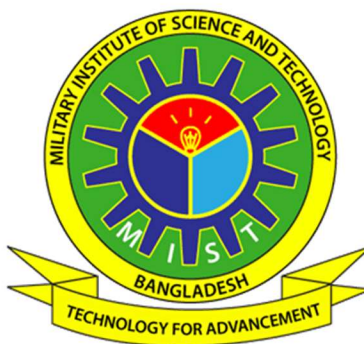


MILITARY INSTITUTE OF SCIENCE AND TECHNOLOGY



Dept. of Computer Science and Engineering

Software Requirements Specification (SRS) for Thermique

Version 3.0

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1. Preface

Thousands of commoners can get contaminated by coronavirus if a COVID infected person comes in close contact with those people. No one knows certainly when this disease will disappear completely and many countries are unable to afford keeping the offices and institutions closed any further. In a situation like this, there is a high risk of spreading of coronavirus, creating more health disaster and taking away more lives.

In order to stop further infection of the disease, detection of COVID infected persons by recording the temperature of every individual at the entrance of an institution are the aims of *Project Thermique*. The temperature will be recorded in a database table against every person's name and ID. The admin or monitoring body will be immediately notified if anyone has a higher thermal reading and will soon be isolated to avoid interaction with the mass public.

2. Introduction

2.1 Purpose

Identification & quick isolation of COVID-infected persons to prevent further spread of the disease in cost-effective way is the purpose of this project. The exact body temperature of every person entering a building will be recorded from his facial expressions in real time using radiometric sensor.

2.2 Intended Audience

Developers willing to implement similar projects or interested in this field are the intended audiences, as the architecture model & its components required for developing the product & system are included in the document.

2.3 Product Scope

Designing of the product is done specifically for settlements, where individuals are to assemble, e.g. educational institutions, commercial organizations and offices with a large number of employees. Small organizations & NGOs will find the product affordable and can easily install the product in their office premises to ensure maximum safety of their employees as well.

3. Glossary

FLIR Lepton:

The FLIR Lepton is a radiometric-capable LWIR camera solution that is smaller than a dime, and is one tenth the cost of traditional IR cameras.

Raspberry Pi:

A single board computer that runs an embedded variant of Linux, and can be used to interface with peripheral modules.

Nvidia Jetson Nano:

A single board computer with Image processing capabilities, enhanced by Nvidia's CUDA-based architecture.

MariaDB:

An open source PL/SQL database.

NodeJS:

A server side program that is syntactically similar to Javascript, based on Chrome's V8 browser engine.

Radiometric Sensor:

A sensor that can detect temperature from an infrared feed, by measuring the radiation levels. Typically included in a few models of Lepton thermal camera modules.

CUDA:

CUDA is a parallel computing platform and application programming interface model created by Nvidia. It allows software developers and software engineers to use a CUDA-enabled graphics processing unit for general purpose processing. Applications range from game development, to AI enabled computer vision.

VNC:

Virtual Network Computing (VNC) is a graphical desktop-sharing system that uses the Remote Frame Buffer protocol to remotely control another computer.

4. Requirements Discovery

Very important and initial challenge in the epidemic of COVID-19 is to identify more probable patients out of a crowd of people. Once identified, probable patients may be sent for more Covid-19 test for identification [1]. At the same time, share facilities and shared usage of materials can be a potential cause of contamination of coronavirus [2].

From this arises the necessity of an automated system that can help in monitoring body temperature of individuals without coming in contact with them.

To collect the user requirements, several meetings were conducted with the lecturers, professor and head of the department of CSE in a reputed university and their suggestions were taken in every step of development to ensure the maximum user friendliness.

5. User Requirements

- The system will be able to detect exact temperature of a person and display the readings on a monitor at the entrance.
- The system would be able to store an individual's detected temperature & his/her info in a database according to time stamps upon completion of scanning, and the database will keep updating in real time for proper monitoring.
- The system will be able to identify the position of an individual's face upon facing the camera using facial detection and mark the location of face within the camera feed displayed on a monitor.
- The system will allow an individual entering the building only after the RFID card is scanned.
- If a person with high temperature is detected, then an immediate notification would be sent to authority so that, that person could be refrained from entering & increase the chances of possible COVID infection.
- The RFID scanner should be in such a position so that the user doesn't have to spend much time positioning himself in front of the camera to be scanned.
- Interface of the camera feed and database website will be responsive and user friendly.
- The scanner will response fast, so that, two users can scan within a time difference of five seconds.
- If a user scans more than once in 30 seconds, then the latest temperature will be recorded in the database table. However, if the time difference is more than 30 seconds, then all the temperatures will be recorded.
- The system will be robust and capable of scanning at a distance.

