6.4. Annex 4: Design and Mockup of the Interface

6.4.1. Interface Design

Interface for Referring physician

First of all, the referring physician logs in their working session by introducing their ID, and their password and pressing enter or clicking on the arrow. Afterward, the physician must select one of the two options depending on whether they want to register a new patient (for which a new ID will be generated) or want to search an existing patient in the database.

Figure 1: Referring physician Login.

Then, the clinician has to enter the necessary information for the patient and check the checkbox ‘Petition for CCTA acquisition’ if the patient needs a CCTA (Figure 2).

Figure 2: System to report clinical and demographic patient information.

Interface for Cardiac Imaging administration

From the information inputted by the referring physician, patients needing a CCTA will be ordered by priority for acquisition. This order will be shown to the Cardiac Imaging administrator in charge of scheduling CCTA acquisitions with the corresponding explainability of the results by clicking on the information button at the right of the patient.

Figure 3: CCTA Acquisition order and Explainability of CCTA Acquisition order.

From this CCTA Acquisition optimal order, the Cardiac Imaging administrator will schedule the CCTA acquisitions linked to the corresponding day and Cardiac Imaging Expert (Figure 4).

Figure 4: CCTA Acquisition scheduled order.

Interface for CCTA technician

After image acquisition, the technician will input the technique information into the database (Figure 5).

Figure 5: System to report technique-related information.

Interface for Cardiac Imaging Expert

After running the algorithm in the backlog, the Cardiac Imaging Expert will log in to their session (Figure 6) by introducing their ID, and their password and pressing enter or clicking on the arrow. Each session of each Cardiac Imaging Expert will have a worklist of ordered patients to evaluate that workday (Figure 7).

Figure 6: Cardiac Imaging Expert Login.

Figure 7: Cardiac Imaging Expert Working List. Order of Report Assessment.

Next to each patient to be evaluated, the clinician can see critical values that provide a reference for the resulting order. Moreover, the clinician can click on the information button to have a detailed explainability as to why that patient is in that particular order. The explainability of each result varies if the patient has undergone or not the AI workflow (Figure 8 and Figure 9).

Figure 8: Explainability of the position in the reporting list for patients undergoing the automatic AI image analysis.

Figure 9: Explainability of the position in the reporting list for patients not undergoing the automatic AI image analysis.

The Cardiac Imaging Expert can choose which patient they want to report by clicking on the 'Validate report' or 'Report' buttons. For the chosen patient, the corresponding database will open with all the information registered (Figure 10). Filled fields are non-modifiable while non-filled ones should be checked and validated by the Cardiac Imaging Expert.

To validate the image information, the clinician will be shown another window with the original CCTA coronary tree with the superposed automatic segmentation and the labeled segments (Figure 11).

Figure 10: Reporting system with the information automatically filled.

Figure 11: Visual support window.

The clinician can change the necessary information from the automatic preliminary report such as the coronary tree dominance (Figure 12) or stenosis degree range of segments. Upon clicking on one segment of the visual support window, the corresponding CPR will be shown and the clinician will be able to correct the label and the stenosis range if needed (Figure 13).

Figure 12: Correction of the coronary tree dominance.

Figure 13: Correction of the p-LAD artery stenosis degree range.

Moreover, the Cardiac Imaging Expert can delete non-existing segments by clicking the ‘trash’ button and add non-detected vessels by clicking the ‘+’ button (Figure 14 and Figure 15).

Figure 14: Addition of the coronary artery D2 using the visual supporting window.

Figure 15: Addition of the coronary artery D2 using the reporting system.

6.4.2. Interface Mockup

The interface mockup has been developed using the PyQt library of Python, following the design proposed in section 6.4.1. Due to technical limitations and feedback from clinical implementation, the most recent version of the generated interface mockup may differ in some aspects from the original design presented in section 6.4.1.

Figure 16: Login Window and Actions to Perform. Depending on the user's permissions, access to the requested actions may vary.

Figure 17: Register/Search a patient window.

Figure 18: Register a patient system to enter all the clinical data necessary.

Figure 19: Search a patient system with all the clinical data related to the patient searched.

CCTA Acquisition List

CCTA Acquisition Order

Order	ID	Age	Sex	Chest pain	Diabetes	Hypertension	Dyslipidaemia	Smoking	CACs	Model	%risk
1 (before: 14)	920835	67	Male	Typical	Yes	No	Yes	No	-	Clinical	68.85
2 (before: 4)	920831	82	Male	Non-specific	No	No	Yes	No	-	Clinical	58.61
3 (before: 10)	920836	54	Male	Typical	No	Yes	No	Yes	-	Clinical	48.45
4 (before: 13)	920826	69	Male	Atypical	No	No	Yes	Yes	-	Clinical	39.82
5 (before: 5)	920825	57	Male	Typical	No	No	No	No	-	Clinical	33.74
6 (before: 8)	920838	55	Male	Typical	No	No	No	No	-	Clinical	31.02
7 (before: 7)	920833	74	Male	Non-specific	No	No	Yes	No	-	Clinical	23.2
8 (before: 3)	920832	85	Female	Atypical	No	No	Yes	No	-	Clinical	22.9
9 (before: 9)	920834	69	Male	Atypical	No	No	No	No	-	Clinical	21.48
10 (before: 1)	920837	79	Male	Non-specific	No	No	No	No	-	Clinical	21.27
11 (before: 15)	920824	57	Male	Atypical	No	No	No	Yes	-	Clinical	17.09
12 (before: 6)	920830	60	Male	Non-specific	No	Yes	Yes	No	-	Clinical	15.1
13 (before: 11)	920829	72	Female	Non-specific	No	No	No	Yes	-	Clinical	6.82
14 (before: 2)	920827	61	Female	Non-specific	No	No	No	No	-	Clinical	2.28
15 (before: 12)	920828	45	Female	Non-specific	No	Yes	No	No	-	Clinical	1.2

Figure 20: CCTA Acquisition list ordering the generated patients. CACs: CAC score.

