | | |
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Sheet1

READY 100%

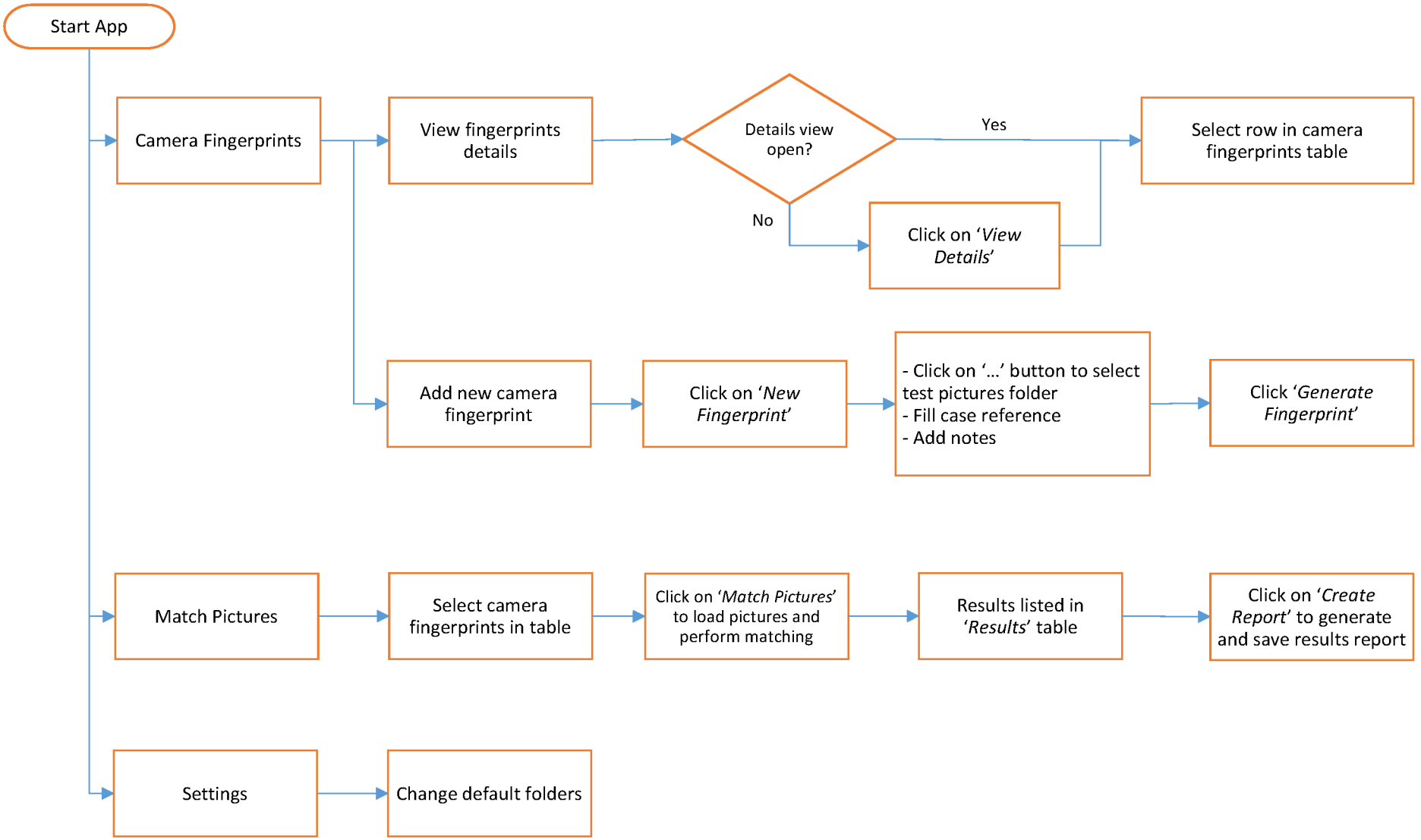
Figure 4: Match pictures with results

## Settings

The settings view can be used to change the default folders for the location of the SPN camera fingerprints and the reports.

The notes section indicates that the results produced by the matching process of Sensor Pattern Noise (SPN) of pictures against the selected SPN camera fingerprints are to be used for intelligence purposes to aid investigations.

## Appendix A


Start App
Camera Fingerprints
View fingerprints details
Details view open?
Yes
No
Select row in camera fingerprints table
Click on 'View Details'
Add new camera fingerprint
Click on 'New Fingerprint'
- Click on '...' button to select test pictures folder
- Fill case reference
- Add notes
Click 'Generate Fingerprint'
Match Pictures
Select camera fingerprints in table
Click on 'Match Pictures' to load pictures and perform matching
Results listed in 'Results' table
Click on 'Create Report' to generate and save results report
Settings
Change default folders