6. System Architecture

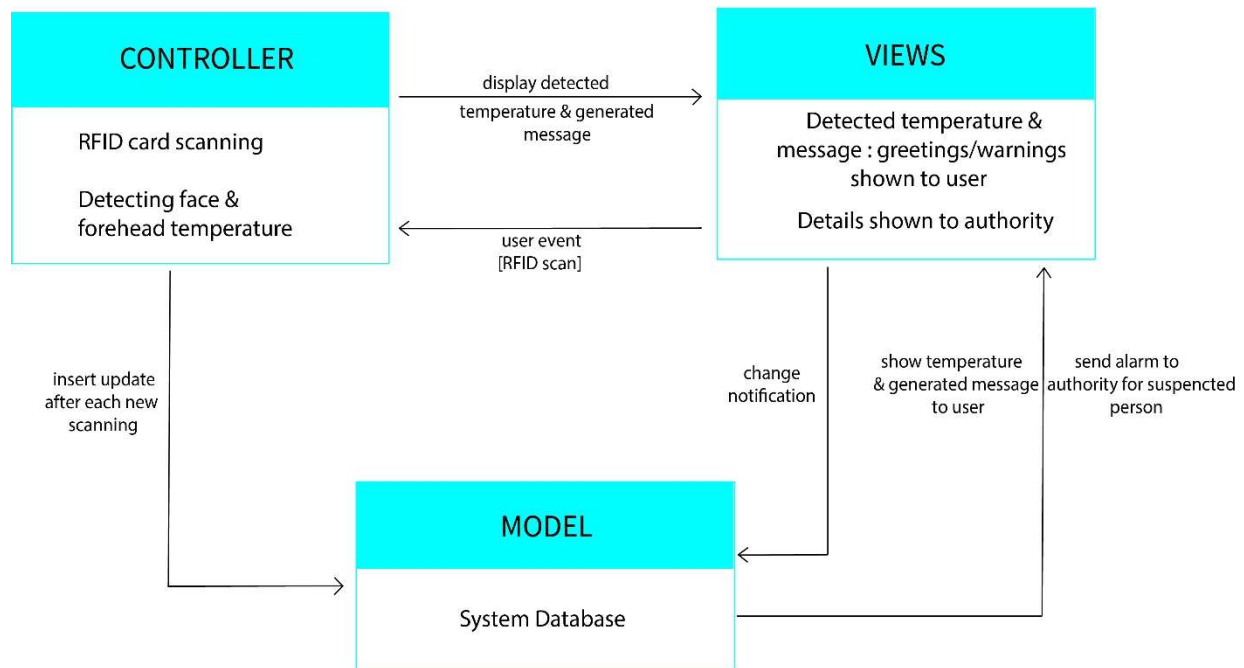


Figure-1: MVC Architecture for *Thermique* system

MVC (Model-View-Controller) architecture approach is followed in system *Thermique*. MVC pattern is generally used when there are multiple ways to view & interact with data supporting presentation of the same data in several ways & any change, which goes along perfectly with our system. Here, our system is structured in three logical components that'll interact with one another & these are:

Model Component: The Model Component will manage the system database & associated operations on those data as necessary. So, after each new scan, it'll enable insert/update of data & show according temperature, message & also send alert notice from the retrieved data.

View Component: This will define & manage how the data will be presented. So, this component will mainly manage displaying detected temperature of the user & generated message to both user & the authority.

Controller Component: This will basically manage user interactions which is RFID card scanning & facial detection of the user for our system, and will pass these interactions to Model & View component.

7. System Requirements Specification

7.1. The system will be able to detect exact temperature of a person and display the readings on a monitor at the entrance

- Using Lepton module, thermal feed will be taken to detect exact temperature of the person from the bounded region.

7.2. The system would be able to store an individual's detected temperature & his/her info in a database according to time stamps upon completion of scanning, and the database will keep updating in real time for proper monitoring

- A database system will be developed so that upon scanning, RFID number and measured temperature can be stored in that database along with the timestamp of scanning RFID.

7.3. The system will be able to identify the position of an individual's face upon facing the camera using facial detection and mark the location of face within the camera feed displayed on a monitor

- AI will be used to recognize exact face position and calculated co-ordinates will be sent to the lepton module

7.4. The system will allow an individual entering the building only after the RFID card is scanned

- The whole system will be set up at the entrance so that a person at first will scan his/her RFID & upon complete scanning, he/she can enter.

7.5. If a person with high temperature is detected, then an immediate notification would be sent to authority so that, that person could be refrained from entering & increase the chances of possible COVID infection

- A notification alert will be set up in our system so that when a high temperature is recorded in the database, the authority will receive that & note that person's info required to detect him/her & continue further procedure.