Working List

Working List

Urgent study	Order	Patient	Priority	CAD-RADS	Clinical info	Notes	Explainability	
True	1 (before: 4)	Vidal Alarcón	CRITICAL	4A*	Assessment of known coronary artery disease (not revascularized)		+	Validate
True	2 (before: 9)	Gracia Hoz	CRITICAL	4A*	Other		+	Validate
False	3 (before: 8)	Lalo Merino	CRITICAL	4A*	Other		+	Validate
True	4 (before: 14)	Loreto Benavent	HIGH	-	Other	Stent/ACTP	+	Report
False	5 (before: 12)	Amílcar Córdoba	HIGH	4B	Other		+	Validate
False	6 (before: 7)	Augusto Cervera	MEDIUM	3	Screening for coronary artery disease in cardiomyopathy		+	Validate
True	7 (before: 5)	Plácido Alegría	MEDIUM	3	Other		+	Validate
True	8 (before: 1)	Iris Berrocal	MEDIUM	3	Other		+	Validate
True	9 (before: 3)	Ileana Armengol	MEDIUM	3	No information		+	Validate
False	10 (before: 11)	Fabio Andrés	MEDIUM	3	Other		+	Validate
True	11 (before: 13)	Rodolfo Roselló	MEDIUM	-	Chest pain/atypical symptoms in patient without known CAD		+	Report
True	12 (before: 2)	Reinaldo Carrasco	MEDIUM	-	Nonspecific ECG/Holter alteration	Suboptimal	+	Report
False	13 (before: 10)	Evita Bas	LOW	2	Other		+	Validate
True	14 (before: 15)	Jose Antonio Lucena	LOW	2	Chest pain/atypical symptoms in patient without known CAD		+	Validate
True	15 (before: 6)	Joel Carranza	LOW	2	Checkup, patient without cardiologic symptomatology or known coronary artery disease		+	Validate

Figure 21: CCTA Assessment list in order of priority after conducting the automatic AI-based analysis of the CCTA images (if applicable). Patient names are randomly generated.

Explainability

Clinical Information

- Patient presenting Atypical chest pain and under the consultation motive: Assessment of known coronary artery disease (not revascularized).
- Patient has a Pre-Test Risk Score of 83.7%.
- Patient does not have any previous procedures reported.
- Study was an URGENT request.

Image Analysis Information

Patient has a CAD-RADS value of 5
Maximum stenosis degrees of the main vessels are LAD=25-49, Cx=25-49 and RCA=50-69.

Patient presents a detected calcium score of >400 through Agatston score.

Curved Planar Reformations (CPR)

LAD

Cx

RCA

Figure 22: Explainability for the patient's order in the CCTA Assessment list which has gone through automatic AI analysis of the CCTA image.

Figure 23: Explainability for the patient's order in the CCTA Assessment list which has not gone through automatic AI analysis of the CCTA image.

Figure 24: Snapshot of the interface displaying the integrated algorithm for generating preliminary case reports. This interface presents Cardiac Imaging Experts with the patient's clinical information alongside data automatically extracted from the CCTA image. D1: first diagonal. D2: second diagonal. d-LAD: distal segment of LAD. RI: ramus intermedius. OM1: first obtuse marginal. OM2: second obtuse marginal. d-Cx: distal segment of Cx. LPL: left posterolateral artery. LPD: left posterior descending artery. d-RCA: distal segment of RCA. RPL: right posterolateral artery. RPD: right posterior descending artery.

Figure 25: Snapshot of the interface displaying the integrated algorithm for generating preliminary case reports. This interface presents Cardiac Imaging Experts with only the patient's clinical information since data could not be automatically extracted from the CCTA image due to the stent. D1: first diagonal. D2: second diagonal. d-LAD: distal segment of LAD. RI: ramus intermedius. OM1: first obtuse marginal. OM2: second obtuse marginal. d-Cx: distal segment of Cx. LPL: left posterolateral artery. LPD: left posterior descending artery. d-RCA: distal segment of RCA. RPL: right posterolateral artery. RPD: right posterior descending artery.

Figure 26: Corrections introduced in the reporting system regarding the stenosis degree range of some segments and the addition of plaque type.

Figure 27: Visual Support Windows Consisting of a 3D Visualization of the Segmented Coronary Tree, Raw CCTA Images in Coronal, Axial, and Sagittal Axes with Overlapping Segmented Coronary Vessels, and CPRs of Selected Vessels.

Figure 28: Final case report validated by the clinician with non-modifiable data.

Figure 29: Final case report for RIS upload.