EEE 495

Electrical and Electronics Engineering Design II

Project Title: Multifunctional Smart Home using IoT Technology

Test Plan

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1.0 INTRODUCTION

1.1 Product Definition

The aim to be accomplished by this product is to develop a smart home that provides multiple features for the sake of both security and quality of life improvement, allowing the residents with more time to spend more productively elsewhere.

1.2 Overview of the Product

The main customer base for this product are homeowners, or people living in a rented home; hence the main application of the product is in domestic use. The users are required to have a stable internet connection to be able to use the product properly. The application itself will have a login system, so the user will need to make an account with a username and password to be able to use it for the smart home. Furthermore, for both the door camera and gate camera systems, the user will need to register to the system the faces of the people living in the house and the licence plates of the cars they use respectively. The automatic lights will need to be manually turned on from the smartphone application for them to have functionality as intended. The user will also need to register a phone number to which calls will be placed in emergency situations. The goal of the product is to provide the user with both security and comfort in the sense that there is time saved using these automated systems to be used productively elsewhere.

The product is limited in functionality for this implementation because of the Raspberry Pi 3 Model B+. The controller is too slow to handle the features, but still is capable of running them.

2.0 TEST PLAN

The functional and nonfunctional specifications of the product to be tested are referred from the Product Specifications Document [1].

2.1 Functional Requirement: Door Camera Identifies Faces

Test Objective: The Door Camera System should recognise and identify registered faces, and return unknown in case of an unregistered face.

Test Procedure:

- Set up the hardware of the product with the software also functioning
- Train a face of one of the people testing, or use a face already trained
- The person whose face is being tested should get in position in front of the camera
- The camera should give a response when seeing a face in its field of view

Test Criteria: The test passes if the system detects registered faces and marks unregistered faces as unknown with a reasonable level of accuracy. The test fails if there is no response from the system to the faces.

Test Setup: The product and faces of people testing it.

Constraint: The process requires a significant level of processing power, which the controller unit affordable in the budget does not allow, so it would run slower in the demonstration.

Responsible Member: Payam Sedighiani.

2.2 Functional Requirement: Gate Camera Identifies Licence Plates

Test Objective: The Gate Camera System should be able to read and identify registered licence plates, and return unknown in case of an unregistered face.

Test Procedure:

- Set up the hardware of the product with the software also functioning
- Get a smartphone ready with picture(s) of licence plate(s)
- The picture of a licence plate should be in position in front of the camera
- The camera should give a response when seeing a licence plate in its field of view

Test Criteria: The test passes if the system detects registered licence plates and marks unregistered licence plates as unknown with a reasonable level of accuracy. The test fails if there is no response to the licence plates.

Test Setup: The product and pictures of a licence plate on a smartphone.

Constraint: The process requires a significant level of processing power, which the controller unit affordable in the budget does not allow, so it would run slower in the demonstration.

Responsible Member: Fahad Waseem Butt

2.3 Functional Requirement: Automatic Lights System Modes Work for Each Mode

Test Objective: The Automatic Lights System should work for each of the following cases; sensor based activation; time based activation; mobile application activation.

Test Procedure:

- Set up the hardware of the product with the software also functioning
- The sensor dependant light should turn on when the light sensor gets covered
- The time dependant light should turn on/off at the assigned times
- The lights in the system should manually turn on/off from the mobile application

Test Criteria: The test passes if the lights turn on and off as specified in the objective. The test fails if there is no response by the system.

Test Setup: The product.

Responsible Member: Maaz Ud Din

2.4 Functional Requirement: Mobile Application Features Function

Test Objective: The Mobile Application takes data to register faces and licence plates; activate and deactivate systems; show a live feed from the cameras.

Test Procedure:

- Start up the Mobile Application
- Go to each of the pages to check the features
- Pressing the button should show an observable reaction

Test Criteria: The test passes if the features work as specified in the objective. The test fails if there is no functionality communicated by the Mobile Application.

Test Setup: The product.

Responsible Member: Ahsan Mehmood

2.5 Functional Requirement: Admin User Shall be Able to Register/Sign In

Test Objective: Admin user shall be able to register and/or sign in when using the mobile application.

Test Procedure:

- Start up the Mobile Application
- Go to the register/sign in page
- Create admin user

Test Criteria: The test passes if an admin user can be made/login. The test fails if an admin user cannot be made/login.

Test Setup: The product.

2.6 Functional Requirement: Admin User Shall be Able to Modify Residents of the Home

Test Objective: Admin user shall be able to add and/or delete residents of their home through the system by their email addresses.

Test Procedure:

- Start up the Mobile Application
- Sign in as the admin user
- Go to the page for users
- Modify resident accoutns

Test Criteria: The test passes if the admin user can modify residents of the home. The test fails if the admin user cannot modify residents of the home.

