

Document Due Date: 31.05.2020 (M09)
Document Submission Date: 29.05.2020

Work Package 4: Platform setup

Document Dissemination Level: Public



Abstract

This document introduces the design guidelines that build the common basis for all user interfaces developed within the D4FLY research project. Major focus is put on the usability of the interfaces for the target users. The general usage flows of the different scenarios, as well as first drafts of the screen layouts are presented. It is the starting point for the first integration sessions and field trials. Since this project is following an agile approach to improve the overall system in several steps these flows and layouts will be adapted later on based on the end user and field trial feedbacks.

Project Information

| | |
|----------------------------|--|
| Project Name | Detecting Document frauD and iDentity on the fly |
| Project Acronym | D4FLY |
| Project Coordinator | Veridos GmbH |
| Project Funded by | European Commission |
| Under the Programme | Horizon 2020 Secure Societies |
| Call | H2020-SU-SEC-2018 |
| Topic | SU-BES02-2018-2019-2020 Technologies to enhance border and external security |
| Funding Instrument | Research and Innovation Action |
| Grant Agreement No. | 833704 |

Document Information

| | |
|-------------------------------|---|
| Document reference | D4.1 |
| Document Title | UI Specification 1 |
| Work Package reference | WP04 – Platform Setup |
| Delivery due date | 31.05.2020 (M09) |
| Actual submission date | 29.05.2020 |
| Dissemination Level | Public |
| Author(s) | Frank Schmalz(VD) |
| Contributor(s) | |
| Reviewers | Dr. Susanne Kränkel (VD) Marcin Kowalski (WAT) Bartłomiej Jankiewicz (WAT) Armin Reuter (VD) |

Document Version History

| Version | Date created | Beneficiary | Comments |
|---------|--------------|-------------|---|
| 0.1 | 06.04.2020 | VD | Initial Revision |
| 0.2 | 20.04.2020 | VD | Principles of UI design |
| 0.3 | 30.04.2020 | VD | Scenario 1 descriptions |
| 0.4 | 10.05.2020 | VD | Scenario 2 descriptions |
| 0.5 | 12.05.2020 | VD | Scenario 3 descriptions |
| 0.6 | 15.05.2020 | VD | Scenario 4 added |
| 0.7 | 15.05.2020 | VD | Adding more detailed descriptions |
| 0.8 | 20.05.2020 | VD | Introduction reworked |
| 0.9 | 21.05.2020 | VD | Summary included |
| 0.95 | 25.05.2020 | VD | Review comments from Marcin added |
| 1.0 | 29.05.2020 | VD | Final edits |
| 1.1 | 24.06.2021 | VD | Small edits based on review comments on p.20. |

List of Acronyms and Abbreviations

| ACRONYM | EXPLANATION |
|---------|--|
| BG | Border guard |
| EC | European Commission |
| EU | European Union |
| D4FLY | Detecting Document frauD and iDentity on the fly |
| DTC | Digital Travel Credential – a digital representation of a passport |
| DTC-App | A smartphone application to support the digital travel credential solution. |
| UI | User Interface |
| OVI | Optical variable ink. A physical security feature used on passport datapages. The feature changes the color depending on the viewing angle. |
| MLI | Multiple laser image. Multiple images lasered into a lens structure from multiple angles. The image changes when looking at it from different angles. |
| Smombie | Smartphone Zombie. The term is used in popular culture to describe pedestrians who walk without attention to their surroundings because they are focused upon their smartphone. Since smombies have only 5% of the field of view of normal walking persons this poses a significant safety hazard. |

Table of Contents

| | | |
|-----------------|--|------------------|
| <u>1</u> | <u>Introduction</u> | <u>8</u> |
| 1.1 | Aim of this document | 8 |
| 1.2 | Input / Output to this document..... | 8 |
| <u>2</u> | <u>General Principles of UI Design</u> | <u>9</u> |
| 2.1 | General principles of UI Design | 9 |
| | Clarity..... | 9 |
| | Familiarity..... | 9 |
| | Appearance follows behaviour..... | 9 |
| | Efficiency | 9 |
| 2.2 | Application in the D4FLY system | 9 |
| <u>3</u> | <u>UI for enhanced document verification</u> | <u>11</u> |
| 3.1 | High level use case description | 11 |
| 3.2 | Main system components | 11 |
| 3.3 | Requirements | 11 |
| 3.4 | Control flow | 12 |
| 3.5 | Visual UI design | 13 |
| 3.5.1 | General screen layout..... | 13 |
| 3.5.2 | Scan data page..... | 13 |
| 3.5.1 | Scan visa page..... | 14 |
| 3.5.2 | Detailed result pages..... | 14 |
| <u>4</u> | <u>UIs used in the biometric corridor scenario</u> | <u>19</u> |
| 4.1 | Scenario Description..... | 19 |
| 4.2 | System description | 19 |
| 4.3 | Requirements | 20 |
| 4.3.1 | Kiosk | 20 |
| 4.3.2 | Border Guard Station..... | 20 |
| 4.3.3 | Biometric Corridor | 20 |
| 4.3.4 | App | 20 |
| 4.4 | Control flow of kiosk..... | 21 |
| 4.5 | Visual UI Design of kiosk..... | 22 |
| 4.6 | Control flow of border control station | 27 |
| 4.7 | Visual UI Design of border control station | 28 |
| 4.8 | Control flow of app..... | 28 |
| 4.9 | Visual UI Design of app..... | 29 |
| 4.10 | Control flow of corridor..... | 31 |
| 4.11 | Visual UI Design of Corridor Screens | 32 |
| 4.11.1 | Entry screen..... | 33 |
| 4.11.2 | In corridor screen | 34 |
| <u>5</u> | <u>UI for advanced imposter fraud countermeasures</u> | <u>36</u> |
| 5.1 | Scenario Description..... | 36 |
| 5.2 | System description | 36 |
| 5.3 | Requirements | 36 |

| | | |
|----------|-------------------------------------|------------------|
| 5.4 | Control flow | 36 |
| 5.5 | Visual UI Design | 37 |
| 5.5.1 | Screen Scan data page..... | 38 |
| 5.5.2 | Screen Scan Results | 38 |
| 5.5.3 | Screen: Biometric Verification..... | 39 |
| 5.5.4 | Screen: Reject Entry | 39 |
| 6 | <u>Coach scenario</u> | <u>40</u> |
| 6.1 | Scenario Description..... | 40 |
| 6.2 | System description | 40 |
| 6.2.1 | Kiosk | 40 |
| 6.2.2 | Border Guard App..... | 41 |
| 6.3 | Control flow of kiosk..... | 41 |
| 6.4 | Visual UI Design of kiosk..... | 42 |
| 6.5 | Control flow of app..... | 46 |
| 6.6 | Visual UI Design of app..... | 47 |
| 7 | <u>Conclusions</u> | <u>50</u> |
| | <u>References.....</u> | <u>51</u> |
| | <u>List of figures</u> | <u>52</u> |

1 INTRODUCTION

The D4FLY research project addresses challenges in several border control situations. Novel ways of document fraud detection and new biometric modalities are explored for seamless border crossing and enhanced verification accuracy. The D4FLY System will be validated in several field tests and demonstrations during the course of the project. One major focus of the validation lies in the usage of the D4FLY System by its respective user groups, the travellers and the border guards. The usability of the D4FLY System will be improved in an agile approach with the feedback from internal trials and field tests.

The objective of Task 4.1. in work package 04 is to create user interfaces for terminals and applications that require interaction from travellers or border guards. Great emphasis is put on the usability for travellers as they shall be able to interact with the D4FLY System without training.

1.1 Aim of this document

Deliverable D4.1 presents the main UI design guidelines for all developed user interfaces. The interactions of users with the D4FLY System are displayed in flow charts. First drafts of the user interfaces for in the different D4FLY scenarios have been created and are shown in this deliverable. During the course of the project they will be refined and modified reflecting the user feedback from the field tests. An update on the individual user interfaces will be given in deliverable D4.5 – “Platform user interface design 2” towards the end of the project.

1.2 Input / Output to this document

The first user interface drafts incorporate functional and data privacy requirements that have been collected in initial discussions and a workshop with the end users and stakeholders in the consortium. General, high level functional requirements are described in the chapters of the respective system configuration.

Moreover, experiences and requirements from the preceding H2020 project PROTECT (grant agreement no. 700259) as well as general user interface design guidelines have been taken as input.

The document will serve as input for the development of the prototype and the demonstrators as covered by task 4.3.

The UI will be continuously improved with user feedback from the integration and field tests. An update will be presented in the deliverable D4.5 “Platform user interface design 2” in M33 close to the end of the project.

2 GENERAL PRINCIPLES OF UI DESIGN

2.1 General principles of UI Design

Justin Psaila Lead Digital UX Designer with Deloitte Digital (Psaila, 2016) describes in an online article “The principles of user interface design”. Psaila is focusing on web design but with some adaptation the same principles can be applied to user interfaces other applications in general:

Clarity

For a positive user experience, the user should be well-aware and confident of the information being displayed. Clarity is best achieved through simplicity. The user interface shouldn't be simple because it's in vogue, but because it serves a higher purpose. The primary question is: “Is what I need from the screen obvious and easy to access?” When initiating actions it should be clear what will happen.

Familiarity

Use common yet successfully proven solutions. The user should not need to adapt to new design ideas if not necessary. Conventional layouts seem less complex, simply because they are familiar.

- Use simple, popular verbs when it comes to naming CTAs (call to actions), links, buttons, etc.
- Use common colour codes such as red for warnings, green for successful, etc.
- Use text when you think the icons won't get your point across

Appearance follows behaviour

Size, colour, and placement of each element should work together. Create a clear path to help users find what they want. Have a clear hierarchy to reduce the appearance of complexity. Inform the user on what is happening.

Efficiency

Ui design should be as easy and as straight forward as possible. The effort that is required to complete the task should be measured. This could be done e.g. with the number of clicks, input boxes and screens.

2.2 Application in the D4FLY system

The design of the D4FLY user interfaces follow the principles as described above. The implementation concept of the D4FLY user interfaces is described in the following sections structured according to the four main configurations of the system, which are based on the four scenarios, that are described in the Grant Agreement.

In these configurations different user interfaces are used, as different hardware is used for the user interaction. There are three main categories:

- 1) User interface displayed on a desktop monitor, where the user interaction is done using a mouse and a keyboard.
- 2) User interface displayed on a touch screen monitor, where the user interaction is done by touching the touchscreen.

- 3) User interface on a smartphone, where the user interaction is operated by touching the smartphone touch screen

3 UI FOR ENHANCED DOCUMENT VERIFICATION

The first system configuration relates to enhanced document verification. In this scenario traveller documents, mainly ePassports, are being checked for genuineness using advanced methods.

For better understanding of the following UI designs the main process steps of the different use cases are repeated here. The use cases are being further analysed and worked out, as the project progresses.

3.1 High level use case description

1. The border guard (BG) requests the passport from a traveller.
2. The traveller hands out his/her passport to the BG.
3. The BG places the passport holder page on the passport reader.
4. The system scans holder page in UV, IR and VL spectrum, extracts MRZ lines and sends the scanned data to the advanced passport checker components for verification
5. The system reads the digital content and sends the data to particular passport checker
6. The system displays all check results for passport holder page on the user interface.
7. The system instructs the BG to scan all stamped visa pages.
8. The BG places all stamped visa pages on the passport reader for scanning
9. After completing all scans, the BG instructs the system to evaluate travel pattern.
10. The system displays the recognized and sorted travel pattern to the BG

3.2 Main system components

The system configuration for the advanced document verification consists of:

- a standard PC or laptop
- a screen (monitor)
- a keyboard
- a mouse
- an advanced document reader
- several further connected devices, for the several checker software components

The user interaction in this case is done using a mouse and a keyboard and the graphical user interface is displayed on a desktop monitor. The desktop monitor is the only user interface that is required in this scenario.

3.3 Requirements

This chapter describes requirements to the enhanced document checker as far as they are available at the delivery date. These will be further refined during integration tests and field tests.

- The system shall be usable by a trained border guard.
- The display of the document check results shall be simple and clear.
- The system is mainly intended for the 2nd line of control. One handed operation is not important.

3.4 Control flow

The user interface in this application consists of a start screen, which is displayed after starting the D4FLY application. On the start screen, there are dedicated areas for interaction and displaying results or instructions (see section 3.5.1). Depending on the action performed by the user, the display is switched to show the screen, that is designed to support the specific step in the process, showing results of previous actions or instructions and buttons for the next activity. The flow through the whole process and the respective screens, which are displayed are shown in Figure 3-1.

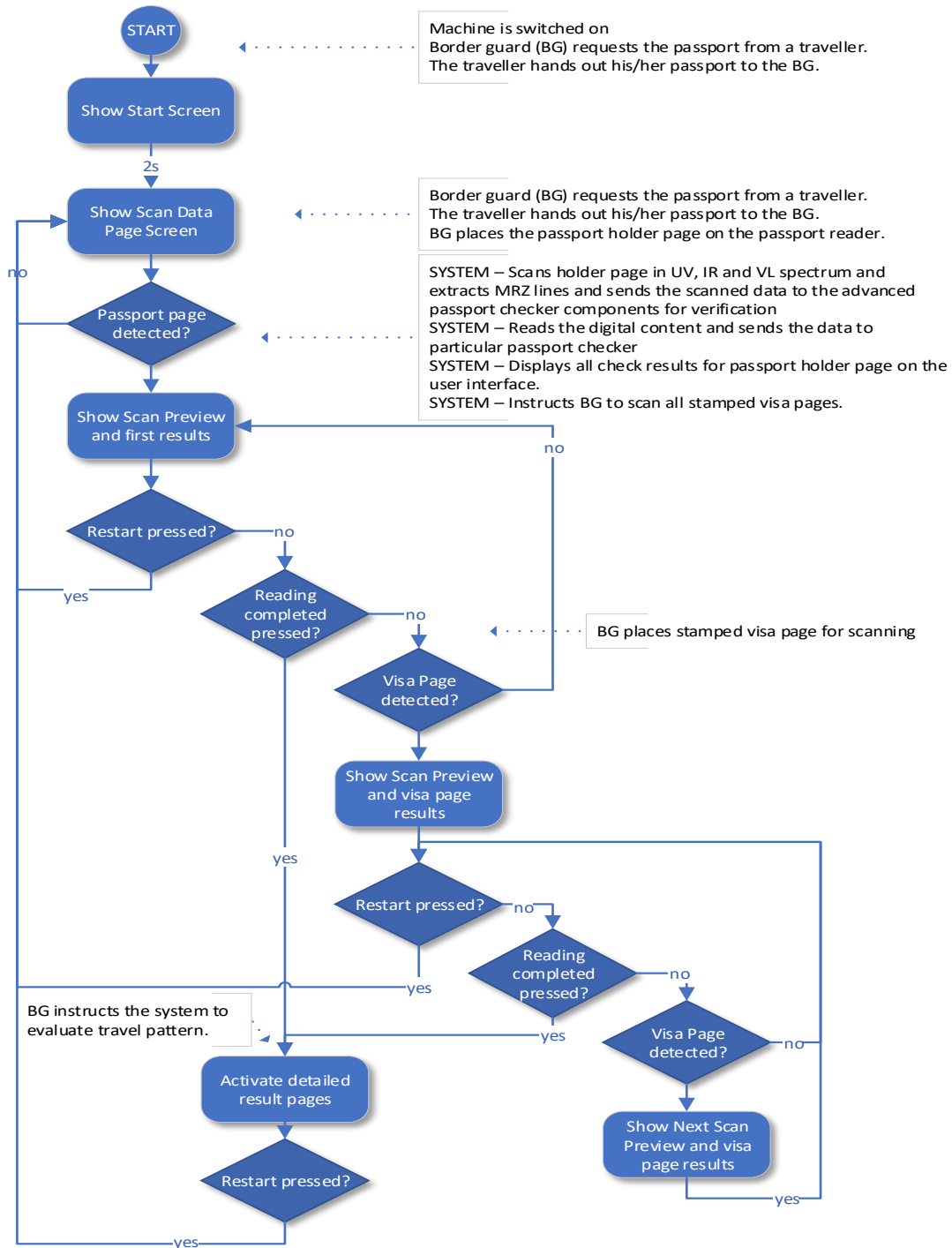


FIGURE 3-1 CONTROL FLOW ENHANCED PASSPORT VERIFIER

3.5 Visual UI design

This chapter shows the first design drafts for the screen layouts of the application. The applications will be developed with the Qt framework to ensure interoperability on many platforms. In the enhanced document verification scenario several partners, each specialized in a specific security feature, develop individual verification components. These components run on specialized hardware, optimized for the task. The central component with the user interface distributes the data to be analysed by the different partners and shows the results from each partner in one UI.

3.5.1 General screen layout

The general screen layout, is divided in several sections, serving different purposes. On the left side of the screen, several tabs are shown, which can be clicked on to switch to the screens of the single checking steps, which relate to one specific checker component. The biggest area of the screen in the centre is used to display the specific information related to the selected checker component. The upper part of the screen is divided in two parts, the left part is used for buttons to connect to specific system components. The right upper part is used to display check boxes for the different checker components, allowing the user to select, which of the components shall be activated.

