Cyprus International University

Faculty of engineering

Department of Software Engineering

2021-2022 Spring semester

Masked Face Recognition System (MFR) Report

Project Supervisor

Assist. Prof. Dr. Parvaneh ESMAİLİ

Author

Ahmad Jawabreh & Zaid Mohtaseb

V1

Table of content

PROPOSAL

WORK BREAKDOWN STRUCTURE

WORK BREAKDOWN STRUCTURE DICTIONARY

ACTIVITY LIST

ACTIVITY RESOURCE REQUIREMENTS

ACTIVITY DURATION ESTIMATE

CAUSE AND EFFECT

Proposal

1.0 Statement of purpose

When the Corona pandemic began to spread, governments issued laws requiring people to wear masks in public places, and this led to problems in face recognition systems, Where the systems can no longer identify the user' s identity, which led to the suspension of all these systems, whether public facial recognition systems such as systems for opening and closing doors or personal systems such as Face ID in iPhone devices.

On the other hand, facial recognition systems in public places that are used in countries such as China, as these countries follow a political pattern, they track the movements of citizens through artificial intelligence systems that analyze and track the movements and actions of citizens and issue violations or orders to arrest or give rewards to citizens according to their behavior in public places and this system are based on the face recognition.

So, we decided to find a solution to this problem by creating a masked facial recognition system, where it makes it easier for people to use security systems. It is also based on the principle of (touchless) where you do not have to touch the device like fingerprint systems.

2.0 Company Information

Masked Face Recognition system – MFR project needs two types of work, hardware and software, the company employees are four persons so the team will be divided one of them for the hardware side and three of them for the software side.

Ahmad Jawabreh: Smart contract development, blockchain bridges, Dealing with the blockchain services providers and Database creation.

Zaid Mohtaseb: Software Development for the RFID system & MFR system.

Rahaf Ismail: Responsible to connect the hardware parts and sensors to the Arduino and deliver the system connected correctly to the software side.

Ferhat Bal: Software quality assurance and testing the system at all.

3.0 Product Description

The MFR project will use two methods for user identification, and all of these methods will be used for identification, which means that identification and analysis depends on a combination of these methods to ensure that the system works properly, and each of them has some negative points so we will remove this negative point of a method by covering it from Positive points of another method.

1-) MATCHING APPROACH:

This method based on training the system in advance by flooding it with a set of samples and images without a user mask, and the system automatically extracts the characteristics and measurements of the face, nose, mouth and eye, the distance between the eyes, the distance between the mouth and the nose, the distance between the mouth and the first eye and the second eye, and the distance between the nose and the first eye second.

2-) RESTORATION APPROACH:

According to the gallery, the covered portions in the sample faces are restored here. The covered areas are detected by threshing the 3D image profound map values. The main component analysis is then carried out (PCA). Several techniques rely on the assessment of the covered areas. The iteration close point (ICP) technique was utilized. A curve is used to control the covered regions using a statistical estimate of the curve. Partly observed curves are completed using the PCA- technical curve model.

4.0 Major Deliverables

➢ **Masked Face Recognition**: The system will be able to recognize the masked user face, and the system will be able to work in scenarios like public control.

➢ **Quality**: we chose hardware parts that simulate a real scenario to be able to simulate a real scenario

➢ **Security**: The system will not work in any way with a wireless connection, the connection to the network will be done through ethernet port.

➢ **Decentralization**: The validation step for the faces will not work any way with centralize server, The validation step will be done through high TPS blockchain to make the system literally not crackable.

5.0 Delivery Scheduled

Task	Time (days)
Order the hardware parts from Turkey	7– 15
Hardware Connecting	5
RFID coding	1
Face recognition coding	3
Masked Face Recognition	4
Database creation	2
Testing the hardware & software	2
Testing the system in many scenarios	5
EVMC Smart Contract coding	3
EVMC Smart Contract Testing	2
Chainlink to Kadena bridge	2
Testing the smart contract on the mainnet	2
Total days	**39 - 46**