7.6. The RFID scanner should be in such a position so that the user doesn't have to spend much time positioning himself in front of the camera to be scanned

- In the system design, the RFID will be positioned such that a person can easily access it from a moderate distance & complete the scanning procedure.

7.7. Responsive camera feed interface & database website

- Two different camera modules will be used – Lepton and Pi-Cam.
- Thermal feed will be taken by Lepton module. Pi-Cam will be used to plug-in with the thermal feed and determine the position of the face from a bounded region within the thermal feed.
- Using AI, the position of face will be recognized and two co-ordinates are calculated and sent to the lepton module. From these co-ordinates, a rectangular bounded region will form.
- The maximum temperature will be synthesized within the bounded region is recorded.

7.8. Fast response time of the scanner

- The process of storing records will be initiated immediately after punching the RFID card.
- The moment the RFID is scanned, the maximum temperature around the forehead will be determined. RFID number and measured temperature will be stored in database along with the timestamp of scanning RFID.
- Pool connection will be used by the device, so that another user doesn't need to wait for the previous process to be completed. Thus, the scanning process will become faster.

7.9. If a user scans more than once in 30 seconds, then the latest temperature will be recorded in the database table. However, if the time difference is more than 30 seconds, then all the temperatures will be recorded.

- A user may look away from the camera while scanning the RFID, and this may cause storing of inaccurate records. In such cases, a user may want to rescan the RFID.
- If an RFID is rescanned within 30s, the system can determine it and to avoid redundancy, the previous record is replaced with the new one.

7.10. Robust system capable of scanning at a distance

- The system will be developed to reduce error as much as possible so that the maximum error is ± 1 °F.

8. Requirement Classification

Table-1: Categorization of User Specification

Sl. no.	User Specification	Type of requirement		Remarks
		Functional	Non-functional	
1	Temperature detection & displaying it	✓	✗	The whole system is based on detecting temperature
2	Storing detected temperature in a database after scanning & real time updating	✓	✗	Without storing temperature, a person of high temperature can't be detected
3	Facial detection & marking face location within camera feed	✓	✗	Without detecting face, the system won't function as it needs to detect face to get the temperature
4	RFID card scanning at entrance	✓	✗	Temperature & info of a person will be stored against scanned RFID num & time of scanning
5	Immediate notification sent to authority upon detecting a person with high temperature	✓	✗	Without alert, the authority won't be able to know whether a person with high temperature entered
6	Comfortable positioning of RFID scanner	✗	✓	It will make it easier for a person to scan his/her RFID from a moderate distance
7	Responsive & user-friendly UI	✗	✓	It will make it easier for that person to easily scan & get temp
8	Reduced server awaiting time	✗	✓	It will fasten the whole process & person next in line won't have to wait long
9	Fewer data redundancy for multiple scanning of same RFID card	✗	✓	This will prevent unnecessary data from the database & reduce data redundancy
10	Robust system capable of scanning at a distance	✗	✓	The system will be fast & also ensuring a person is refraining from touching the system causing any damage

9. System Model

Each user will stand before the scanning device and bring their faces in the appropriate position in the camera feed. The scanning process is initiated when the user scans the RFID card. The moment the RFID card is scanned, the device will determine the maximum temperature across the forehead and store the reading against the RFID input along with timestamp of scanning. The administrator will be notified if the thermal reading indicates that the user could be infected by coronavirus.