The right part of the screen is used to show the partners acronyms, which contributed to the development of this part of the system.

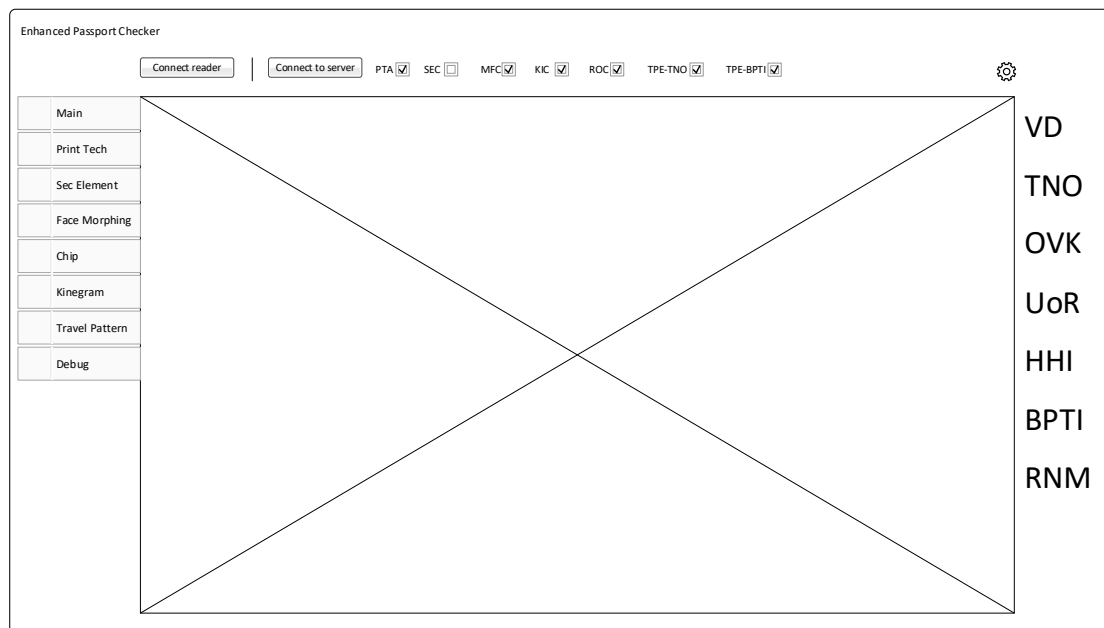


FIGURE 3-2 GENERAL SCREEN LAYOUT

3.5.2 Scan data page

The scan data page is the first screen that is displayed after the application is switched on. It is used to scan the data page of the passport. On the left side the current scan of the data page will be displayed, on the right side the connection status of the different modules and, if applicable, first results will be displayed.

The scan data page relates to the only step that is obligatory for the whole process, as without the data from the electronic passport, no checking can be performed.

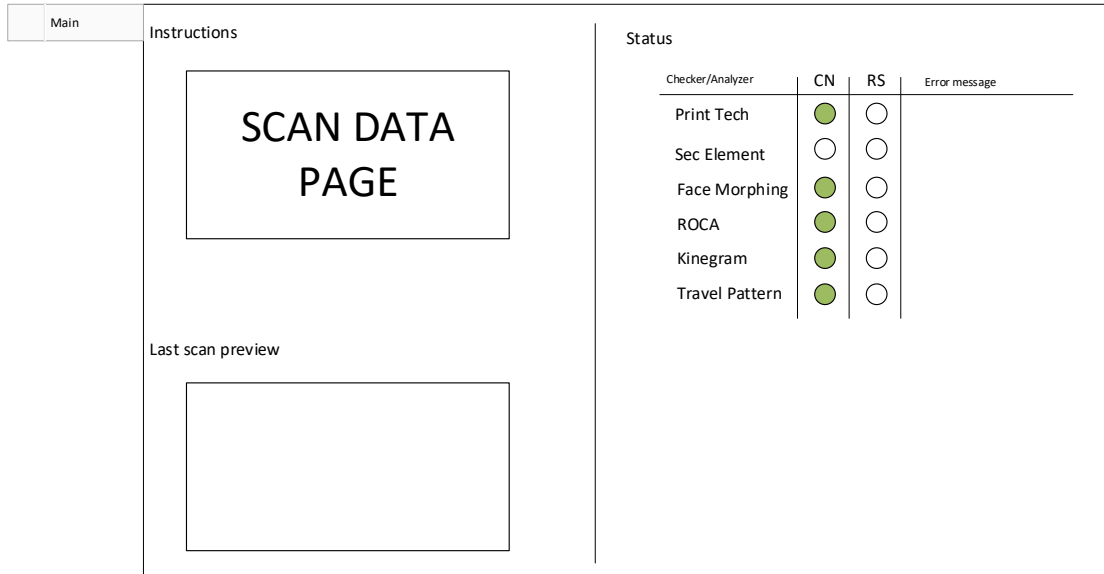


FIGURE 3-3 SCAN DATA PAGE SCREEN

3.5.1 Scan visa page

After successful scan of the data page the screen switches to the scanning of visa pages. The process can be stopped by pressing the “Restart” button or “Reading complete” button.

Connection status and interim results will be shown on the right side as with the scan datapage screen.

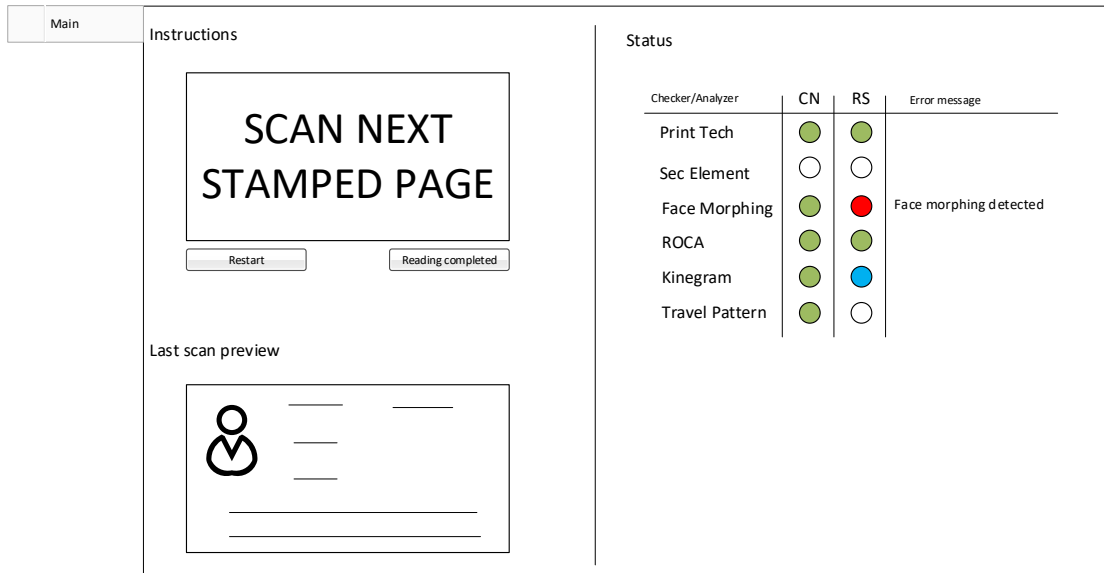


FIGURE 3-4 SCAN VISA PAGE SCREEN

3.5.2 Detailed result pages

After the reading of the passport is completed and the “Reading completed” button has been pressed the detailed result pages become selectable.

As explained in section 3.5.2, in the standard flow of the process, the results are displayed in the status pane on the right side of the “scan data page” / scan visa page screen. Should there be an anomaly or if the user is interested in more details of the individual components, a

separate screen is available for each of the components, which are connected to the system. These component screens can be viewed after clicking the respective tab at the left part of the main screen. The development of the components is not finished at the time of the writing of this deliverable, so the final look of each of the component screens is not finalised, yet.

All of these component detail screens will be designed following the same concept:

Each component screen is divided with a vertical line into a preview pane (left) and a results and information pane (right) (see Figure 3 5, showing the screen for the printing technology check screen as an example).

The preview pane is used to display the image, that has been sent to the specific check component, usually with detail information, which has been created by the checker component and is pre-processed such that it can be displayed in the preview image as a graphical overlay information. For some components, which don't use image information, a text pane can be used, to display certain information, which is used as the specific input for the respective checker component, e.g. the binary digital certificate can be displayed, which is used as an input to the certificate checker.

The results and information pane is used to display any Error messages, which the checker component software might create in case some error occurred and no result could be generated. Further on some space is reserved to display a "Confidence score", as some components use matching technologies, which don't provide a binary output, but a score, which allows to get an additional information about the quality of the result.

Finally in the lower area of this pane, the final result of the checker component is displayed, which is equal to the information that is displayed on the data page screen, as shown in Figure 3 3.

3.5.2.1 TNO Printing technologies

This page displays the results from the printing techniques analysis performed by TNO. On the left side detailed results of the analysis process is shown. The right side shows a detailed error description if applicable.

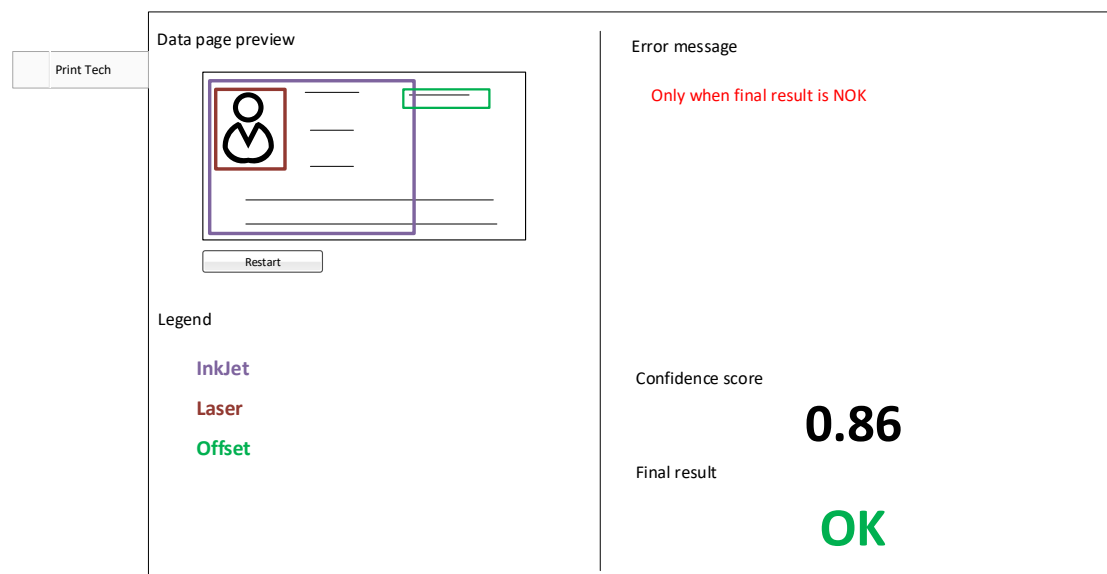


FIGURE 3-5 SCREEN PRINTING TECHNIQUES DETAILS

3.5.2.2 UoR OVI / MLI check

This page shows the detailed results from the variable optical security feature analysis performed by the university of reading. This partner is analysing optical variable ink (OVI) and multiple laser image (MLI) features.

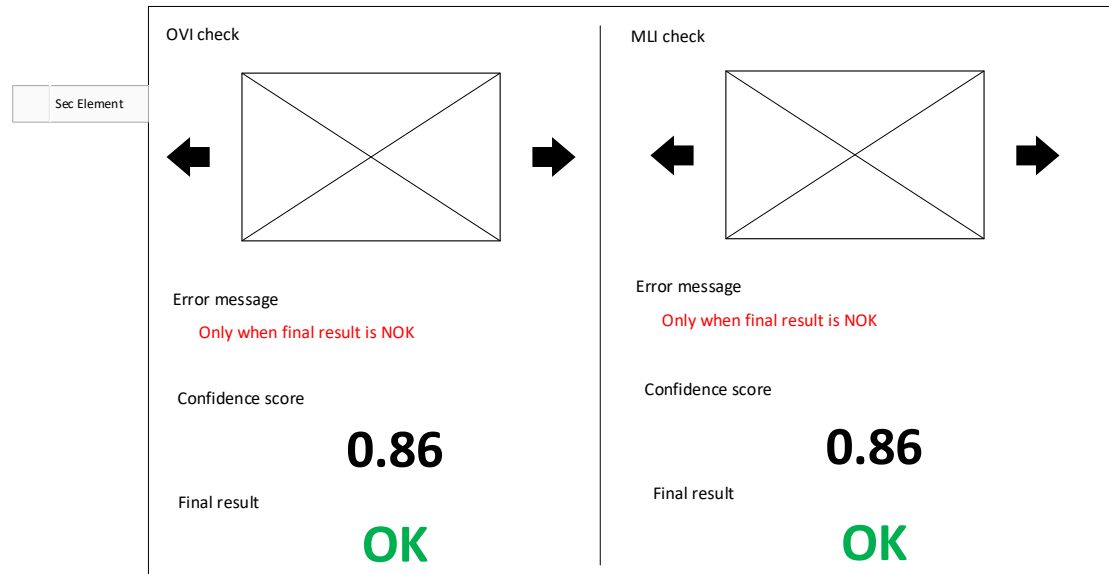


FIGURE 3-6 SCREEN OVI / MLI CHECK

3.5.2.3 HHI Face morphing

This page shows the detailed results from the morphing detection performed by the Fraunhofer HHI. In case anomalies are found, they will be visualized on the left side of the picture. Corresponding error messages are shown on the right side.

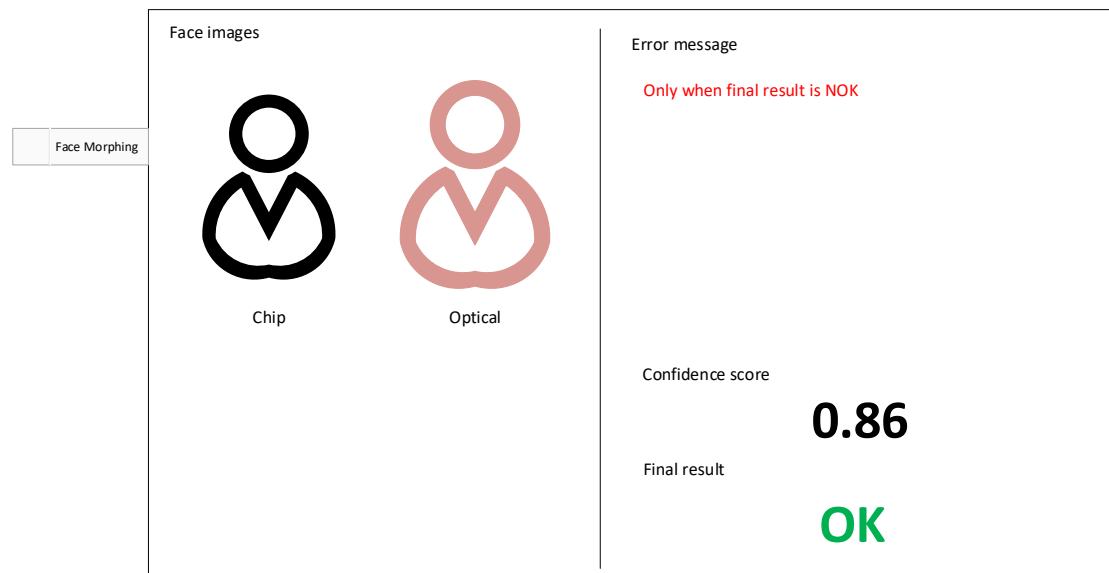


FIGURE 3-7 SCREEN FACE MORPHING RESULTS

3.5.2.4 VD Advanced chip data analyser

This screen shows details from the cryptographic analysis of the chip. The component is supplied by Veridos. It follows the standard layout. Analytic details on the left, error message on the right.

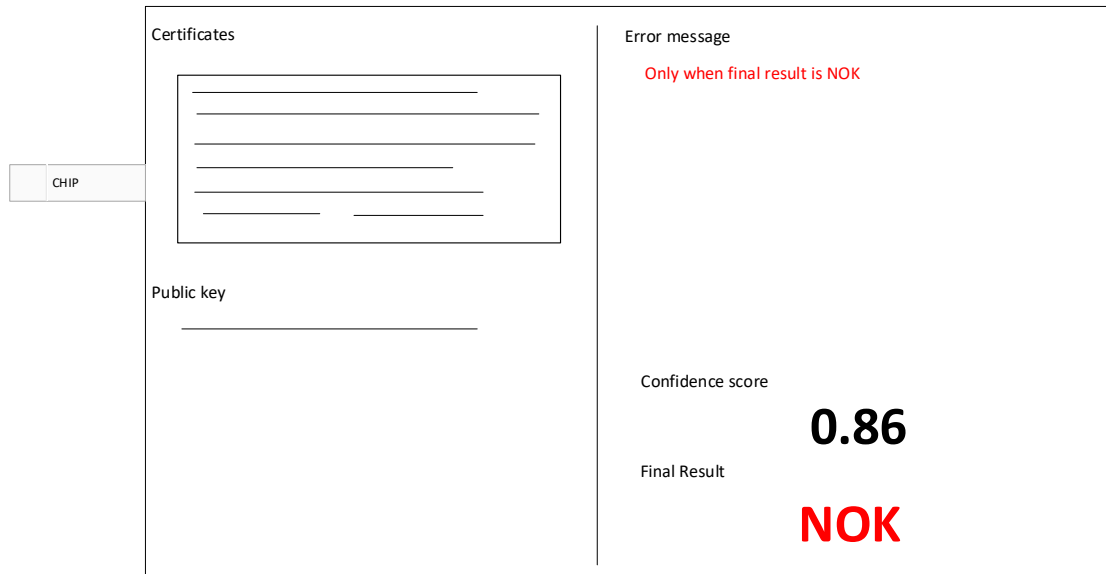


FIGURE 3-8 SCREEN CHIP DATA ANALYSIS

3.5.2.5 OVD Kinegram checker

The kinegram verification component is supplied by OVD Kinegram. It follows the standard layout for detailed pages.