6.0 Cost Estimation

Hardware Part	Version	Piece	Price
Microcontroller	Arduino UNO R3 Kit	1	880 TL
Microchip ports Extenders	74HC595	2	5.25 TL
Ethernet Port	ENC25J60	1	107.5 TL
LCD Screen	1.8inch	1	219 TL
Power Cable	GePro UM-85	1	34.2 TL
Red Led	Red Led Package	1	3.5 TL
NFC Keychain	13.56 MHz	2	4.55 TL
RFID Card	125 kHz	2	4.55 TL
Breadboard	Normal	3	21 TL
Battery	9V	1	9.45 TL
Ticket NFC	13.56 MHz	5	4.2 TL
Jumper Cable Kit	M-M	2	19 TL
RFID Reader	RC522	1	31 TL
Green Led	Green Led Package	1	3.5 TL
Resistors	Resistors Kit	1	56.33 TL
Temperature Sensor	DH11	1	31.3 TL
Welding Gun	ZD 23 30W	1	103 TL
Gas Sensor	MQ-2	1	28.4 TL
Double Faced Pertinax	7*9 cm & 8*12 cm	1	33 TL
Camera	ESP32-CAM	1	157.5 TL
Soldering Tin	1.60 mm 100 g	1	75.7 TL
Multimeter	Marxlow DT-830D	1	51 TL

Total = 1885 TL

7.0 References

- (Face Recognition , Facial recognition Is Everywhere , Wirecutter, 2020) - Link

- (Face Recognition , Biometric Authentication Technology , veriff , 2022) - Link

- (Object Detection , Object Detection Guide , FRITZ AI , 2021) - Link

- (Object Detection , A Beginner's Guide to Object Detection , datacamp , 2018) - Link

- (MFR , Face-mask recognition – better or worse , National Geographic , 2020) - Link

- (MFR , Secure Authentication , ADS , 2020) - Link

- (Face Rebuild , Cropping and attention based approach for face recognition , Springer , 2021) - Link

- (Face Rebuild , 3D Face Reconstruction ,ScienceDirect ,2021)-Link

- (Blockchain Bridges , What Are Blockchain Bridges and Why Do We Need Them? , Liquid , 2020) - Link

- (Blockchain Bridges, Blockchains Have a 'Bridge' Problem, and Hackers Know It , WIRED , 2022) - Link

- (Blockchain Bridges , Types of blockchain bridges , CoinDesk , 2022) - Link

Work breakdown structure

1.0 Statement of purpose

The purpose of this document is to provide a record of the different tasks that need to be completed for MFR project. This document contains a list of these tasks arranged in a hierarchical order.

2.0 Work breakdown structure

1. Hardware connecting

    1.1. RFID connecting

        1.1.1. Connect the RFID Reader

        1.1.2. Connect the LED's t

        1.1.3. Connect the alphanumeric LCD

        1.1.4. Connect the micro servo motor

    1.2. Masked face recognition connecting

        1.2.1 Connect the camera

        1.2.2 Connect the wavesshare LCD screen

    1.3. Sensors connecting

        1.3.1 Connect the distance sensors

        1.3.2 Connect the gas sensor

        1.3.3 Connect the flame sensor

        1.3.4. Connect the speaker

    1.4. Network connecting

        1.4.1 Connect the ethernet port

1.5. Power and electricity connecting

    1.5.1 Connect the 9V battery to the Arduino

    1.5.2. Connect the power cable adapter to the Arduino

2. Coding

  2.1. RFID Coding

  2.2. Face recognition coding

  2.3. Masked face recognition

3. Database creation

  3.1. Database schema preparing

  3.2. Database coding

  3.3. Adding data to the database

  3.4. Database connecting

4. Smart contract development

  4.1. chainlink to Kadena blockchain bridge

  4.2 Smart contract designing

  4.3. Smart contract coding

  4.4. Smart contract testing

    4.4.1 Testing the system with the smart contract on testnet

    4.4.2 Testing the system with the smart contract on mainnet

  4.5 Deployment on mainnet

5. Testing

  5.1. Testing the connection of hardware parts

5.2. Testing the system

    5.2.1 RFID code testing

    5.2.2 Face recognition code testing

    5.2.3 Masked face recognition code testing

5.3. Testing the connection of the database

5.4. Testing the system with the smart contract on the test net

5.5 Testing the system with the smart contract on the mainnet

Work breakdown structure dictionary

1.0 Statement of Purpose

The purpose of this document is to provide a description of each of the tasks in the work breakdown structure (WBS) for **MFR project.** This document contains (a) the WBS item number, (b) the WBS item name, and (c) a description of the WBS item.