9.1. Context Diagram

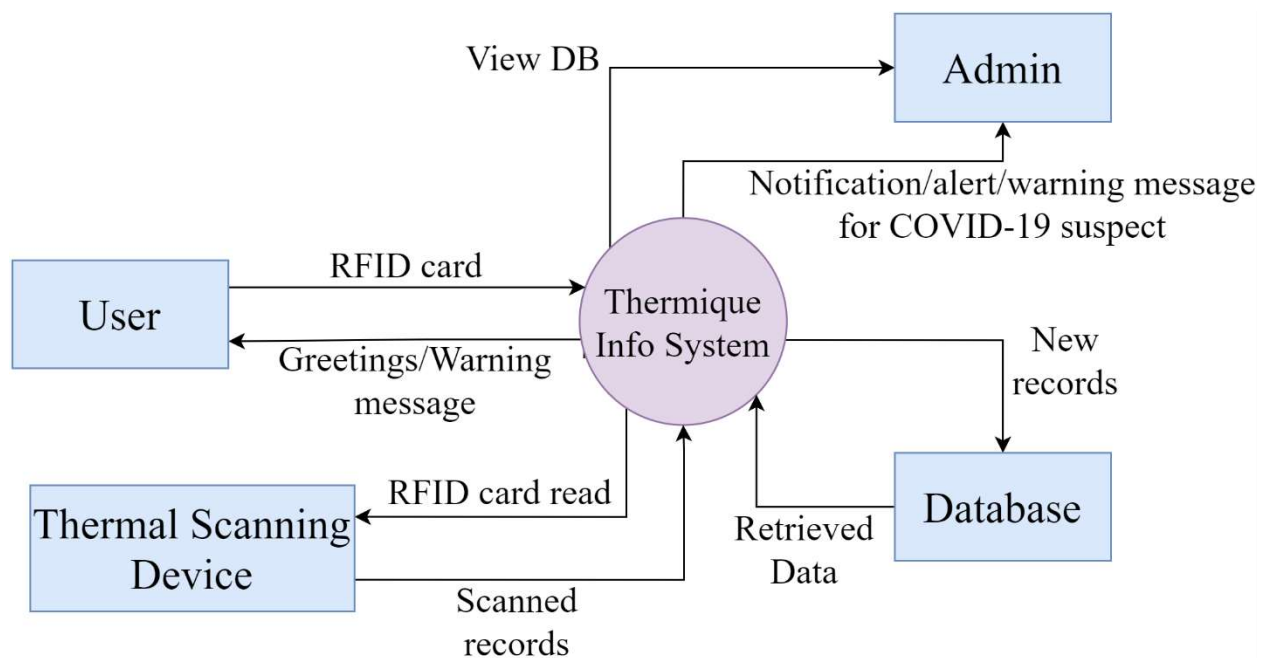


Figure-2: Context Diagram for *Thermique* system

9.2. Use-case Diagram

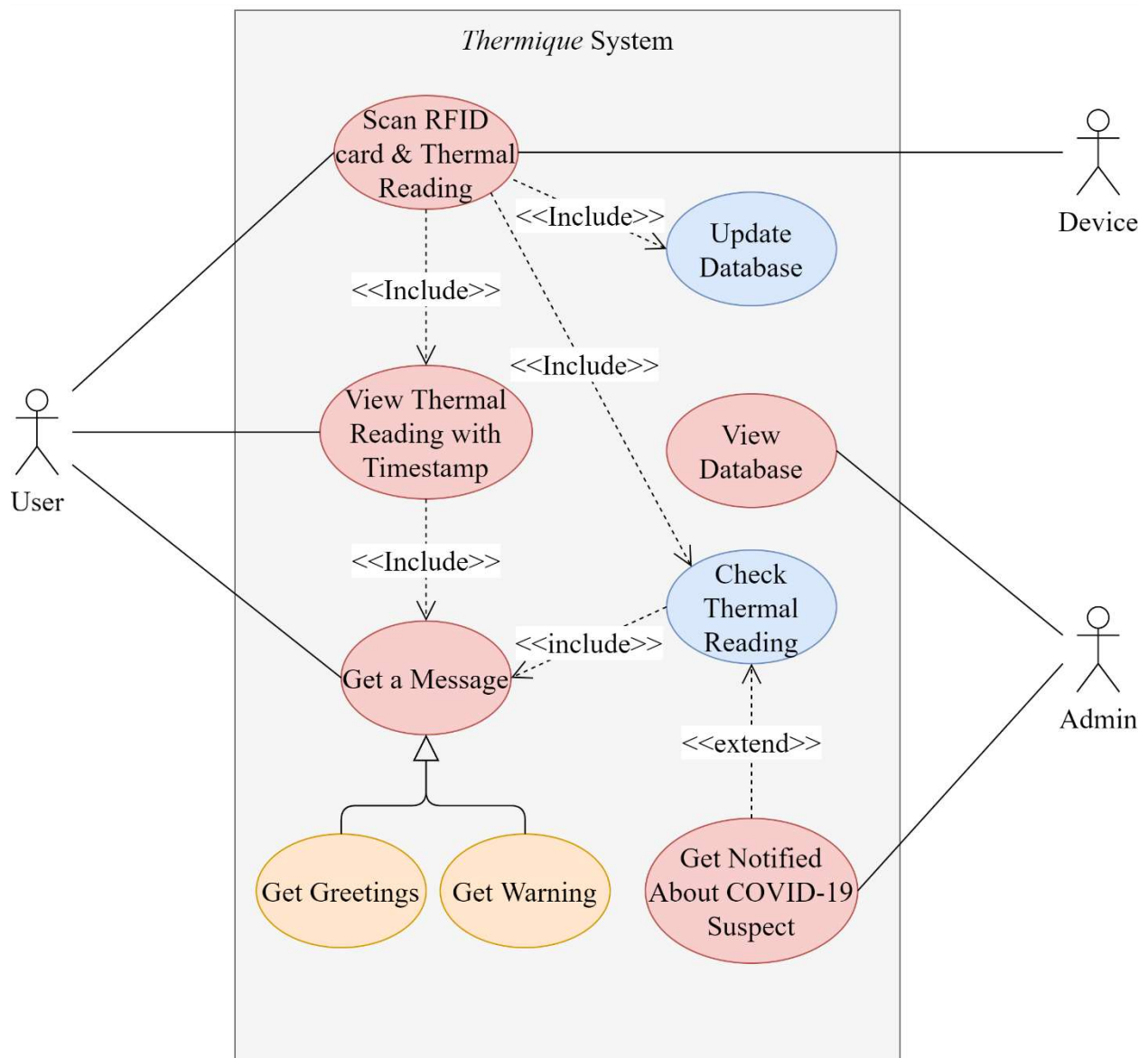


Figure-3: Use-case Diagram for *Thermique* system

Table-2: Tabular representation of Use-case diagram (Figure-2)

Use-case: <i>Thermique</i> system	
Primary Actors	User
Secondary Actors	Admin, Device
Data	RFID card input, Body temperature, Timestamp, Gate/booth
Pre-condition	RFID cards distributed beforehand
Post-condition	No system failure, Successful modification in DB
Stimulus	Scanning RFID card
Response	Displaying body temperature with timestamp, Greetings/warning message based on body temperature
Comments	Device has to detect the user's face position within the camera feed before the RFID is scanned.