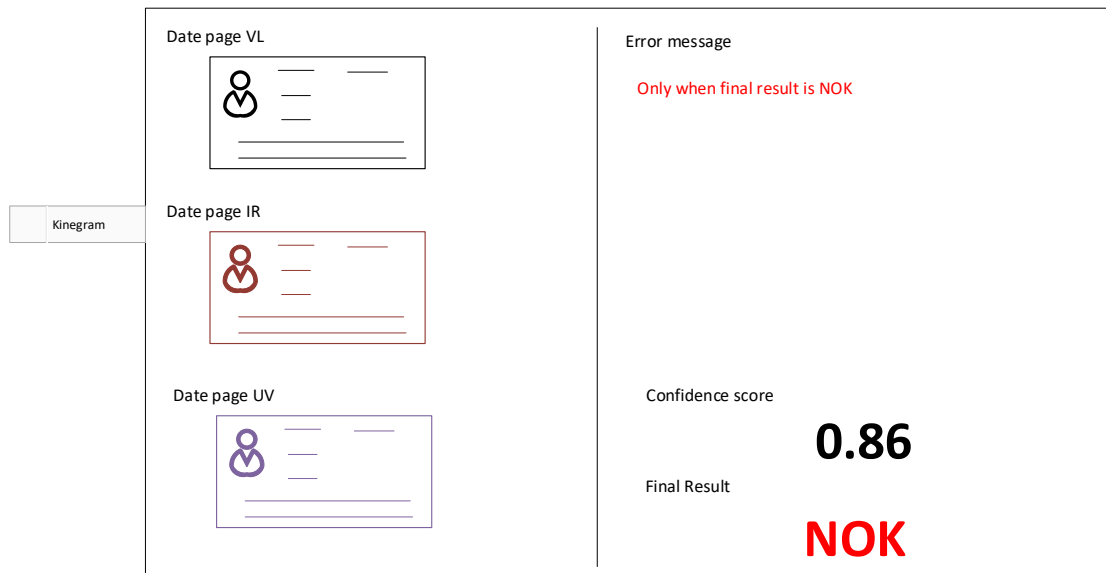


FIGURE 3-9 SCREEN KINEGRAM CHECKER

3.5.2.1 TNO/BPTI Travel Pattern Analysis

Two partners are delivering components to analyse the travel patterns by reading travel stamps. The screen is split in 2 for the 2 partners.

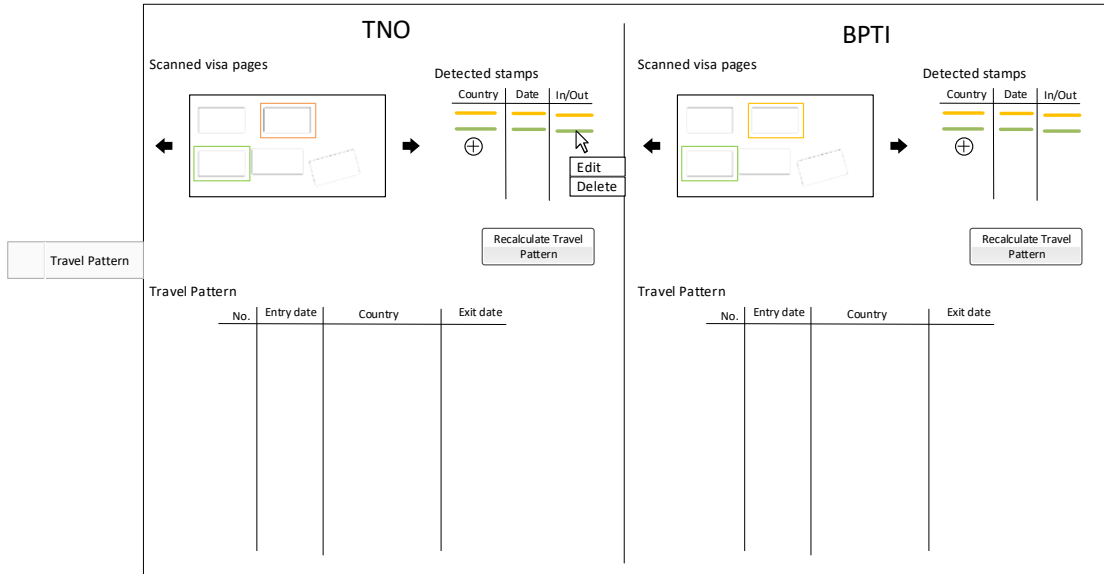


FIGURE 3-10 SCREEN TRAVEL PATTERN ANALYSIS

4 UIS USED IN THE BIOMETRIC CORRIDOR SCENARIO

4.1 Scenario Description

The detailed use cases are described in T2.1 in WP2 and can be found in D2.1 due in M15. For better understanding of the following Ui designs the main process steps are repeated here:

1. The Traveller approaches the enrolment kiosk
2. The system displays welcome screen and selection of supported languages
3. Traveller selects the display language
4. The system displays the consent form in selected language
5. Traveller reads the consent form and accepts it by pressing the accept button
6. The system instructs the traveller how to install the app
7. The system instructs the traveller to tap his/her smartphone on the NFC reader
8. Traveller taps the smartphone on the NFC reader
9. The system verifies the app installation and build a secure channel
10. The system instructs traveller to place his/her passport on the passport reader
11. Traveller puts his/her passport on the passport reader
12. The system scans the passport holder page and reads the content of the chip
13. The system instructs the traveller to remove the passport from the passport reader
14. Traveller removes the passport
15. The system instructs the traveller to look into the face capture camera
16. Traveller looks into the camera
17. The system verifies the live face image with the passport image
18. foreach (available sensor controller)
 - a. The system instructs the traveller how to enrol
 - b. Traveller is following instructions and enrolls
19. The system Instructs the traveller that enrolment procedure is successfully completed
20. Traveller leaves the kiosk

4.2 System description

The system consists of:

- Border control station
 - standard PC or laptop for the border guard
 - a screen (monitor)
 - a keyboard
 - a mouse
- Enrolment kiosk
 - Touchscreen
 - Passport reader
 - Thermal camera
 - Iris scanner
 - Face camera
 - 3D face camera
- Biometric corridor
 - Gate system with doors
 - A screen display at the entrance of the corridor to guide the traveler on how to use the corridor

- Screen at the end directing the traveller either to manual control or to the luggage pickup.
- Several smaller screens for sensor usage guidance. (“look here! screens”)
- 2D face sensor
- 3D face sensor
- Iris sensor
- Somatotype sensor

4.3 Requirements

This chapter describes requirements to the corridor as far as they are available at the delivery date. These will be further refined during integration tests and field tests.

4.3.1 Kiosk

- The GUI of the kiosk shall be usable by travellers without requiring extensive training or reading a manual.
- It has to be adjustable to different body heights.
- It shall be usable by a touch screen.
- When using the sensors the UI has to adapt to enable best sensor data.
- The UI has to make sure that the user is looking in the cameras when data acquisition takes place.
- The UI has to make sure that if the traveller just leaves the kiosk during a session it will automatically return to the start screen after a timeout.
- The UI has to make sure that if a traveller just left the kiosk in the middle of the session it cannot be completed by a third party.

4.3.2 Border Guard Application

- The border guard must be able to verify the results of each passing traveller.
- The app UI design should prioritize good visualization of the information making use of the whole (tablet) screen area. Single handed operation of the app, which is sometimes a requirement for smartphone applications, is not considered a high priority requirement in this case.

4.3.3 Biometric Corridor

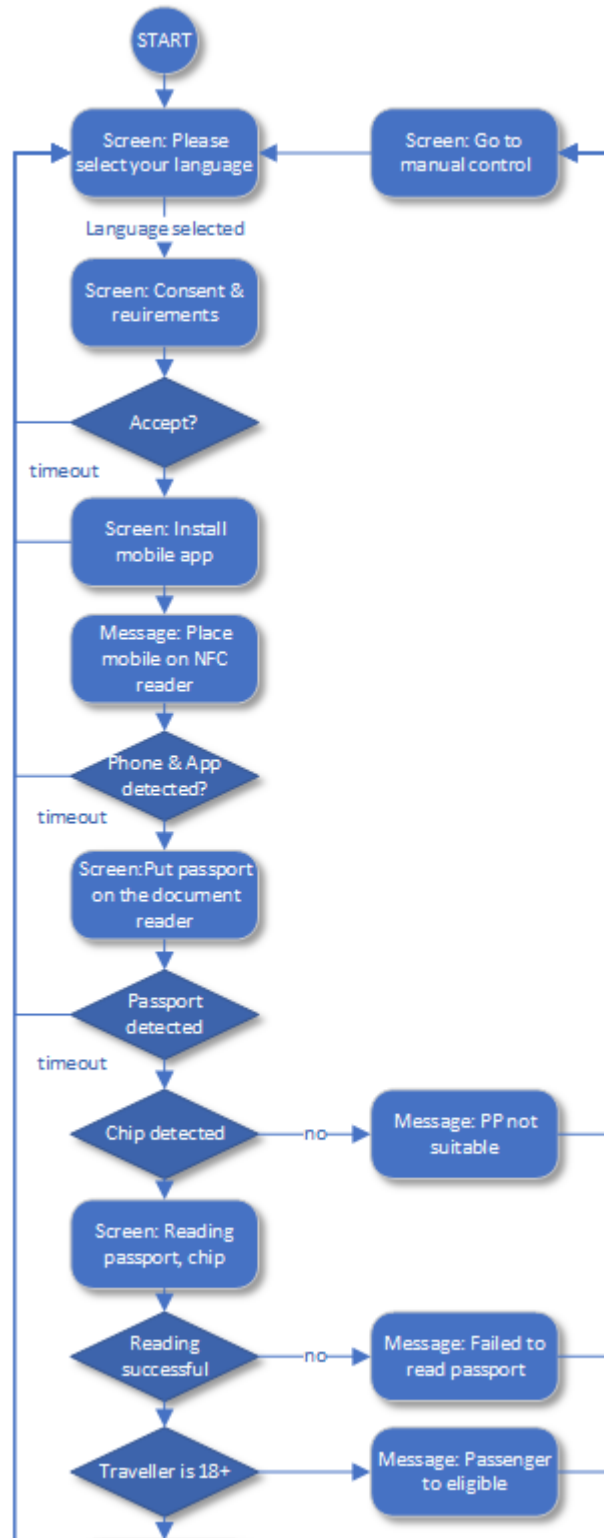
- The corridor needs clear signalling for the traveller
- The usage of the system must be self-explanatory
- The traveller shall be guided to look into the sensors

4.3.4 App

- The app needs clear signalling for the traveller.
- The usage of the system must be self-explanatory
- The amount of screens shall be as few as possible
- Unnecessary tapping for progressing screens shall be prevented
- The usage of the phone and display of information shall be minimized during corridor use too make sure the traveller look into the sensors and not on the phone.

4.4 Control flow of kiosk

The user interface of the kiosk consists of a touchscreen, a passport reader and several biometric sensors. As shown in the following control flow diagram, the traveller always has to start with picking a language and giving informed consent. For each screen mentioned in the control flow there is a picture in section 4.5 Visual UI Design of kiosk.



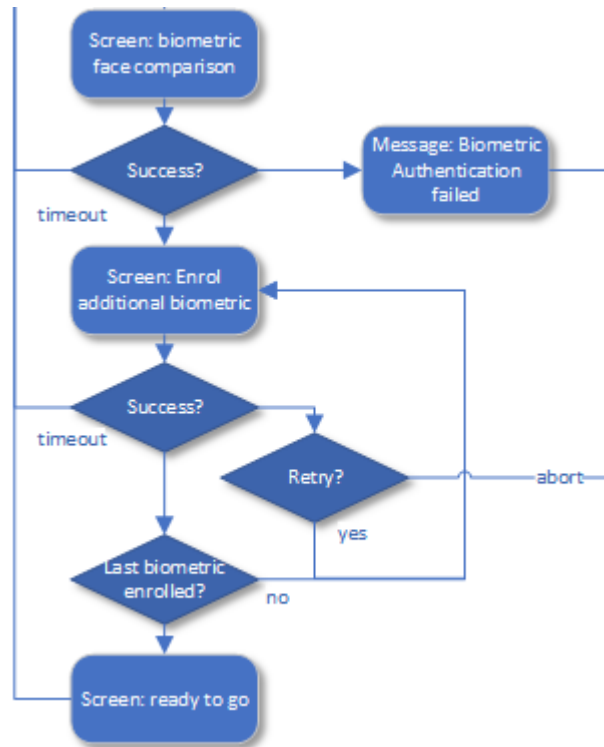


FIGURE 4-1 CONTROL FLOW KIOSK

4.5 Visual UI Design of kiosk

The following pictures show sample designs for each screen mentioned in the control flow diagram. The layout and structure of each screen has been kept consistent with previous screens as far as possible.