2.0 Work breakdown structure dictionary.

WBS NO	WBS Item Name	WBS Item Description
1	Hardware connecting	Connect the all of the hardware parts that will be used for the system
1.1	RFID connecting	Connection of RFID parts to the Arduino which the alternative verification method
1.1.1	Connect RFID Reader	Connection of the RFID reader that will be used to detect the radio frequency
1.1.2	Connect the LED's	Connect the LED's to the Arduino that will be used as red led means close door and green led means opened door, blinking red led mean error and blinking green led means the door will be opened
1.1.3	Connect the alphanumeric LCD	Connect the alphanumeric LCD that will be used to show a message for the user (Hello message, Errors, etc.)
1.1.4	Connect the micro servo motor	Connect the micro servo motor that will be used to open and close the door (Moving the door lock in and out to open and close the door)
1.2	Masked face recognition connecting	Connecting the hardware parts that will be use in Masked face recognition process

1.2.1	Connect the camera	Connecting the camera to the Arduino which will be used to scan the user face
1.2.2	Connect wavesshare LCD screen	Connecting the lcd screen that will be used to show the user face to let the user know if the camera detect his face or not
1.3	Sensors connecting	Connecting all of the sensors that will be used in the system
1.3.1	Connect the distance sensors	Connecting the distance sensor to the Arduino that will be used to detect if there is a object around the system trying to use it, if there is no object the system will tun off otherwise the system will turn on this supposed to help in energy saving
1.3.2	Connect the gas sensor	Connecting the gas sensor to the Arduino that will be used alongside the flame sensor to detect the fire and cigarettes
1.3.3	Connect the flame sensor	Connecting the flame sensor to the Arduino that will be used alongside the gas sensor to detect the fire
1.3.4	Connect the speaker	Connecting the speakers that will be used to make noise if the system detect fire
1.4	Network connecting	Connecting the hardware parts that will be used for the network side of the project
1.4.1	Connect the ethernet port	Connecting the ethernet port to the Arduino that will be used to connect the system to the network
1.5	Power and electricity connecting	Connecting the power supply hardware parts to the system
1.5.1	Connect the 9V battery	Connecting the 9v battery to the system which will be used as alternative power supply If there is a power outage
1.5.2	Connect the power cable	Connecting the power cable adapter that will be used as the main power supply for the system

2	Coding	Coding the system
2.1	RFID Coding	Writing the code for the RFID system
2.2	Face recognition coding	Writing the code for the face recognition system that will help us to build the code of the masked face recognition on it
2.3	Masked face recognition	Writing the code for the masked face recognition
3	Database creation	Creating the database that will be used to test the project before finalizing the smart contract on Kadena blockchain
3.1	Database schema preparing	Preparing the database schema that will help us to understand the entity relationship and the architecture of the database at all
3.2	Database coding	Coding the database
3.3	Adding data to the database	Adding the a real test data to the database that will be used to test the system
3.4	Database connecting	Connection the database to the system which for both main and alternative verification methods (MFR and RFID)
4	Smart contract development	Development of the Kadena smart contract that will be used basically to put out system in the blockchain which will help the project to be littarly not hackable because of the PoW consensus protocol (Decentralization) of Kadena network
4.1	chainlink to Kadena blockchain bridge	Preparing the bridge between chainlink blockchain which is the provider of the data for the smart contract and bridge it with Kadena blockchain
4.2	Smart contract designing	Designing the working mechanism of the smart contract and how it will interact

		with its entities and designing the Algorithm for out smart contract
4.3	Smart contract coding	Starting to write the smart contract code with Pact programming language then convert it to Solidity smart contract to make the code EVMC
4.4	Smart contract testing	Testing the smart contract by focusing on the bugs and the security issues (Called audit step in blockchain community)
4.4.1	Testing the system with the smart contract on testnet	Testing our smart contract on the test net using Truffle and ganache environment
4.4.2	Testing the system with the smart contract on mainnet	Testing the smart contract in a real scenario by testing it on the mainnet
4.5	Deployment on mainnet	Deploy the smart contract after testing it, the deployment here will be directly on Kadena mainnet
5	Testing	Testing the System at all
5.1	Testing the connection of hardware parts	Testing the connection of the hardware parts if there is any type of wrong connection or missing to connect some parts and testing if all of the parts are working or not
5.2	Testing the system	Testing the hardware parts codes
5.2.1	RFID code testing	Testing the RFID code to make sure there is no faults in the RFID system
5.2.2	Face recognition code testing	Testing the face recognition code to make sure there is no faults in the face recognition system
5.2.3	Masked face recognition code testing	Testing the masked face recognition code to make sure there is no faults in the masked face recognition system