9.3. Activity Diagram

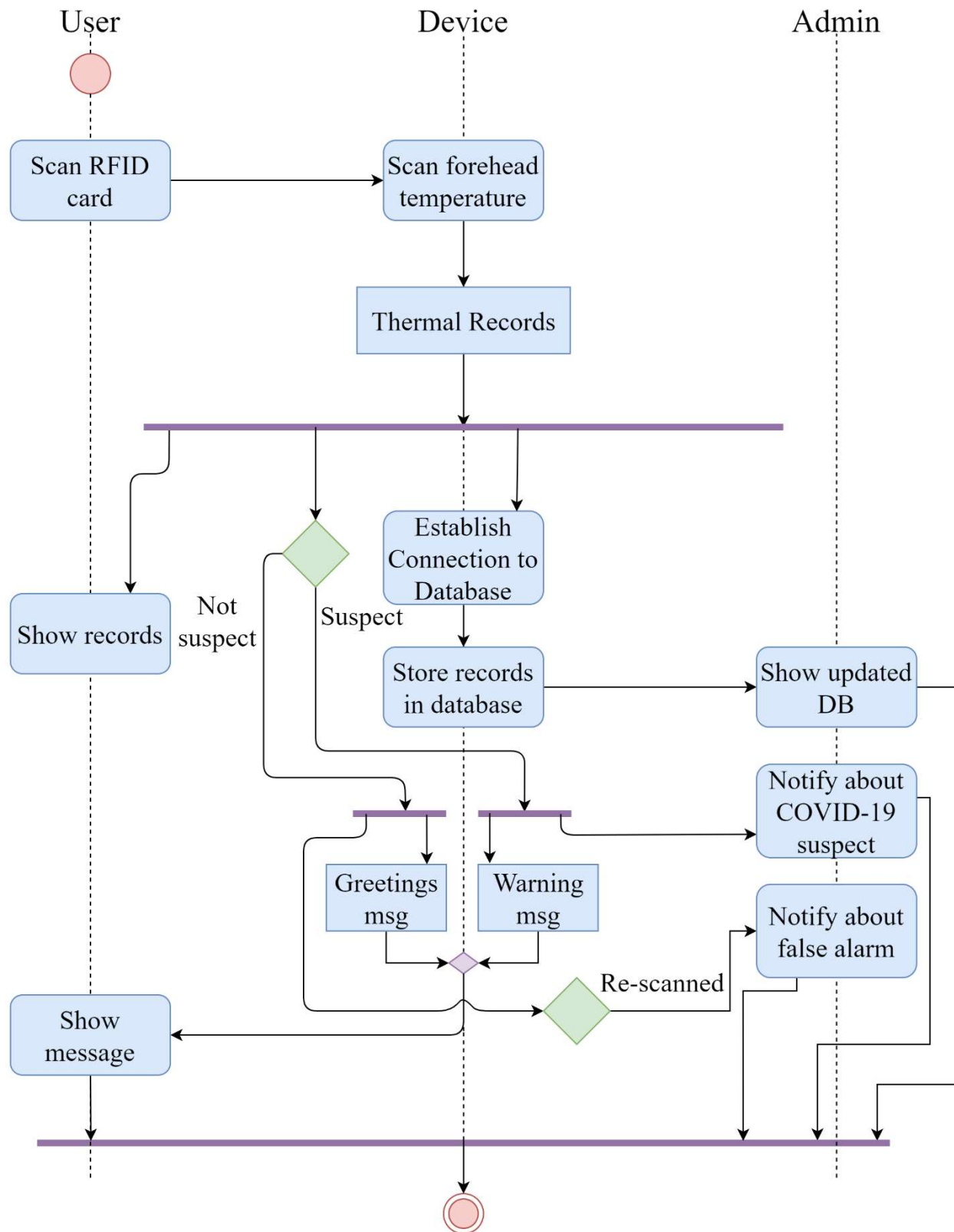


Figure-4(a): Activity Diagram for *Thermique* system

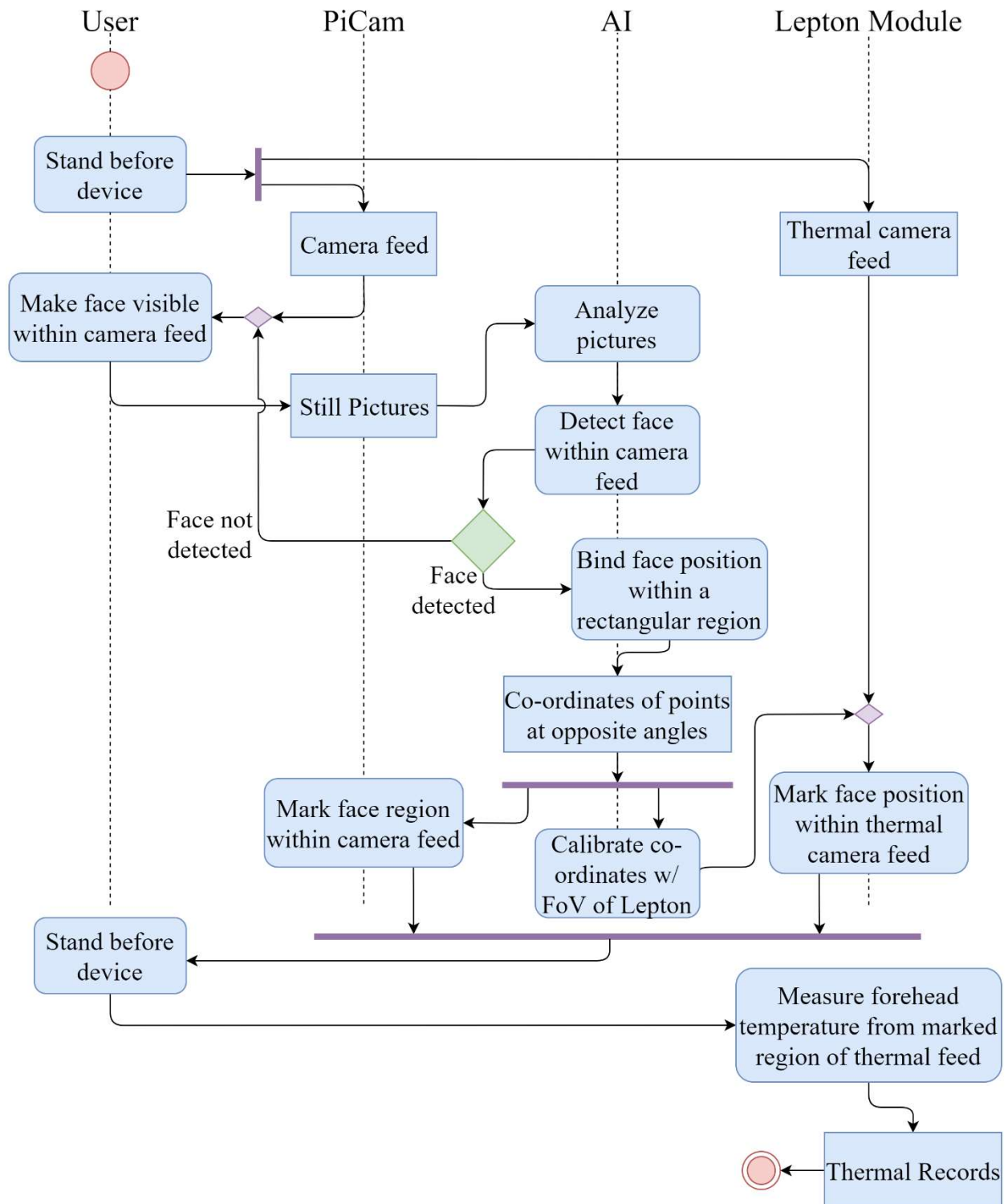


Figure-4(b): Activity Diagram for *Thermique* system – AI scenario

9.4. Sequence Diagram

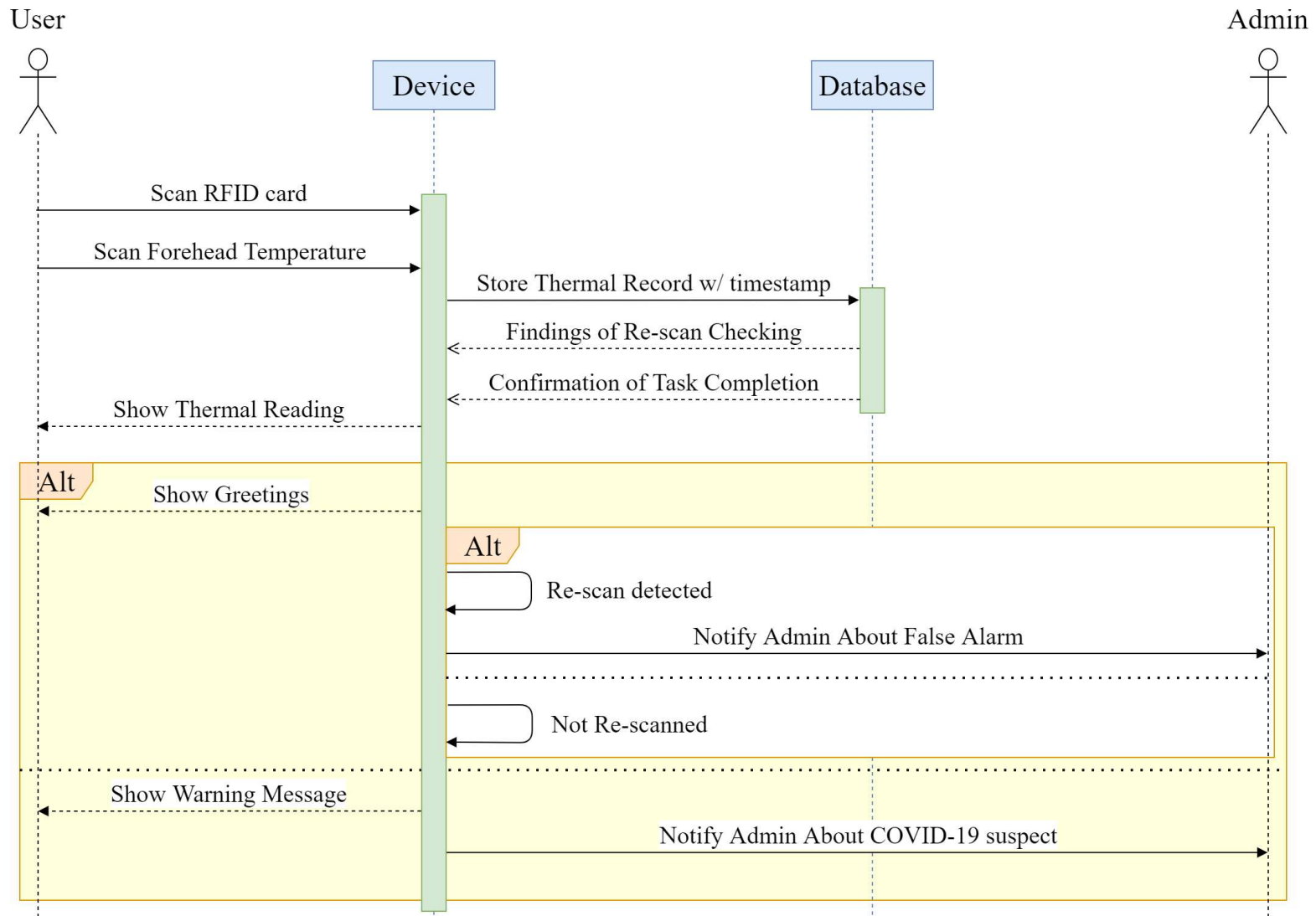


Figure-5(a): Sequence Diagram for *Thermique* system

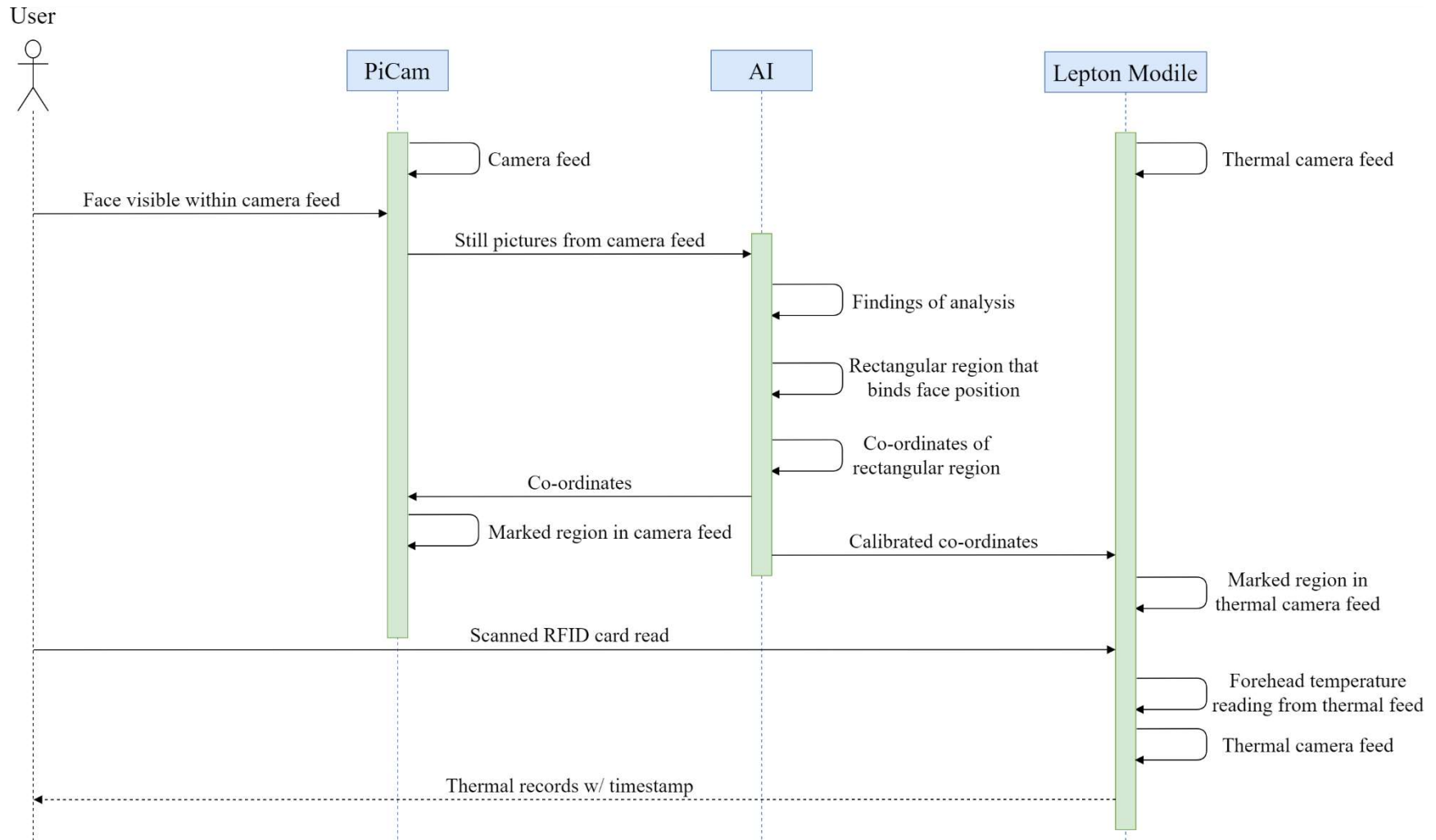


Figure-5(b): Sequence Diagram for *Thermique* system – AI scenario

10. System Evolution

There can be many possible changes incorporated for the evolution of our project. The possibilities for evolution are mentioned below:

- Automated hand sanitizer sprayer could be added in our system so that a person standing at a certain distance would be able to use sanitizer without having to press the bottle or getting in contact. So, this could be a possible change or evolution for our system.
- Our system is capable of detecting faces & extracting forehead temperature of a person. So, there can be possibility of a person detected with high temperature being a COVID suspect & further infection of COVID among people who might have been in close contact with that person. In that case, our system could be extended further to incorporate contact tracing feature basing on RFID information of each person.
- Face recognition is another possible evolution for our system. Facial recognition could be implemented alongside RFID based scanning so that this could be linked with attendance system & store that in attendance database. Thus, a smart attendance system could be implemented which could lessen a lot of hazard & save up a lot of class time.
- Our system is combined of several hardware devices which might be tough to carry & most importantly, these devices have high sensitivity issues. So, a compact box could be built which would make it easier for any sort of transportation & implementation of the system at any place. This is one kind of evolution or possible change for our system

11. References

1. Rane KP. Design and Development of Low Cost Humanoid Robot with Thermal Temperature Scanner for COVID-19 Virus Preliminary Identification. International Journal. 2020 May;9(3).
2. Cheshmehzangi A. 10 Adaptive Measures for Public Places to face the COVID 19 Pandemic Outbreak. City & Society (Washington, DC). 2020 Aug 6.

12. Appendix