FIGURE 4-2 SCREEN: PLEASE SELECT YOUR LANGUAGE

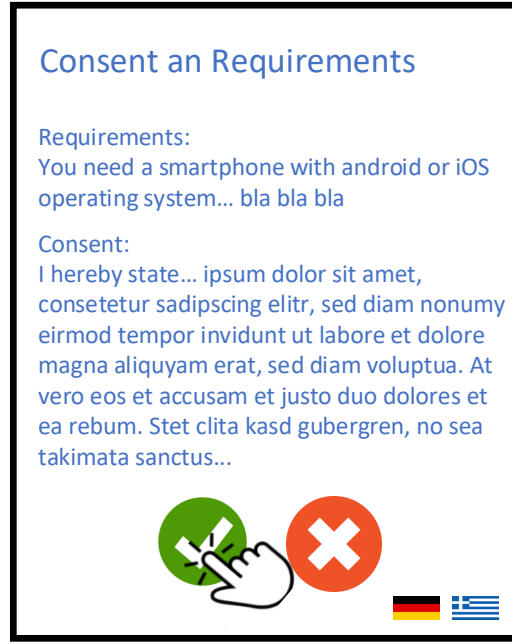


FIGURE 4-3 SCREEN: CONSENT & REQUIREMENTS

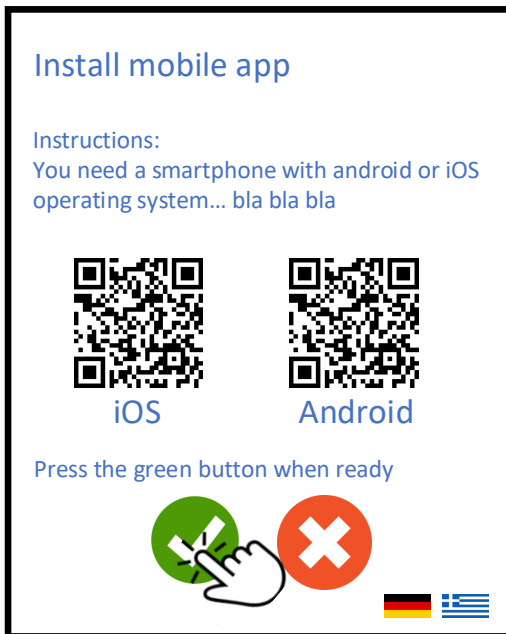


FIGURE 4-4 SCREEN: INSTALL MOBILE APP

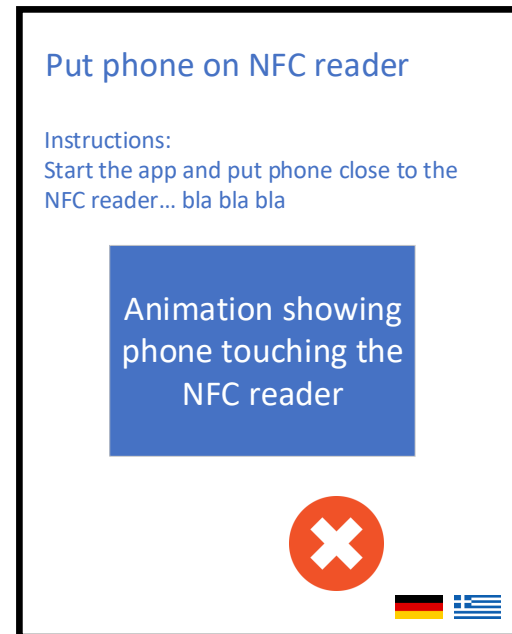


FIGURE 4-5 SCREEN: PUT MOBILE PHONE ON READER

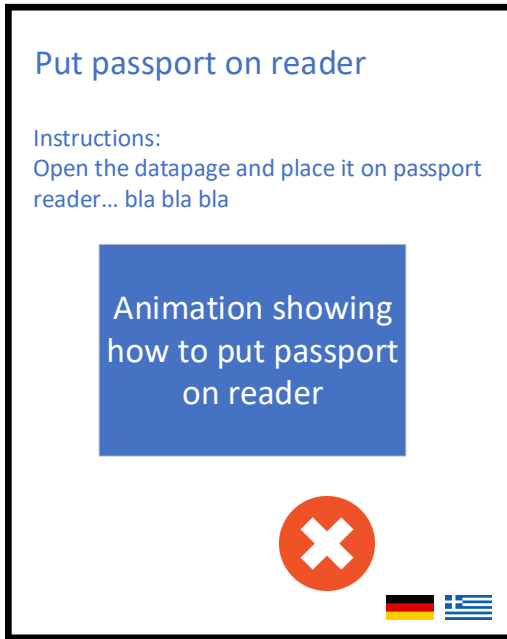


FIGURE 4-6 SCREEN: PUT PASSPORT ON DOCUMENT READER

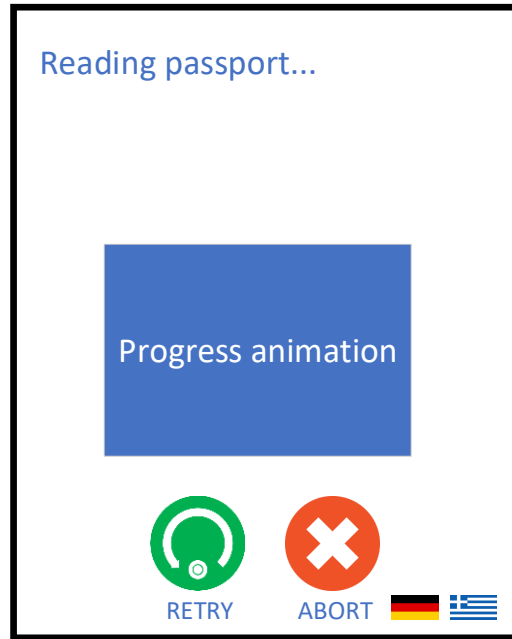


FIGURE 4-7 SCREEN: READING PASSPORT

For the screens “Screen: Biometric face comparison” and “Screen: Enrol additional biometric” the layout was adapted to guide the traveller to look into the sensor. Based on previous experience, one crucial aspect here is, that this is difficult to guide the travellers gaze towards a camera, which is not located “in the screen” but at a one side or above the screen, as the user tends to always look at the screen to get feedback and read potential further instructions. A new layout is proposed where the livestream is directly below the sensors and relatively small. This will be tested during integration and first field tests. If it does not improve the situation signalling directly at the sensor might be introduced. In this case the screen will not display a livestream any more to avoid distraction.

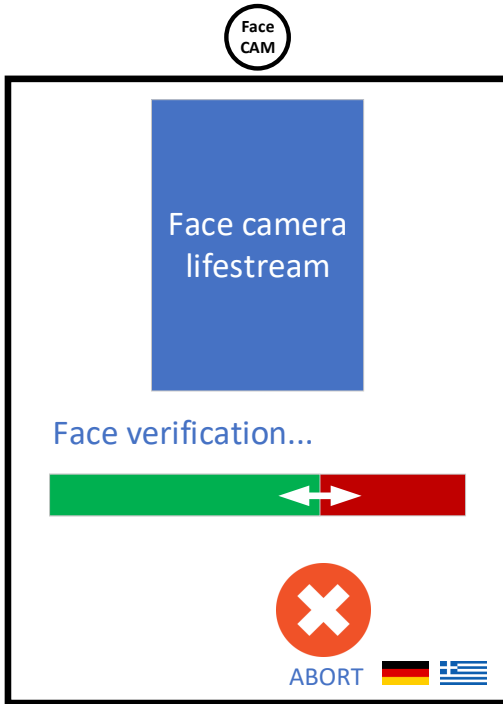


FIGURE 4-8 SCREEN: BIOMETRIC FACE COMPARISON

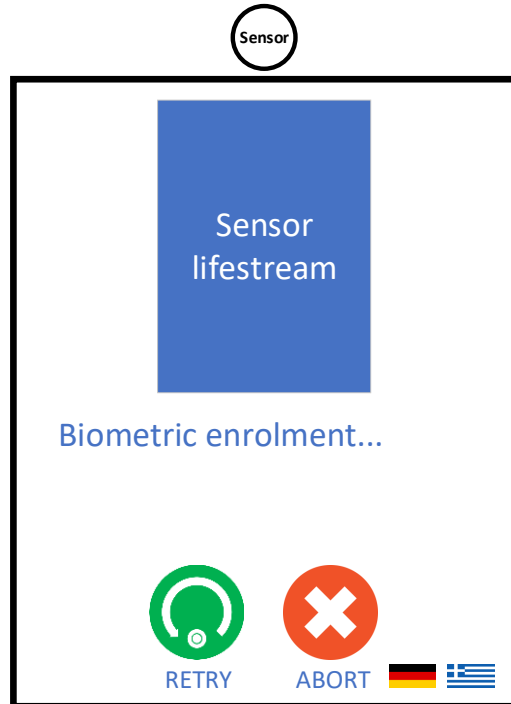


FIGURE 4-9 SCREEN: ENROL ADDITIONAL BIOMETRIC

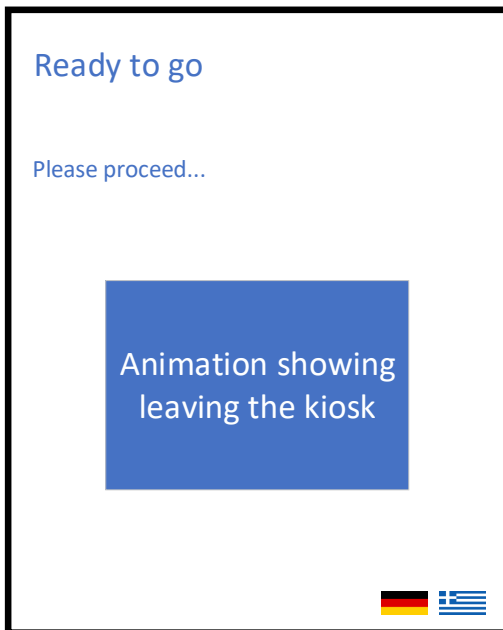


FIGURE 4-10 SCREEN: READY TO GO

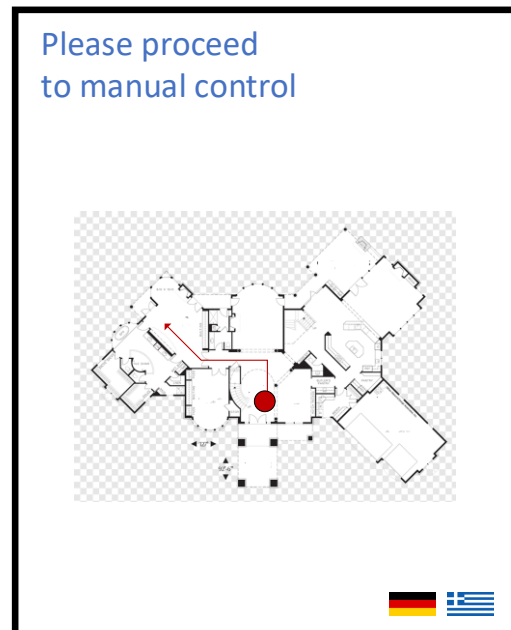


FIGURE 4-11 SCREEN: GO TO MANUAL CONTROL

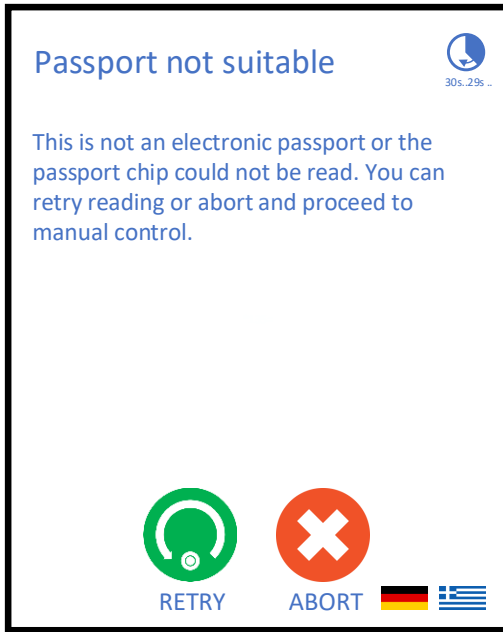


FIGURE 4-12 MESSAGE: PASSPORT NOT SUITABLE

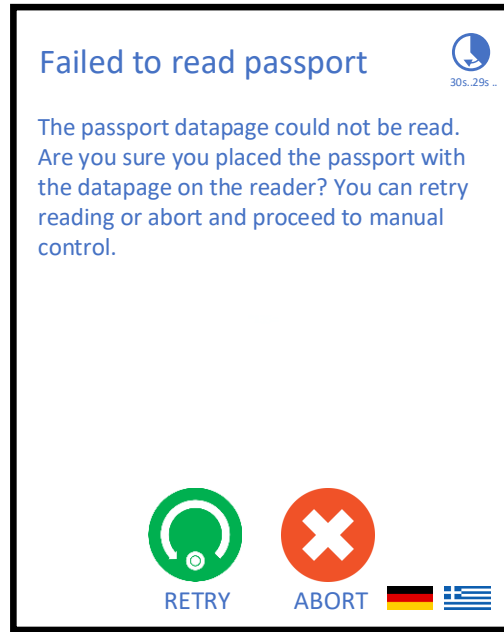


FIGURE 4-13 MESSAGE : FAILED TO READ PASSPORT

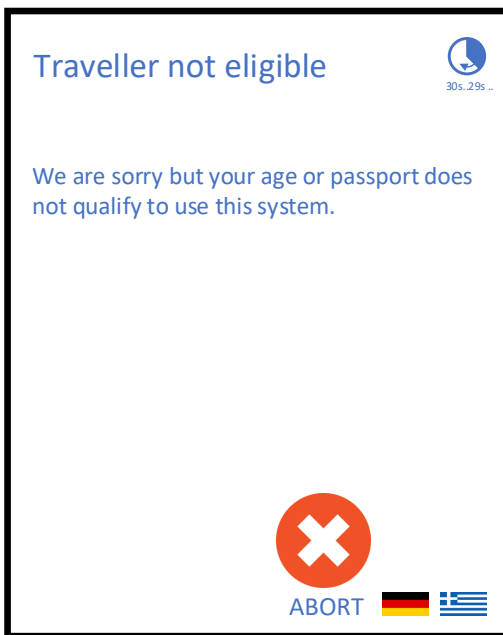


FIGURE 4-14 MESSAGE: TRAVELLER NOT ELIGIBLE

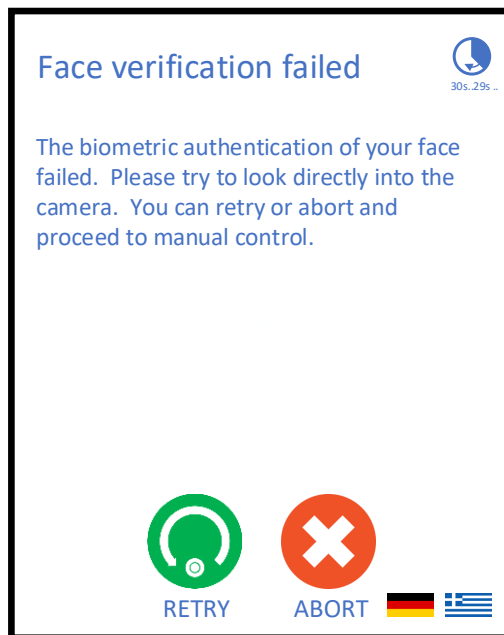


FIGURE 4-15 MESSAGE: BIOMETRIC AUTHENTICATION
FAILED

4.6 Control flow of border control station

The user interface in this application consists of a start “splash” screen, which is displayed after starting the D4FLY application. Apart from that the UI consists of a single interactive screen that displays detailed verification information for each traveller passing the corridor. The current design keeps the last 2-3 results in a list to get back to them. This might be abandoned for more detailed information if requested by the border guards during field tests.

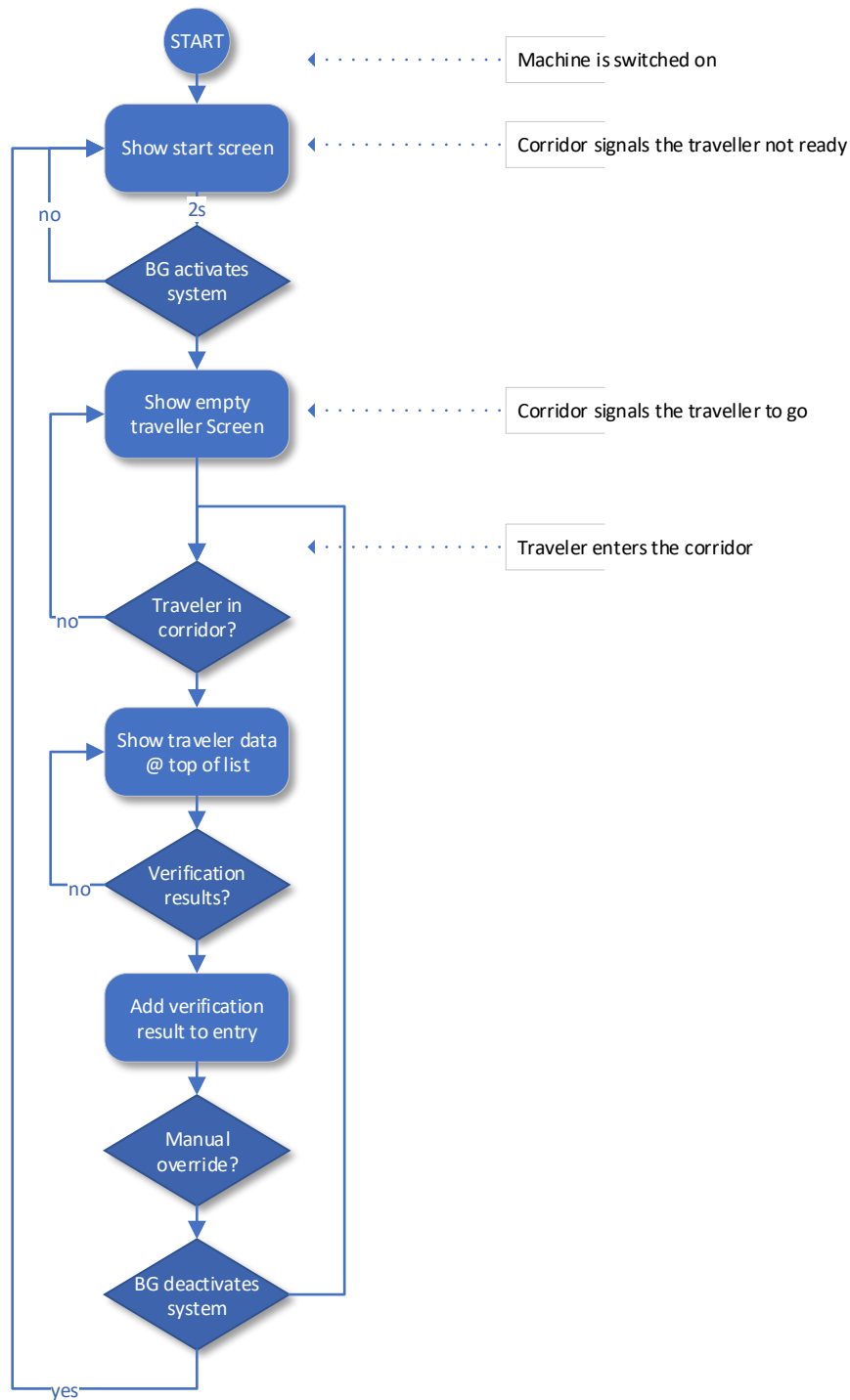


FIGURE 4-16 CONTROL FLOW OF BORDER GUARD STATION

4.7 Visual UI Design of border control station

The border guard UI consists of an interactive single screen UI. This is a first proposed screen layout. The most frequently used buttons are located in the upper left corner to avoid long mouse movements during work. With the “Start/Stop” button the system can be activated and deactivated. The “Pass” and “Reject” buttons are for manual override of the systems decision. Below will be a live feed from the corridors surveillance camera. The traveller slots might be removed for larger information display if requested by the border guards.