5.3	Testing the connection of the database	Testing the connection of the database to make sure there is no faults in the connection between the database and the system
5.4	Testing the system with the smart contract on the test net	Testing the system at all on the testnet to make sure there is no faults in the system at all with the smart contract
5.5	Testing the system with the smart contract on the mainnet	Testing the system at all on the mainnet to make sure the system behaves as it supposed to behave with the smart contract on the mainnet

Activity List

1.0 Statement of purpose

The purpose of this document is to record all activities that are included in the schedule for Masked Face Recognition System (MFR). This document provides information about each activity including its name, an identifier, its duration, any predecessors and successors, resource requirements, any leads or lags, who's been responsible for the task, as well as whether the activity is a milestone.

2.0 Activity Definition

Identifier	Name	Description
1	Determining the idea	Determine the general idea of the project
2	Research	We need to search in books, scientific research and articles on previous similar projects to understand the working mechanism of the system.
3	System Analyzing	After understanding the working mechanism of the system, we will identify all the strengths and weaknesses of each work mechanism and try to integrate work mechanisms to raise the strengths and reduce weaknesses.
4	Order Hardware Parts	Determine the seller from whom we will buy the parts then order the hardware parts.
5	Database creation	Create database contains all of the authenticated user's information such as their faces, masked faces, RF cards, etc...
6	RFID Hardware	Connect the RFID hardware parts.

7	RFID Programming	Coding the RFID reader and connect it with the dataset.
8	RFID Testing	Testing the RFID system after coding and make sure only authenticated users are able to use the system
9	Face Recognition Hardware	Connect the face recognition hardware parts such as the camera.
10	Face Recognition Programming	Coding the normal face recognition side and connect it with the dataset.
11	Masked Face Recognition Programming	Coding the masked face recognition side and connect it with the dataset.
12	Masked Face Recognition Testing	Testing the masked face recognition side to make sure it's working correctly and the possibility of wrong identification is under the specification.
13	Testing the hardware & software	Testing the system at all, hardware testing and software testing.
14	Testing the system in many scenarios	Testing the system on our class mates as one of the scenarios to make sure the system is working correctly.
15	Consensus protocol programming	Preparing the consensus protocol that the system will use to validate the identity of users to increase the security of the system
16	Kadena smart contract programming	Coding the smart contract on KADENA Blockchain that will be used to validate the identity of users.
17	Kadena smart contract testing	Testing the smart contract and send it to a specialized auditing company (Certik) to ensure that there are no errors that allow the smart contract to be hacked
18	System test with smart contract	Testing the system at all with the smart contract and the consensus protocol
19	Deployment	Deployment

4.0 Activity Duration

4.1 Estimated Work Hours Required: <u>15 - 20 hours weekly.</u>

4.2 Start Date (MM/DD/YYYY): <u>April / 2 / 2022</u>

4.3 Finish Date (MM/DD/YYYY): <u>May / 18 / 2022</u>

4.4 Leads and Lags: <u>Kadena bridge.</u>

5.0 Resource Assignment

Resource	Unit_Cost/Salary	Cost
• RFID & Sensors Hardware		
Arduino Uno Rev3	880 TL	
RF Reader	31 TL	
Ethernet Ports (ENC28J60)	107 TL	
Breadboard *2	21 TL + 21 TL	
Jumper cables (MM/FM)	19 TL + 19 TL	
Battery 9V & Battery Cable	9.5 + 2 TL	
RF card	4.55 TL	
RF NFC keychain	4.55 TL	
RF NFC ticket	4.55 TL	Total Cost = 1483.75 TL
Red lids & Green lids	3.5 +3.5 TL	
Microchip ports Extenders	5.25 * 2 TL	
Power Cable	34.2 TL	
Resistors Kit	56.3 TL	
Welding Gun & Soldering Tin	103 + 51 TL	
Gas Sensor	28.4 TL	
Double Faced Pertinax	33 TL	
Multimeter	75.7 TL	

Face Recognition Hardware:		
Arduino Uno Rev3	880 TL	
Red lids	3.5 TL	
Green lids	3.5 TL	
Ethernet Ports (ENC28J60)	107.5 TL	Total Cost = 1244.5 TL
Breadboard	21 TL	
Jumper cables (MM/FM)	19 TL +19 TL	
Battery 9V	9.5 TL	
Battery Cable	2 TL	
Camera	157.5 TL	
Distance Sensor (HC-SR04)	22 TL	

Activity Resource requirements

1.0 Statement of purpose

The purpose of this document is to record the resource requirements for all activities that are included in the schedule for masked face recognition (MFR) project. This document provides information about each activity including its name, an identifier, its definition, its resource requirements along with any assumptions made in estimating the resources needed for that activity.