Test Setup: The product.

2.7 Functional Requirement: Resident User Shall be Able to Register Accounts

Test Objective: Resident user shall be able to register an account by submitting their email addresses and defining their passwords.

Test Procedure:

- Start up the Mobile Application
- Go to the register/sign in page
- Create resident user

Test Criteria: The test passes if a resident user can be made/login. The test fails if a resident user cannot be made/login.

Test Setup: The product.

2.8 Functional Requirement: Admin User Shall be Able to Add and/or Delete Registered Faces

Test Objective: Admin user shall be able to add and/or delete the faces of residents of their home to the list of recognized faces by uploading the photo taken from a smartphone.

Test Procedure:

- Start up the Mobile Application
- Go to the page for user details
- Modify registered faces

Test Criteria: The test passes if the admin user can register faces to the home. The test fails if the admin user cannot register faces to the home.

Test Setup: The product.

2.9 Functional Requirement: Admin User Shall be Able to Add and/or Delete Licence Plates

Test Objective: Admin user shall be able to add/delete licence plates registered in the system using the smartphone application.

Test Procedure:

- Start up the Mobile Application
- Go to the page for user details
- Modify registered licence plates

Test Criteria: The test passes if the admin user can register licence plates to the home. The test fails if the admin user cannot register licence plates to the home.

Test Setup: The product.

2.10 Functional Requirement: Admin User Shall be Able to Set Auto and Manual Modes

Test Objective: Admin user shall be able to set auto and manual modes for the systems in the product.

Test Procedure:

- Start up the Mobile Application
- Go to the page for manual or auto mode
- Modify the mode the product is running on

Test Criteria: The test passes if the admin user can set the product to auto and manual modes. The test fails if the admin user cannot set the product to auto and manual modes.

Test Setup: The product.

2.11 Functional Requirement: In Manual Mode Admin User Shall be Able to Control the Systems from the Mobile Application

Test Objective: When set to the manual mode, the admin user shall be able to control the door, gate and light systems from the mobile application.

Test Procedure:

- Start up the Mobile Application
- Go to the page(s) with buttons to control the systems of the product
- Toggle and interact with the system

Test Criteria: The test passes if the admin user can control the systems of the product in manual mode. The test fails if the admin user cannot control the systems of the product in manual mode.

Test Setup: The product.

2.12 Functional Requirement: In Manual Mode, Resident User Shall be Able to Control the Systems from the Mobile Application

Test Objective: When set to the manual mode, the resident user shall be able to control the door, gate and light systems from the mobile application.

Test Procedure:

- Start up the Mobile Application
- Go to the page(s) with buttons to control the systems of the product
- Toggle and interact with the system

Test Criteria: The test passes if the resident user can control the systems of the product in manual mode. The test fails if the resident user cannot control the systems of the product in manual mode.

Test Setup: The product.

2.13 Functional Requirement: In Auto Mode, the System Shall Open the Door/Gate Based on Recognition and Switch on the Light Based on the Sensor Data

Test Objective: When set to the auto mode, the systems in the product shall open the door/gate based on recognition from the cameras and switch on the light based on the sensor measurements.

Test Procedure:

- Start up the Mobile Application
- Set the system in auto mode
- Observe the systems of the product functioning

Test Criteria: The test passes if all/most systems of the product work in auto mode. The test fails if none of the systems work in auto mode.

Test Setup: The product, faces of people conducting the test and pictures of licence plates on a smartphone.

Constraint: The process requires a significant level of processing power, which the controller unit affordable in the budget does not allow, so it would run slower in the demonstration.

2.14 Functional Requirement: The System Shall Send a Notification to The Admin User in Case of Unrecognised Person

Test Objective: The system shall send a notification to the admin user in case of an unrecognised person at the door, detected by the face identification.

Test Procedure:

- Set up the hardware of the product with the software also functioning
- Train a face of one of the people testing, or use a face already trained
- The person whose face is being tested should get in position in front of the camera
- The camera should give a response when seeing a face in its field of view
- On unknown detection, the admin user gets a notification

Test Criteria: The test passes if a notification is sent to the admin user. The test fails if no notification is sent to the admin user.

Test Setup: The product and faces of people conducting the test.

Constraint: The process requires a significant level of processing power, which the controller unit affordable in the budget does not allow, so it would run slower in the demonstration.

2.15 Functional Requirement: The System Shall Send a Notification to The Admin User in Case of an Unrecognised Licence Plate

Test Objective: The system shall send a notification to the admin user in case of an unrecognised car's licence plate at the gate, detected by licence plate reading.