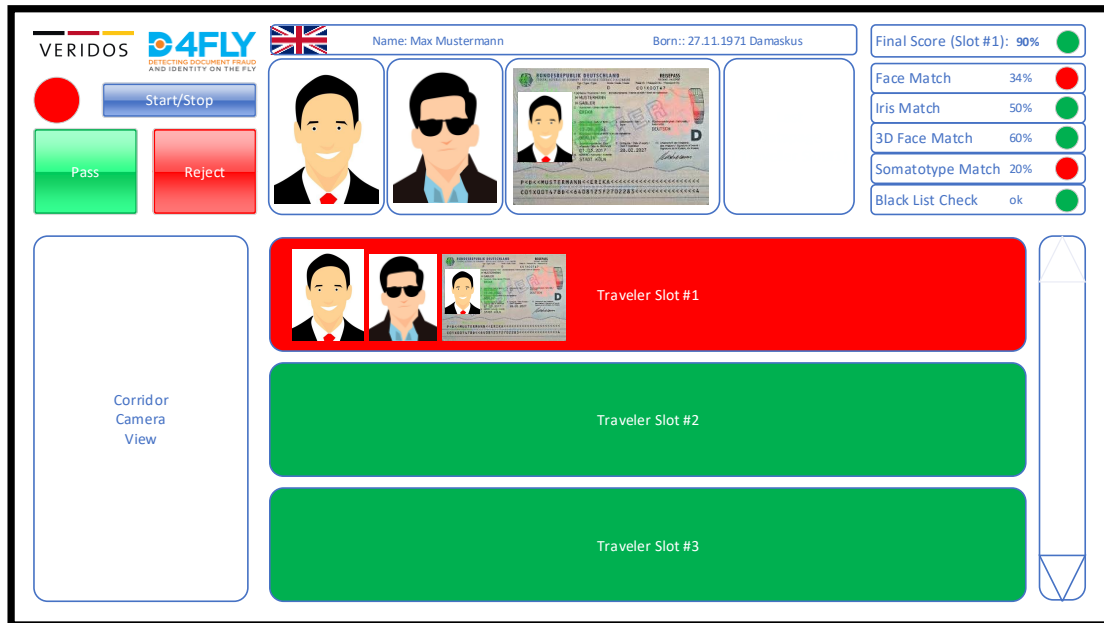


FIGURE 4-17 BORDER GUARD SCREEN

4.8 Control flow of app

The following picture shows the control flow of the travellers smartphone app. The whole UI has been optimized for minimal interaction. As an experience from the Protect project the switching of screens between the app and kiosk or corridor UIs has been minimized. During corridor usage all feedback to the traveller on the smartphone has been removed. The traveller will get the feedback from the corridor UI to avoid the problem of travellers looking at the smartphone during the verification process. This would have a negative impact on the quality of the sensor images. After the traveller has tapped the phone to the NFC reader it can put it away e.g. in a pocket.

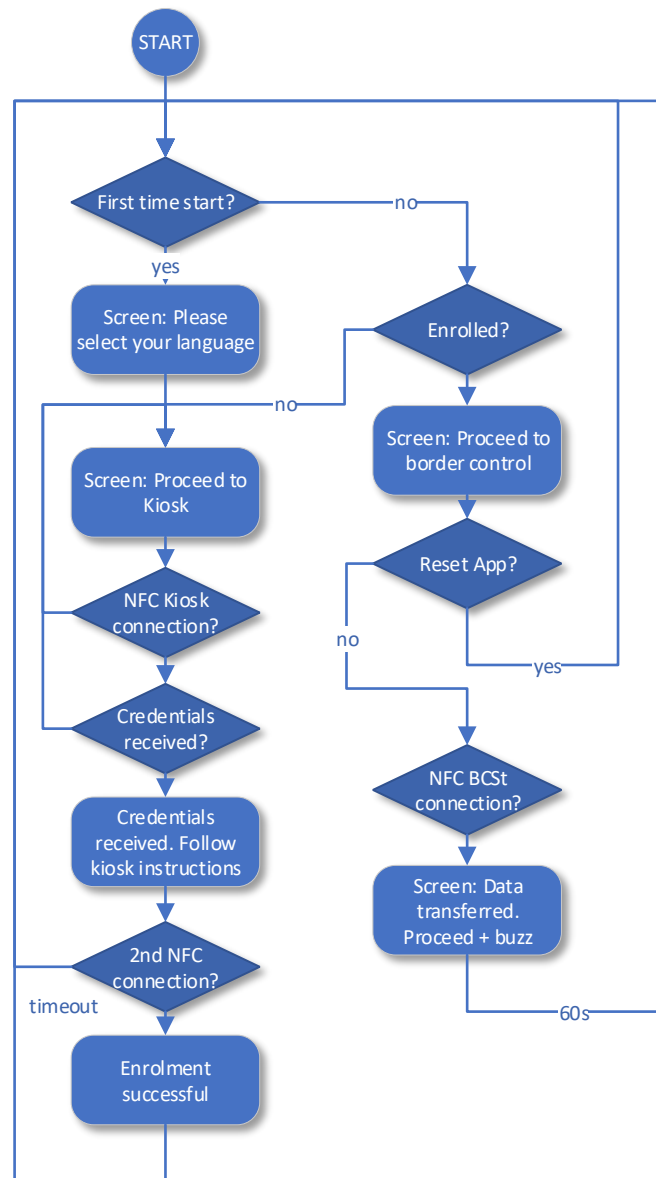


FIGURE 4-18 CONTROL FLOW OF APP

4.9 Visual UI Design of app

The UI screens of the travellers smartphone app have been kept as simple and self-explanatory as possible. Effort has been put in to keep the overall number of different screens as small as possible.



FIGURE 4-19 SCREEN: CHOOSE LANGUAGE



FIGURE 4-20 SCREEN: PLEASE PROCEED TO KIOSK

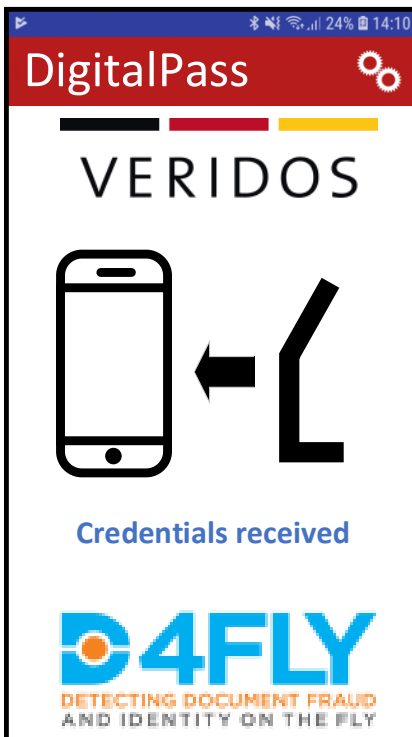


FIGURE 4-21 SCREEN: CREDENTIALS RECEIVED

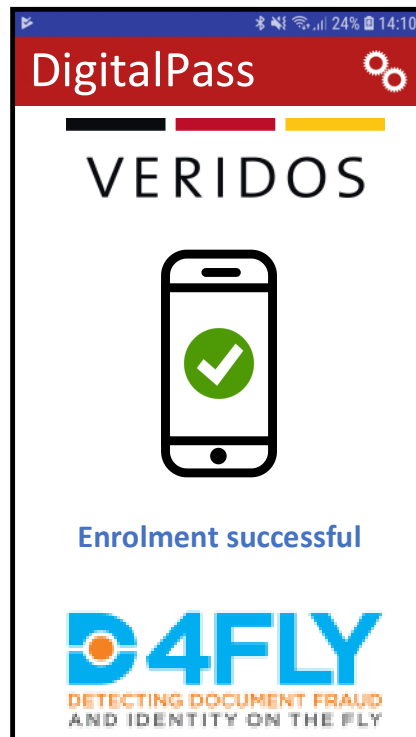


FIGURE 4-22 SCREEN: ENROLMENT SUCCESSFUL

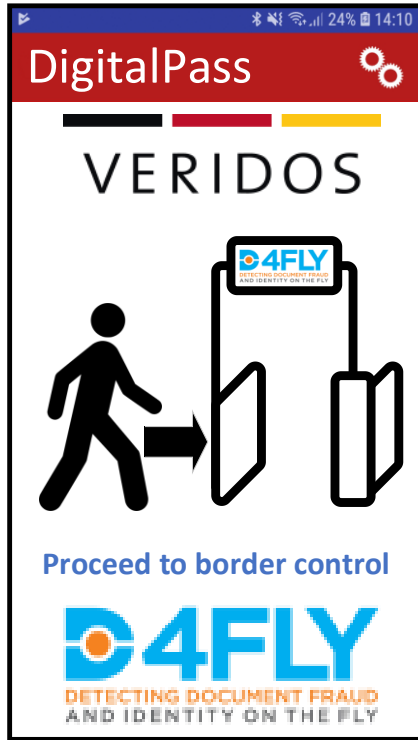


FIGURE 4-23 SCREEN: PROCEED TO BORDER CONTROL

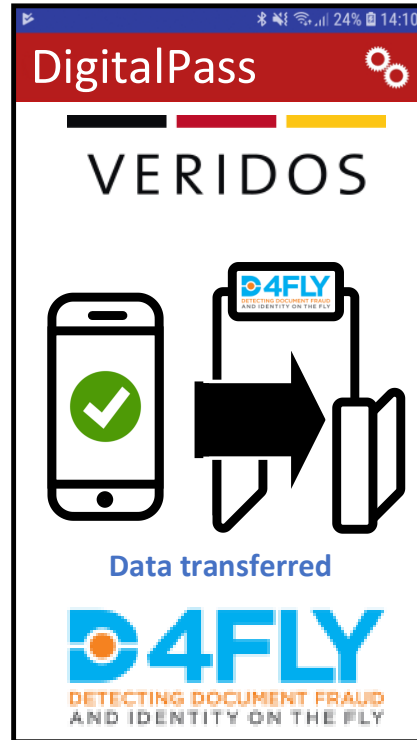


FIGURE 4-24 SCREEN: DATA TRANSFERRED

4.10 Control flow of corridor

Building on the experience of previous H2020 projects, in the D4FLY approach the traveller guidance through the corridor shall be implemented within the corridor. An alternative could be to integrate the user guidance into a smartphone app. The disadvantage of the smartphone approach is, that the traveller tends to look at the smartphone while walking through the corridor, which could impose safety risks (“smombie effect”) and also could impact the quality and usability of the images captured by the various sensors (3D face camera, iris camera). The screens and instructions at the corridor display shall be designed such that there is no need to look at the smartphone while walking through the corridor.

4.11.1 Entry screen

This is the screen shown if the system is deactivated:

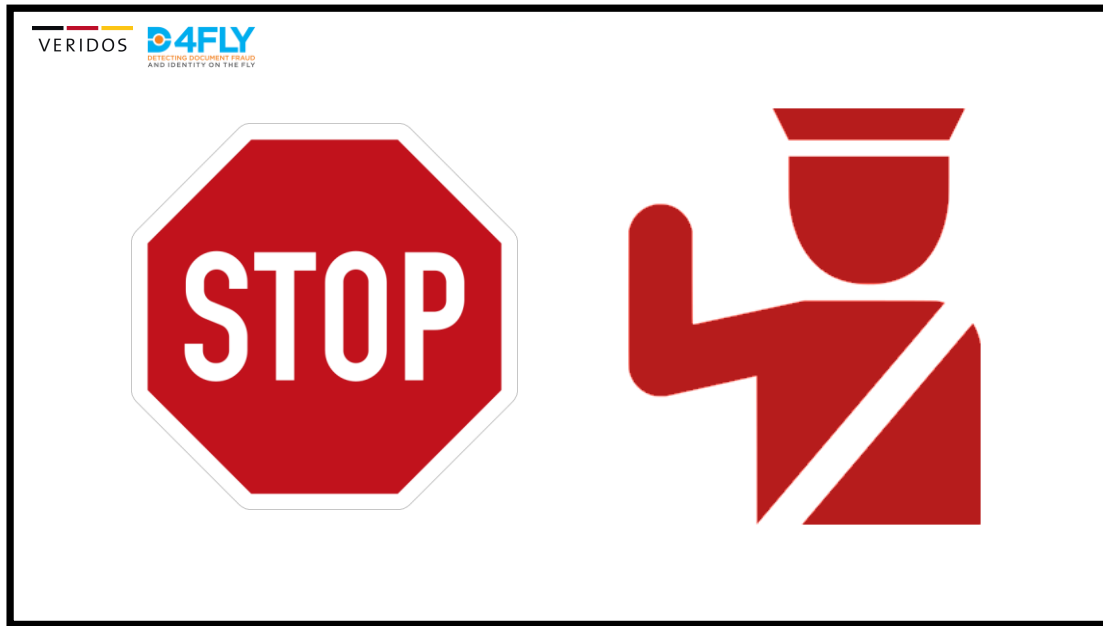


FIGURE 4-26 ENTRY SCREEN: NO ENTRY

This is the screen shown when the system is activated:

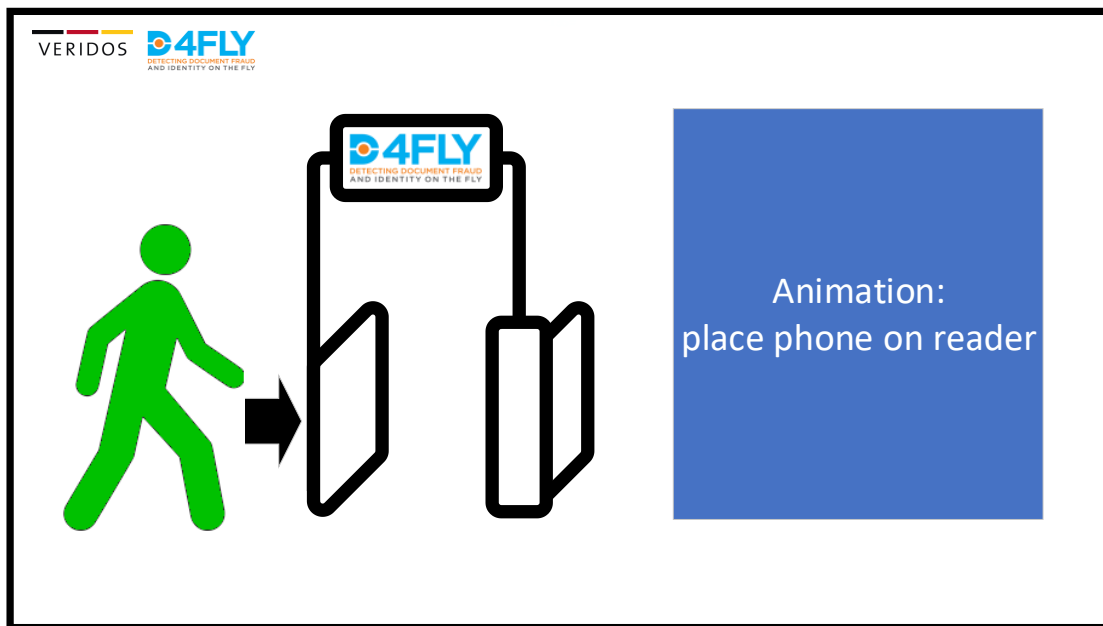


FIGURE 4-27 ENTRY SCREEN: PLEASE ENTER

This screen is shown if there is currently a person walking through the corridor and entering would not leave enough distance for proper guidance at the exit.

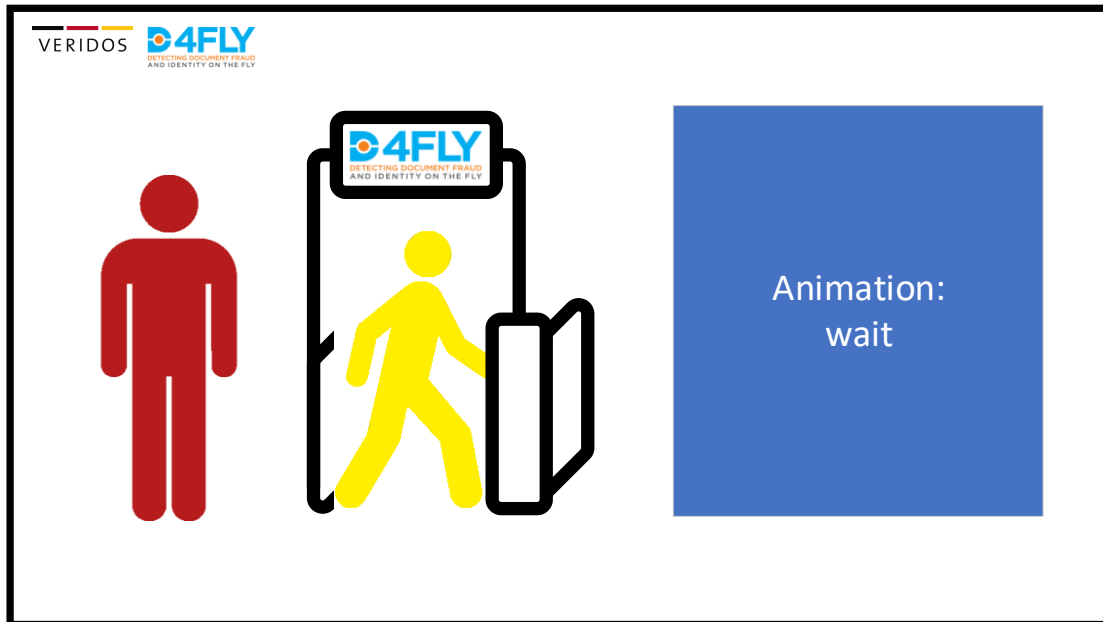


FIGURE 4-28 ENTRY SCREEN: PLEASE WAIT

4.11.2 In corridor screen

This screen is shown if the verification has been successful and the traveller can proceed to the luggage pickup/customs. There will also be a door in the corridor enforcing the direction.