2.0 Activity Definition

Identifier	Name	Description
1	Determining the idea	Determine the general idea of the project
2	Research	We need to search in books, scientific research and articles on previous similar projects to understand the working mechanism of the system.
3	System Analyzing	After understanding the working mechanism of the system, we will identify all the strengths and weaknesses of each work mechanism and try to integrate work mechanisms to raise the strengths and reduce weaknesses.
4	Order Hardware Parts	Determine the seller from whom we will buy the parts then order the hardware parts.
5	Database creation	Create database contains all of the authenticated user's information such as their faces, masked faces, RF cards, etc...
6	RFID Hardware	Connect the RFID hardware parts.

7	RFID Programming	Coding the RFID reader and connect it with the dataset.
8	RFID Testing	Testing the RFID system after coding and make sure only authenticated users are able to use the system
9	Face Recognition Hardware	Connect the face recognition hardware parts such as the camera.
10	Face Recognition Programming	Coding the normal face recognition side and connect it with the dataset.
11	Masked Face Recognition Programming	Coding the masked face recognition side and connect it with the dataset.
12	Masked Face Recognition Testing	Testing the masked face recognition side to make sure it's working correctly and the possibility of wrong identification is under the specification.
13	Testing the hardware & software	Testing the system at all, hardware testing and software testing.
14	Testing the system in many scenarios	Testing the system on our class mates as one of the scenarios to make sure the system is working correctly.
15	Consensus protocol programming	Preparing the consensus protocol that the system will use to validate the identity of users to increase the security of the system
16	Kadena smart contract programming	Coding the smart contract on KADENA Blockchain that will be used to validate the identity of users.
17	Kadena smart contract testing	Testing the smart contract and send it to a specialized auditing company (Certik) to ensure that there are no errors that allow the smart contract to be hacked
18	System test with smart contract	Testing the system at all with the smart contract and the consensus protocol
19	Deployment	Deployment

<u>Activity Duration Estimate</u>

1.0 Statement of purpose

The purpose of this document is to provide an estimate of how long it would take to complete each activity in the work breakdown structure of masked face recognition (MFR) project. This document contains (a) a list of the activities in the work breakdown structure, (b) the duration estimate for each activity, (c) an estimated project duration, and (g) any assumptions made.

2.0   Critical Assumptions and Constraints

➢ <u>Chainlink to Kadena bridge:</u> We partnered with chainlink labs to be the data providers for our project (Providers for off-chain data) and to create bridge between chainlink blockchain and Kadena blockchain and the time estimation for the bridge creation is 2-3 weeks, we assumed we will not face any issues with chainlink labs and the bridge will be done during the estimated time.

➢ <u>Delivery time:</u> We assumed the hardware parts will arrive on time without any latencies or logistic problems.

➢ <u>Weekly work time:</u> We assumed we will not have any exams or projects for other courses, because having exams or other projects for other courses will reduce the time spent on this project.

➢ <u>Testing:</u> We assumed that the project's testing phase will reveal reasonable errors that we could solve in a timely manner

3.0 Duration Estimate

Task	Time (days)
Order the hardware parts from Turkey	7– 15
Hardware Connecting	5
RFID coding	1
Face recognition coding	3
Masked Face Recognition	4
Database creation	2
Testing the hardware & software	2
Testing the system in many scenarios	5
EVMC Smart Contract coding	3
EVMC Smart Contract Testing	2
Chainlink to Kadena bridge	2
Testing the smart contract on the mainnet	2
Total days	**39 - 46**

Cause and effect

1.0 Cause and effect diagram

Inability to find unique features

Inbaility to rebuild the face

Inability to imagin the face features

Mouth and nose are covered

Inability to recognize masked faces

Camera not high accurated

Inability to detect the darkness of eye gaps or skin color

Main face features are Covered

Inability to find unique features