Test Procedure:

- Set up the hardware of the product with the software also functioning
- Get a smartphone ready with picture(s) of licence plate(s)
- The picture of a licence plate should be in position in front of the camera
- The camera should give a response when seeing a licence plate in its field of view
- On unknown detection, the admin user gets a notification

Test Criteria: The test passes if a notification is sent to the admin user. The test fails if no notification is sent to the admin user.

Test Setup: The product and pictures of licence plates on a smartphone.

Constraint: The process requires a significant level of processing power, which the controller unit affordable in the budget does not allow, so it would run slower in the demonstration.

2.16 Functional Requirement: Admin User Shall be Able to Request and Watch The Live Camera Feed

Test Objective: Admin user shall be able to request and watch the live camera feed from the mobile application.

Test Procedure:

- Start up the Mobile Application
- Go to the page(s) for the live feed(s)
- Observe the live feed

Test Criteria: The test passes if the live feed from the camera can be seen in the mobile application. The test fails if the live feed from the camera cannot be seen in the mobile application.

Test Setup: The product.

Constraint: The process requires a significant level of processing power, which the controller unit affordable in the budget does not allow, so it would run slower in the demonstration.

2.17 Non-Functional Requirement: Product Receives Sufficient Power to Function

Test Objective: All components in the entire product receive enough power from the power supply (or supplies) to turn on and function.

Test Procedure:

- Set up the overall system with all the hardware connections
- Power on the system

Test Criteria: The test passes if the system components are powered on and function. The test fails if the components do not power on.

Test Setup: The product.

2.18 Non-Functional Requirement: Product Designed to Facilitate Multiple Products and Users

Test Objective: The product is designed and developed for multiple products and users such that in the database, each product and user should also have an ID.

Test Procedure:

- Check the database
- Observe that each house will have its own set of data

Test Criteria: The test passes if each product saves unique data. The test fails if each product does not save unique data.

Test Setup: The product.

2.19 Non-Functional Requirement: Each Product Shall Have One Admin User

Test Objective: For each individual smart home system, meaning that each instance of the product to be sold, there will be one admin user for each product.

Test Procedure:

- Check database
- Observe that each house has one admin user

Test Criteria: The test passes if each house has one admin user. The test fails if each house does not have one admin user.

Test Setup: The product.

2.20 Non-Functional Requirement: Admin User Shall be Able to See The Logs of Entries With Resident Name and Time

Test Objective: Admin user shall be able to see the logs of manual/automatic entrances to the home/garage with resident name and time of entry.

Test Procedure:

- Start up the Mobile Application
- Go to the page for the entry logs
- Observe the logs

Test Criteria: The test passes if logs for each entry to the house has its log shown. The test fails if the logs for entries to the house are not shown.

Test Setup: The product, faces of people conducting the test and pictures of licence plates on a smartphone.

Constraint: The process requires a significant level of processing power, which the controller unit affordable in the budget does not allow, so it would run slower in the demonstration.

2.21 Non-Functional Requirement: Cameras Should be Placed at Good Positions

Test Objective: The cameras are positioned optimally such that they capture the faces of people and licence plates of cars within a good field of view for identifications.

Test Procedure:

- Set up the hardware of the product

- Check that the position of the cameras are chosen for good functionality

Test Criteria: The test passes if the cameras are shown to be in good positions. The test passes if the camera positions are bad.

Test Setup: The product.

2.22 Non-Functional Requirement: Light Sensors and Placed at Good Positions

Test Objective: The light sensors for the automatic lighting are placed in such a manner that there is no light, other than the light they are meant to detect, leaking in their range of detection.

Test Procedure:

- Set up the hardware of the product
- Check that the position of the light sensors are chosen for good functionality

Test Criteria: The test passes if the light sensors are shown to be in good positions. The test passes if the light sensor positions are bad.

Test Setup: The product.

2.23 Non-Functional Requirement: Construction of The Product Should be Done with Durability in Mind

Test Objective: The construction of the product in the house should be done with durability in mind, for all hardware components of the house.

Test Procedure:

- Set up the house
- Check that the product construction is good

Test Criteria: The test passes if the product construction has good durability. The test fails if the product construction has bad durability.

Test Setup: The product.

2.24 Non-Functional Requirement: Admin User can Access Data Stored in the Database

Test Objective: The user can have access to all of the information using his phone through a connection to Google Firebase, where the data is stored.

Test Procedure:

- Start up the Mobile Application
- Go to the page(s) for the user details
- Observe that the admin user can access the stored information

Test Criteria: The test passes if the admin user can access data stored in the database. The test fails if the admin user cannot access data stored in the firebase.

Test Setup: The product.

3.0 REFERENCES

[1] Team 4. “Multifunctional Smart Home using IoT Technology: Product Specifications Document.” *Bilkent University EEE 495*, March 2023. [Online] Available: https://moodle.bilkent.edu.tr/2022-2023-spring