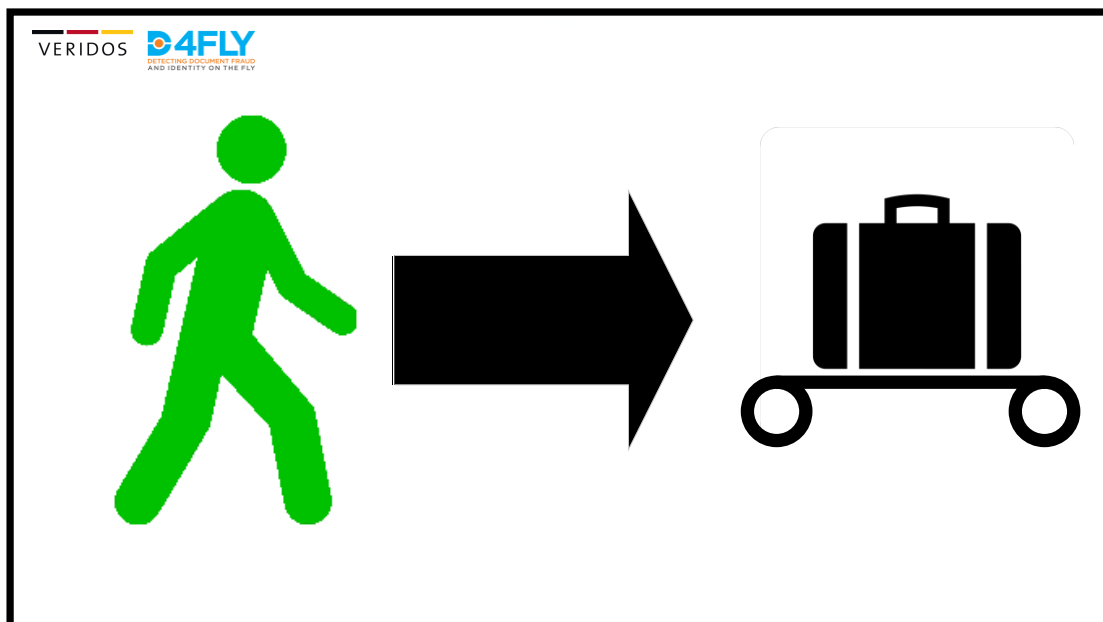


FIGURE 4-29 IN CORRIDOR SCREEN: PROCEED TO LUGGAGE PICKUP

This screen is shown if the verification has not been successful and the traveller has to proceed to manual control. There will also be a door in the corridor enforcing the direction.

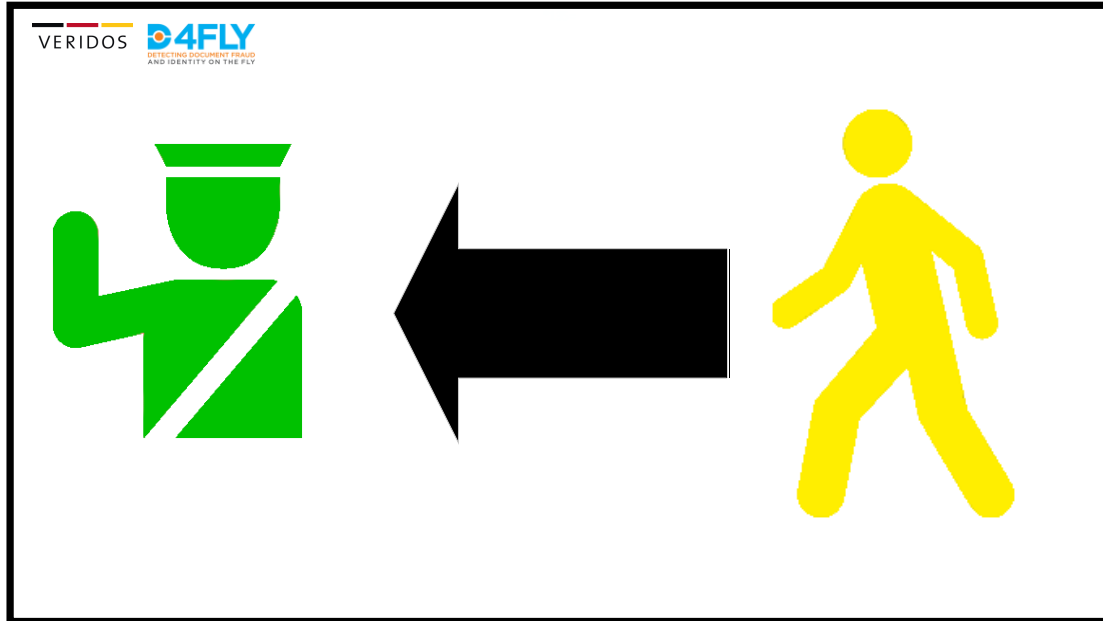


FIGURE 4-30 IN CORRIDOR SCREEN: PROCEED TO MANUAL CONTROL

5 UI FOR ADVANCED IMPOSTER FRAUD COUNTERMEASURES

5.1 Scenario Description

1. Border guard (BG) asks traveller for his passport.
2. BG puts the data page of the passport on the passport reader.
3. The overall printing layout in UV, IR and visible light of the page is checked to be genuine
4. The digital information is read out.
5. The passport is recognized (Country of Origin) based on the MRZ (state-of-the-art).
6. The digital information is checked (background checks, risk assessment)
7. The BG gets a visual display, indicating if irregularities were identified and further investigation is needed.
8. The BG is guided through the manual face verification by an UI on the screen

5.2 System description

The system consists of:

- a standard PC or laptop
- a screen (monitor)
- a keyboard
- a mouse
- an advanced document reader

5.3 Requirements

- The system shall be usable by a trained border guard
- The system is intended for the 1st line of control. One handed operation is to be considered.

5.4 Control flow

The control flow of the border guard station is very similar to a standard flow of today's border control systems in the European Union. The flow is extended by screens providing information on imposter fraud check results.

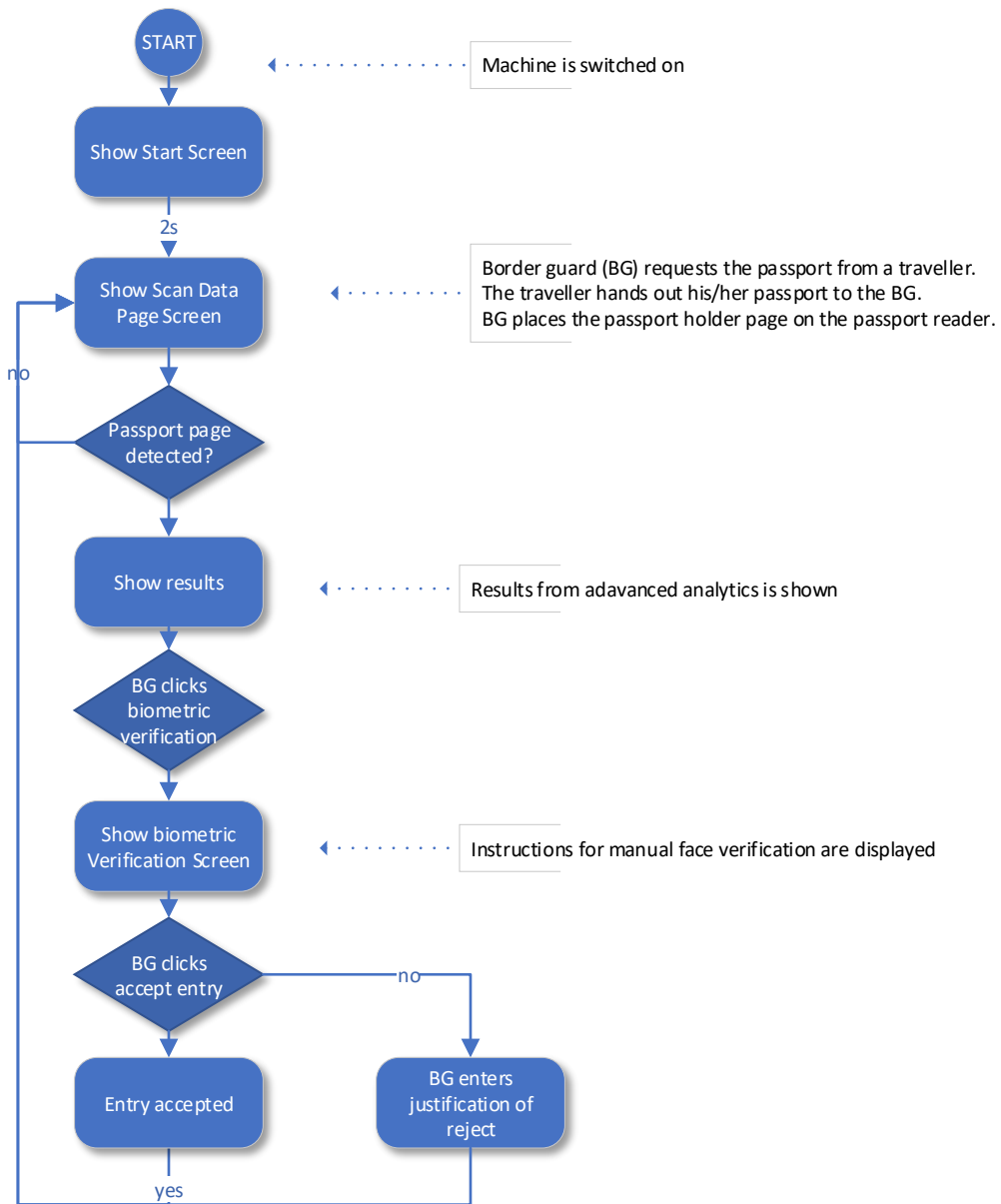


FIGURE 5-1 CONTROL FLOW OF BORDER GUARD STATION

5.5 Visual UI Design

The UI consist of 3 screens related to standard document verification information, biometric verification and in case of a reject, a justification.

5.5.1 Screen Scan data page

This screen is displayed as long as no passport has been scanned, yet.

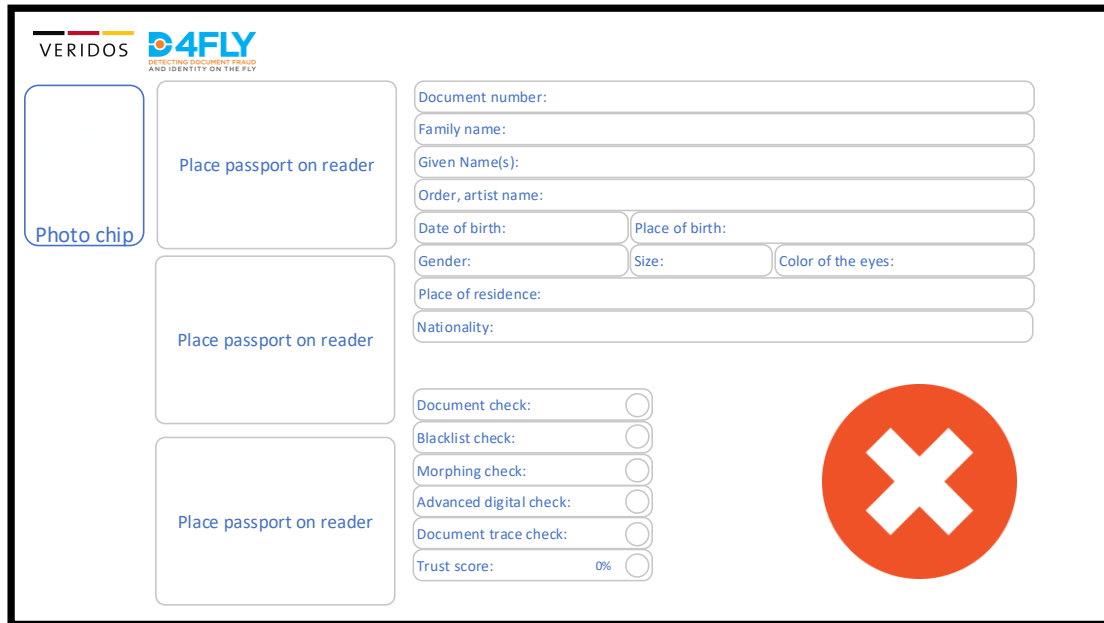


FIGURE 5-2 SCREEN: SCAN DATA PAGE

5.5.2 Screen Scan Results

This screen provides detailed information on the document checks. In addition to the standard checks, checks on morphing, cryptographic integrity and document tracing are added.

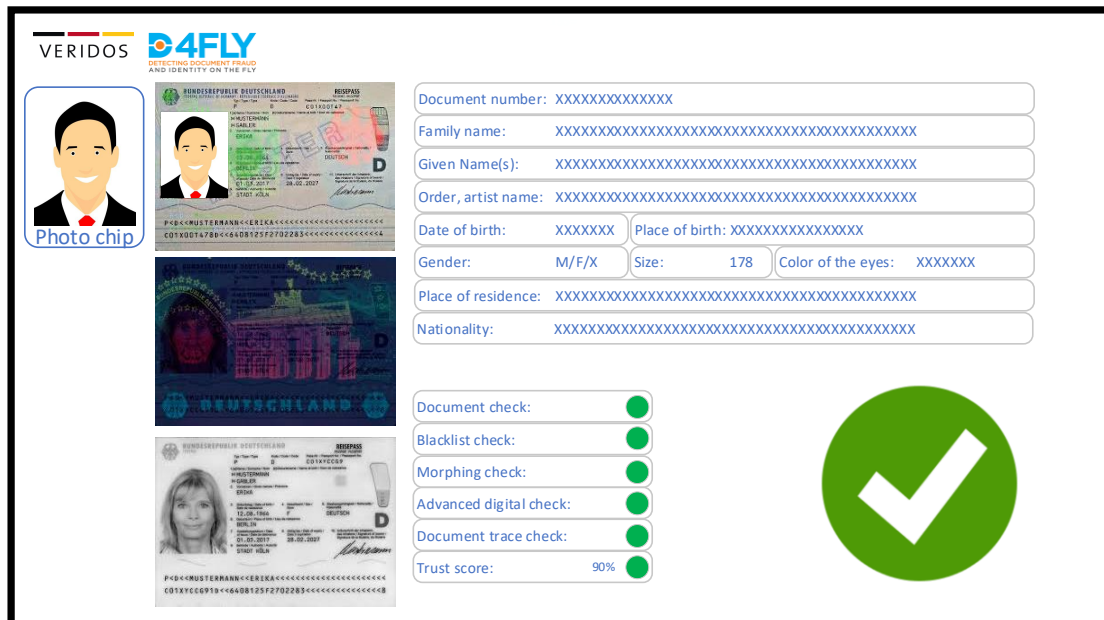


FIGURE 5-3 SCREEN: SCAN RESULTS

5.5.3 Screen: Biometric Verification

This screen supports the biometric verification check. If there is no biometric verification of the face available, the system will show the border guard which features of the face should be checked manually.

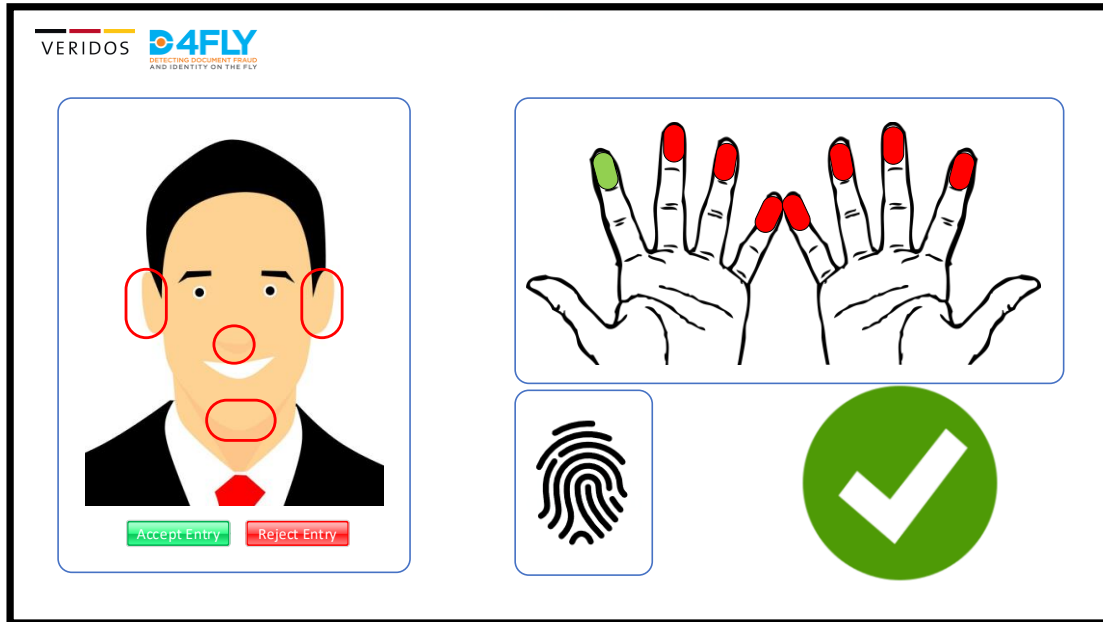
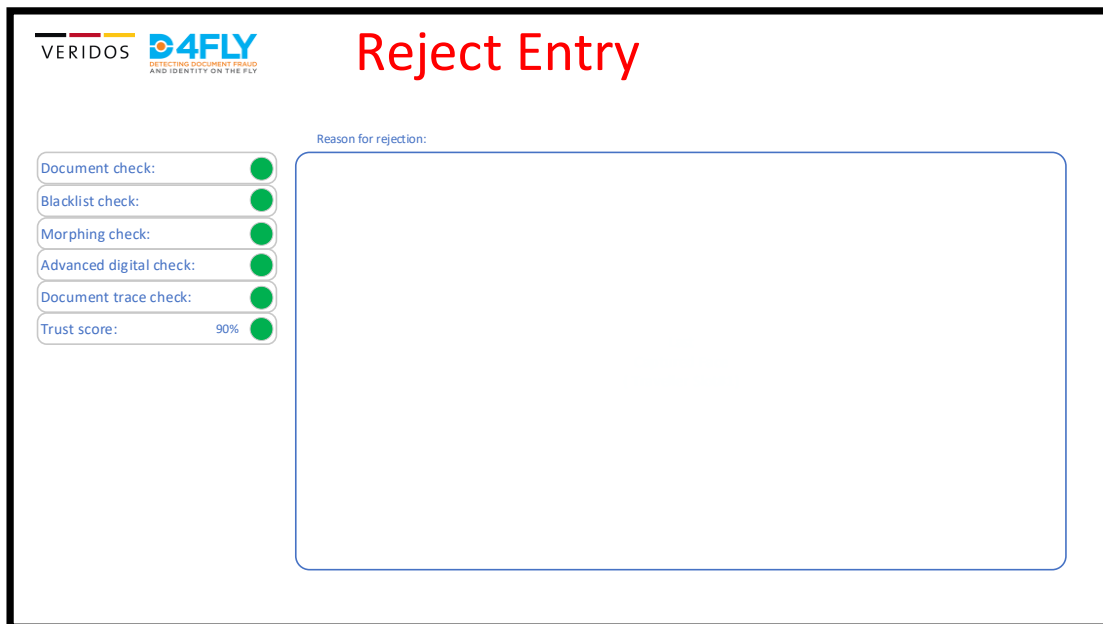


FIGURE 5-4 SCREEN BIOMETRIC VERIFICATION

5.5.4 Screen: Reject Entry

In case of a reject, the border guard can give a short explanation for his fellow officers.



6 COACH SCENARIO

6.1 Scenario Description

For better understanding of the following Ui designs the main process steps in this use case are noted here:

1. A traveller is arriving in the waiting area of the coaches departure hall.
2. He approaches the pre clearance kiosk and starts the kiosk application.
3. He accepts the consent form.
4. He enters his travel data or scans the barcode on his ticket (coach number, ticket)
5. The traveller places his passport on the reader, which is part of the kiosk.
6. The passport reader verifies the genuine of the passport
7. A background check on searched persons is performed, based on the biographic data
8. The passport holder is identified using the image stored in the passport
9. Up-to-date 2D Face image is enrolled
10. The dataset and verification results are transmitted to the border control system of the relevant border crossing
11. In case the background check fails, the traveller is informed to go to the helpdesk
12. The traveller leaves the kiosk and boards the coach.
13. The coach arrives at the border.
14. The border guard takes his mobile devices, starts the D4FLY-App and enters the coach number.
15. The D4FLY-App transfers the data of all pre-registered passengers in the coach onto the border guard's mobile device.
16. The border guard boards the coach.
17. The border guard performs a 2D-face recognition using the D4FLY-App. The status of the recognized passenger is shown to the border guard .
18. In case the face recognition does not work as expected, the border guard scans each passport MRZ and the verification status for the passport is displayed together with the recent 2D face image.
19. After all the passengers have been checked successfully, the border guard leaves the coach and the coach continues its journey

6.2 System description

- Border guard: Smartphone with an android application
- Enrolment kiosk
 - Touchscreen
 - Passport reader
 - Face camera

6.2.1 Kiosk

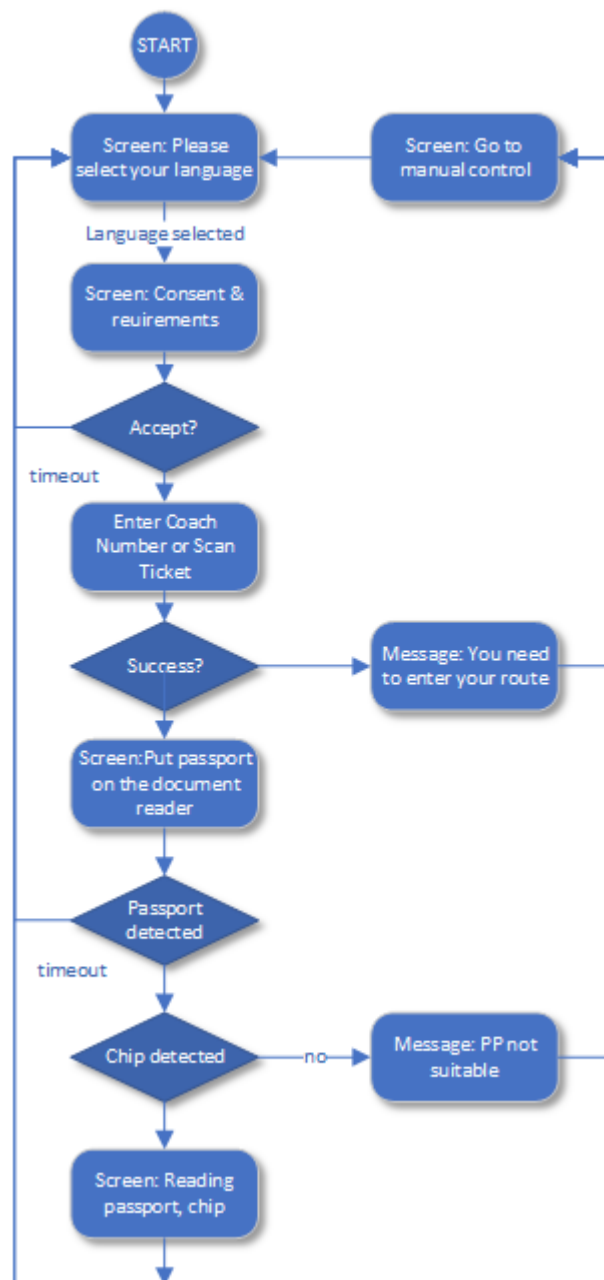
- The kiosk shall be usable by untrained travellers.
- It has to be adjustable to different body heights.
- It shall be usable by a touch screen.
- When doing face recognition the UI has to adapt to enable best sensor data.
- The UI has to make sure that the user is looking in the cameras when data acquisition takes place.

6.2.2 Border Guard App

- The border guard must be able to verify the results of each traveller.
- The border guard app shall be usable by a trained border guard.
- The border guard app has to be usable in the confined space of a coach.

6.3 Control flow of kiosk

The control flow of the kiosk is very similar to the biometric corridor scenario. Since no additional biometrics have to be enrolled, the steps have been removed. In this scenario also no smartphone of the traveller is involved. Therefore the smartphone steps have been removed. To get the connection to the used coach, the entry of a coach number has been added.



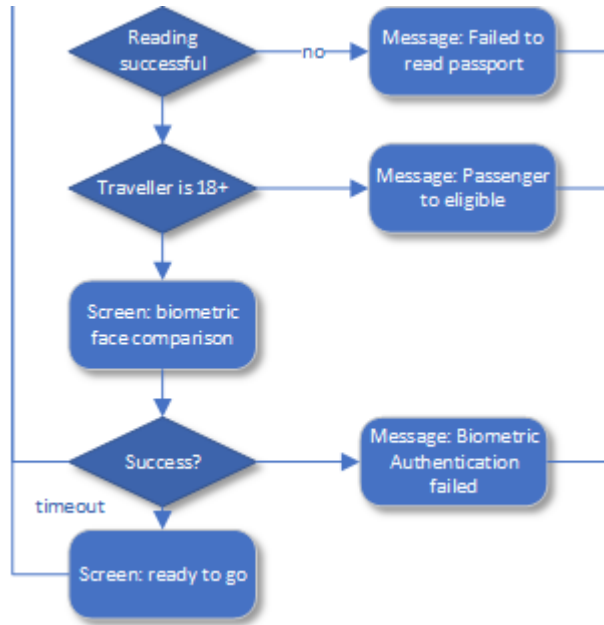


FIGURE 6-1 CONTROL FLOW OF THE KIOSK

6.4 Visual UI Design of kiosk

The visual design is also very similar to the biometric corridor scenario.



FIGURE 6-2 SCREEN: PLEASE SELECT YOUR LANGUAGE

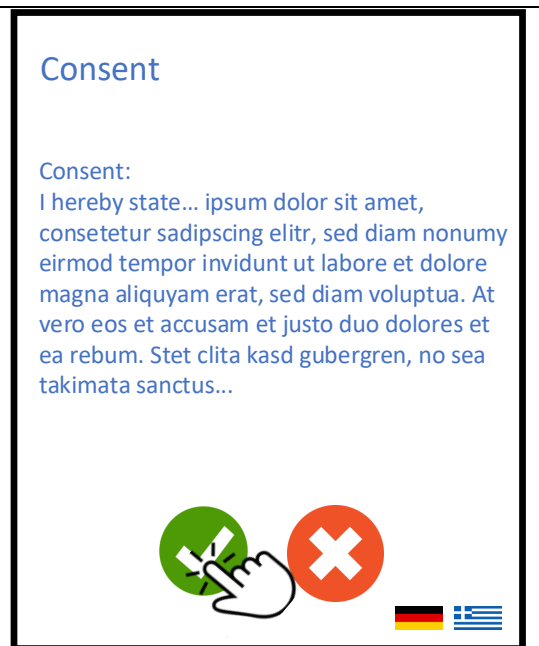


FIGURE 6-3 SCREEN: CONSENT

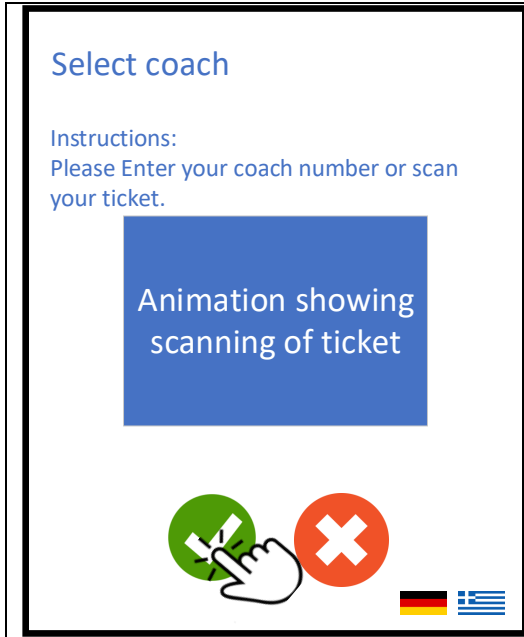


FIGURE 6-4 SCREEN: SCAN TICKET

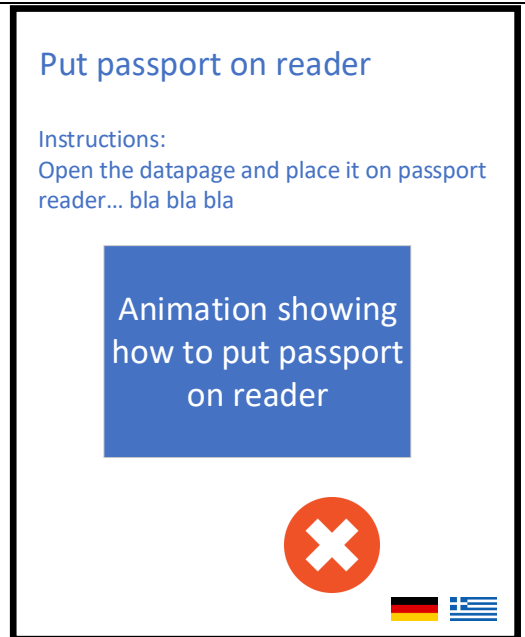


FIGURE 6-5 SCREEN: PUT PASSPORT ON DOCUMENT READER

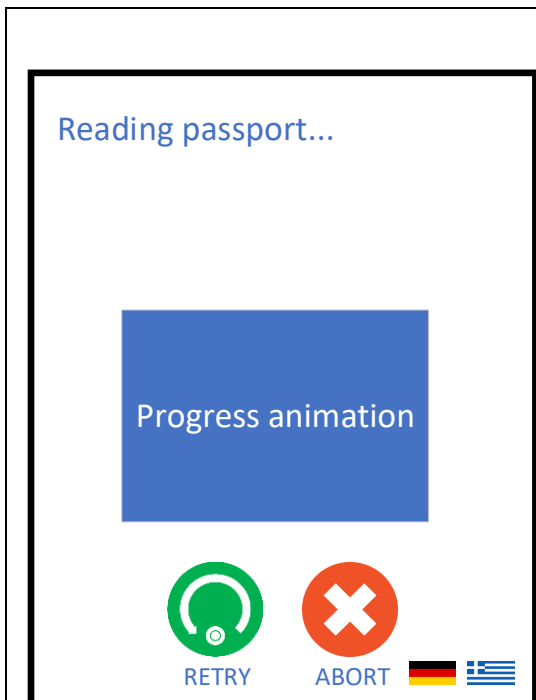


FIGURE 6-6 SCREEN: READING PASSPORT

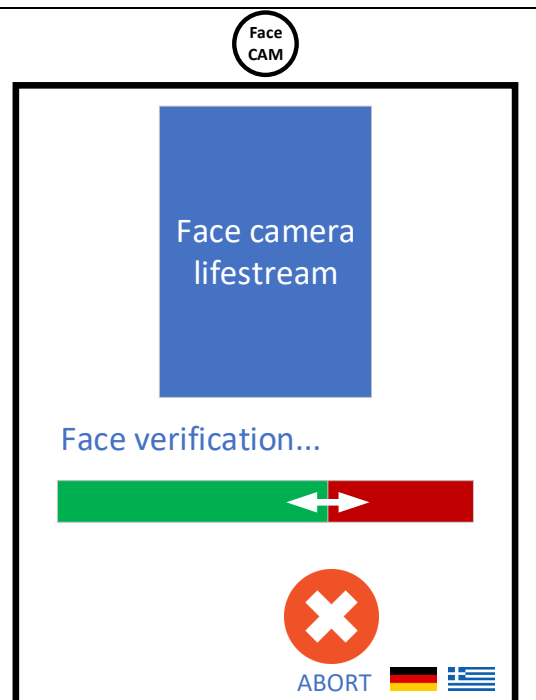


FIGURE 6-7 SCREEN: BIOMETRIC FACE COMPARISON

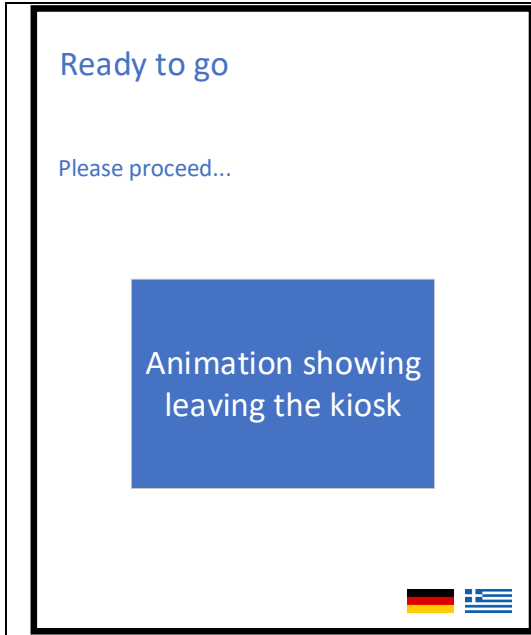


FIGURE 6-8 SCREEN: READY TO GO

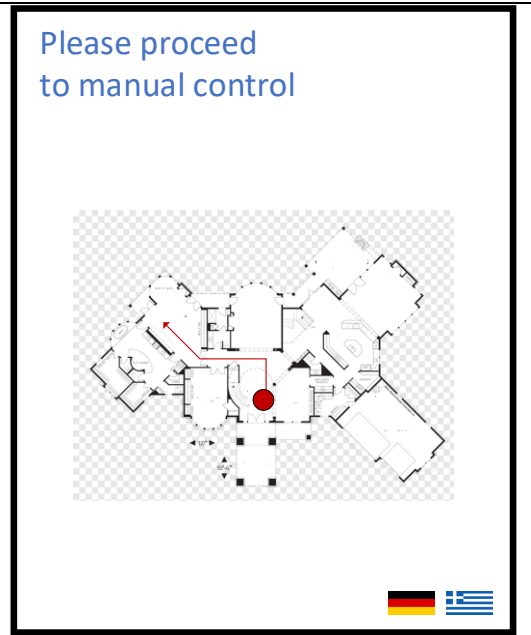


FIGURE 6-9 SCREEN: GO TO MANUAL CONTROL

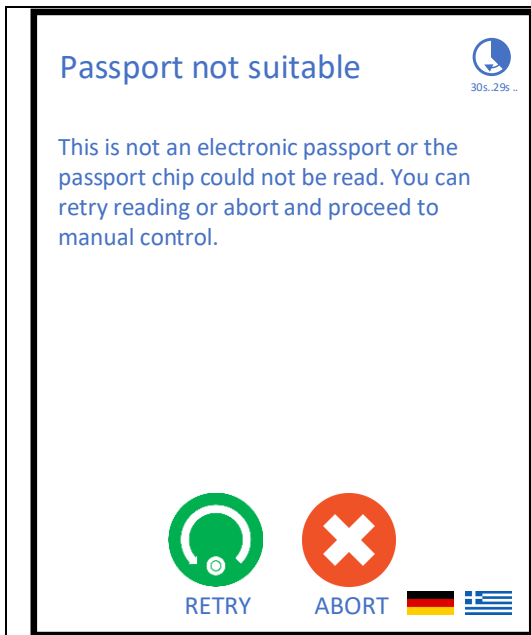


FIGURE 6-10 MESSAGE: PASSPORT NOT SUITABLE

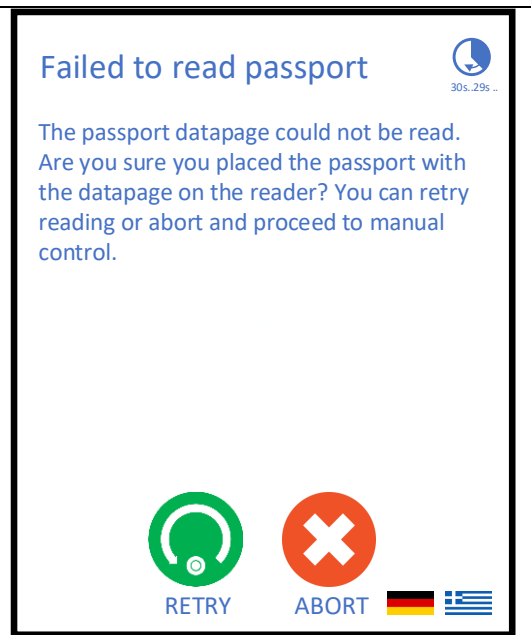
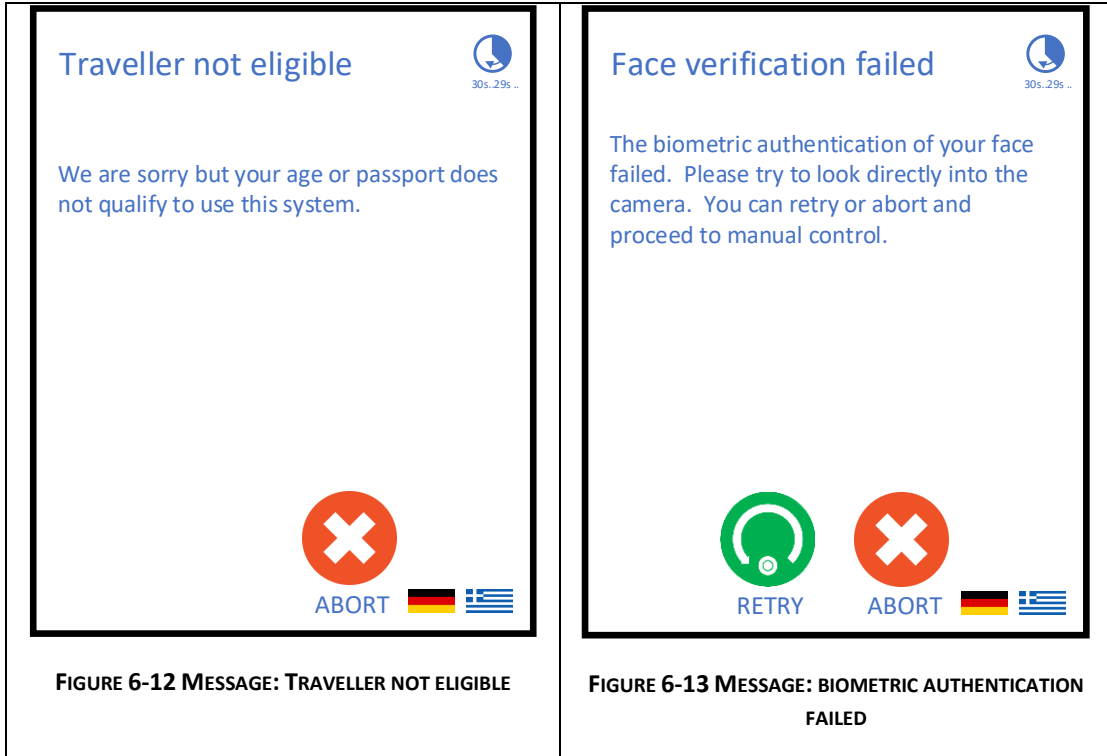


FIGURE 6-11 MESSAGE : FAILED TO READ PASSPORT



6.5 Control flow of app

The control flow of the border guard app has been designed as simple and intuitive as possible. After the border guard has entered the coach number, one hand operation is possible unless a traveller has to be rejected or the face cannot be verified.

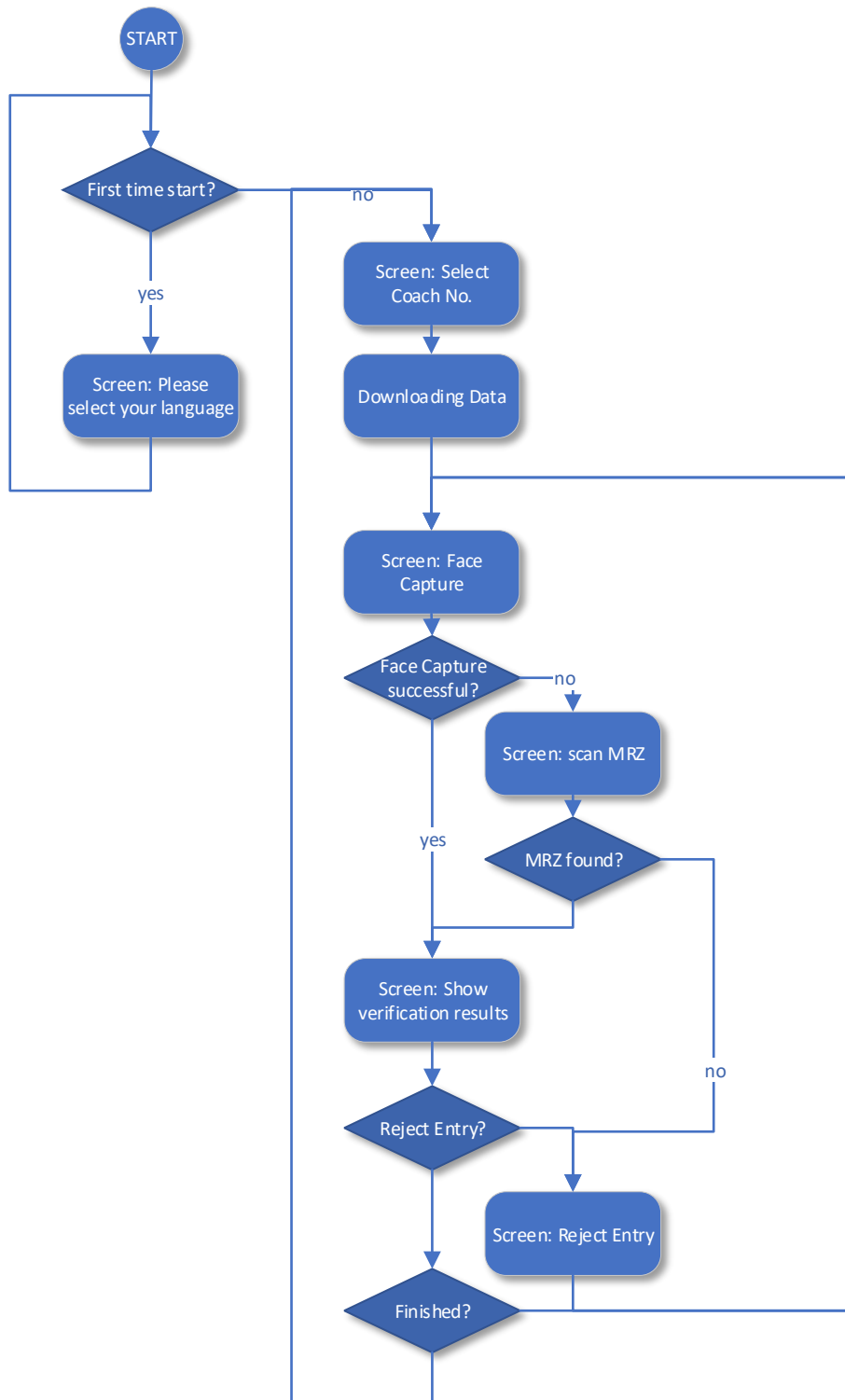


FIGURE 6-14 CONTROL FLOW APP

6.6 Visual UI Design of app

Displaying information for the border guard that is usually viewed on an at least 20" size screen on a smartphone is very challenging. Adaptions on the screens are likely after the first feedback from the field tests.



FIGURE 6-15 SCREEN: CHOOSE LANGUAGE



FIGURE 6-16 SCREEN: ENTER COACH NUMBER

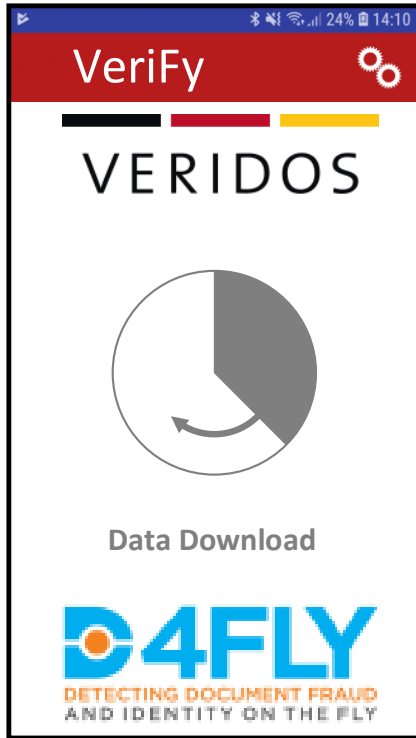


FIGURE 6-17 SCREEN: DATA DOWNLOAD



FIGURE 6-18 SCREEN: FACE CAPTURE

The document information screen might have to be distributed over several swipe screens for clarity and text size. This will be evaluated in the first integration and field tests.

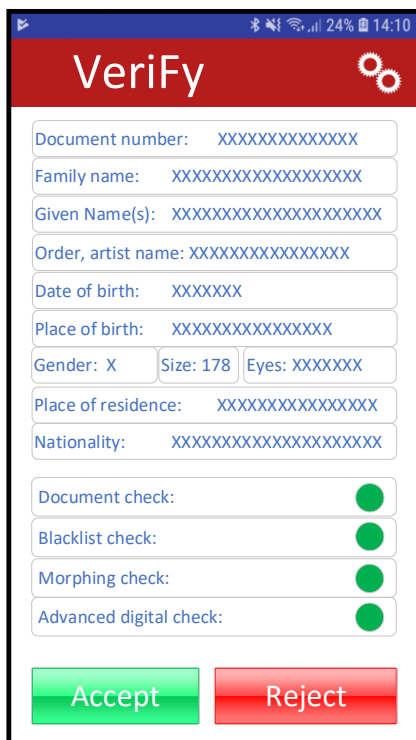


FIGURE 6-19 SCREEN: VERIFICATION RESULTS



FIGURE 6-20 SCREEN: REJECT ENTRY

7 CONCLUSIONS

User interaction is a very important aspect in the D4FLY system. The main target users are either travellers, who enrol their data at an enrolment kiosk and at a later stage interact with the system by using the biometric corridor for identity verification or border guards, who operate the system using its features for document verification or identity verification.

The user interactions happen on different types of screens and are based on different operating systems with different user interface design options. There is desktop monitors, operated with mouse and keyboard, touchscreen monitors and applications on a smartphone.

In this document the basic concepts and guidelines for the design of the user interfaces are described, with examples and first draft screens for the various system configurations for the scenarios as they are described in the Grant Agreement of the project.

The document shall serve as a guideline and specification for the development of the different UIs on the different terminals, that the target users will face.

In the course of the further project, the following steps shall be followed:

- UIs will be developed according to the guidelines in this document for the desktop monitor UI, the enrolment kiosk UI, the border guard station at the biometric corridor, as well as the smartphone applications used in connection with the biometric corridor scenario and the coach scenario.
- User feedback will be collected in various ways, during internal tests as well as the field tests
- The feedback will be analysed and improvements will be defined for the user interfaces
- The improvements will be incorporated and the improved UI will be used in subsequent internal tests, the field tests and the final demonstrations.

By using this successive refinement methodology, following an agile approach, the user interfaces shall be designed for ease of use and best efficiency for the targeted user groups.

REFERENCES

Psaila, J., 2016. *Deloitte*. [Online]
Available at: <https://www.deloittedigital.com/mt/en/news/2016/12/the-principles-of-user-interface-design-357>
[Accessed 10 May 2020].

LIST OF FIGURES

| | |
|--|----|
| Figure 3-1 Control flow enhanced passport verifier | 12 |
| Figure 3-2 General screen layout | 13 |
| Figure 3-3 Scan data page screen..... | 14 |
| Figure 3-4 Scan visa page screen..... | 14 |
| Figure 3-5 Screen printing techniques details..... | 15 |
| Figure 3-6 Screen OVI / MLI check | 16 |
| Figure 3-7 Screen face morphing results..... | 16 |
| Figure 3-8 Screen chip data analysis | 17 |
| Figure 3-9 Screen kinegram checker | 17 |
| Figure 3-10 Screen travel pattern analysis | 18 |
| Figure 4-1 Control Flow Kiosk..... | 22 |
| Figure 4-2 Screen: Please select your language | 23 |
| Figure 4-3 Screen: Consent & requirements | 23 |
| Figure 4-4 Screen: Install mobile app | 23 |
| Figure 4-5 Screen: put mobile phone on reader | 23 |
| Figure 4-6 Screen: Put passport on document reader | 24 |
| Figure 4-7 Screen: Reading passport..... | 24 |
| Figure 4-8 Screen: Biometric face comparison..... | 25 |
| Figure 4-9 Screen: Enrol additional biometric..... | 25 |
| Figure 4-10 Screen: Ready to go..... | 25 |
| Figure 4-11 Screen: go to manual control | 25 |
| Figure 4-12 Message: passport not suitable | 26 |
| Figure 4-13 Message : failed to read passport..... | 26 |
| Figure 4-14 Message: Traveller not eligible | 26 |
| Figure 4-15 Message: biometric authentication failed | 26 |
| Figure 4-16 Control flow of border guard station | 27 |
| Figure 4-17 Border Guard Screen..... | 28 |
| Figure 4-18 Control Flow of App..... | 29 |
| Figure 4-19 Screen: Choose Language..... | 30 |
| Figure 4-20 Screen: Please proceed to kiosk..... | 30 |
| Figure 4-21 Screen: Credentials received..... | 30 |
| Figure 4-22 Screen: Enrolment successful..... | 30 |
| Figure 4-23 Screen: Proceed to border control..... | 31 |

Figure 4-24 Screen: Data transferred 31

Figure 4-25 Control Flow of Corridor..... 32

Figure 4-26 Entry screen: No entry 33

Figure 4-27 Entry screen: Please enter..... 33

Figure 4-28 Entry screen: Please wait 34

Figure 4-29 In corridor screen: Proceed to luggage pickup..... 34

Figure 4-30 In Corridor screen: Proceed to manual control..... 35

Figure 5-1 Control flow of border guard station 37

Figure 5-2 Screen: Scan data page 38

Figure 5-3 Screen: Scan Results..... 38

Figure 5-4 Screen Biometric Verification..... 39

Figure 6-1 Control Flow of the Kiosk 42

Figure 6-2 Screen: Please select your language 42

Figure 6-3 Screen: Consent..... 42

Figure 6-4 Screen: Scan Ticket..... 43

Figure 6-5 Screen: Put passport on document reader 43

Figure 6-6 Screen: Reading passport..... 43

Figure 6-7 Screen: Biometric face comparison..... 43

Figure 6-8 Screen: Ready to go..... 44

Figure 6-9 Screen: go to manual control 44

Figure 6-10 Message: passport not suitable 44

Figure 6-11 Message : failed to read passport..... 44

Figure 6-12 Message: Traveller not eligible 45

Figure 6-13 Message: biometric authentication failed 45

Figure 6-14 Control Flow App..... 46

Figure 6-15 Screen: Choose Language..... 47

Figure 6-16 Screen: Enter coach number 47

Figure 6-17 Screen: Data download 48

Figure 6-18 Screen: Face capture 48

Figure 6-19 Screen: Verification results 48

Figure 6-20 Screen: Reject entry 48

Figure 6-21 Screen: Scan MRZ..... 49