

	<b>Document Ref.:</b>		
	<b>Version No.:</b>		1
	<b>Date:</b>		24 <sup>th</sup> March 2020
	<b>Copy No.:</b>		
<b>Project Name:</b>		Connected Living Spaces	
<b>Project Code:</b>		PW20CBR01M	
<b>Status:</b>		Current	
<b>Document Type:</b>		Controlled	
<b>Connected Living Spaces</b>			
<b>Smart Automation for educational institutions – Access Control Systems, Facial Recognition, Mood Detection and Rejuvenation, Automation of appliances, Automatic Cooling and Heating Systems, Temperature Monitoring and Leakage Detection.</b>			
<b>Prepared By:</b>		<b>Reviewed By:</b>	
<b>Name</b>	<b>Date</b>	<b>Name</b>	<b>Date</b>
Chirag N Vijay	24/03/2020		
D G Sudheer	24/03/2020	<b>Approved By:</b>	
		<b>Name</b>	<b>Date</b>
Dhanush Ravi	24/03/2020		
<b>Distribution List</b>			
<b>Project Representative(s)</b>		<b>PESU Representative(s)</b>	
1. Chirag N Vijay 2. D G Sudheer 3. Dhanush Ravi		4. Prof. H B Prasad 5. Charanraj B R	

## TABLE OF CONTENTS

<b>Definitions, Acronyms and Abbreviations.....</b>	<b>3</b>
<b>References.....</b>	<b>3</b>
<b>Change History .....</b>	<b>3</b>
<b>1.0 Introduction.....</b>	<b>5</b>
1.1 Overview.....	5
1.2 Purpose .....	5
1.3 Scope.....	5
<b>2.0 Design Constraints, Assumptions and Dependencies.....</b>	<b>5</b>
<b>3.0 Design Description .....</b>	<b>5</b>
3.1 Access Control .....	Error! Bookmark not defined.
3.1.1 Access Control.....	Error! Bookmark not defined.
3.1.1.1 Class Description .....	6
3.1.1.2.1 Lock the Door .....	Error! Bookmark not defined.
3.1.1.2.2 Unlock the Door .....	Error! Bookmark not defined.
3.1.2 Facial Recognition.....	Error! Bookmark not defined.
3.1.2.1 Class Description .....	Error! Bookmark not defined.
3.1.2.2.1 Capture Images .....	Error! Bookmark not defined.
3.1.2.2.2 Identify Users .....	Error! Bookmark not defined.
3.1.2.2.3 Verify Users .....	Error! Bookmark not defined.
3.2 Automatic Heating and Cooling Systems .....	Error! Bookmark not defined.
3.2.1 Temperature Sensor.....	Error! Bookmark not defined.
3.2.1.1 Class Description .....	6
3.2.1.2.1 Calculate Temperature .....	Error! Bookmark not defined.
3.2.1.2.2 Turn On Fan/AC .....	Error! Bookmark not defined.
3.2.1.2.3 Turn Off Fan/AC .....	Error! Bookmark not defined.
3.3 Leakage Detection .....	Error! Bookmark not defined.
3.3.1 Water Sensor.....	Error! Bookmark not defined.
3.3.1.1 Class Description .....	6
3.3.1.2 Data Members .....	Error! Bookmark not defined.
3.3.1.2.1 Detect water leakage .....	Error! Bookmark not defined.
3.3.2 Gas Sensor.....	Error! Bookmark not defined.
3.3.2.1 Class Description .....	Error! Bookmark not defined.

3.3.2.2.1 Detect gas leakage .....**Error! Bookmark not defined.**

#### **4.0 Traceability Matrix ..... 10**

### **Definitions, Acronyms and Abbreviations**

- MQTT - Message Queueing Telemetry Transport
- IOT - Internet of Things
- DHT - Digital Humidity and Temperature
- GUI - Graphical User Interface

### **References**

- Microcontroller based Home Security System with Remote Monitoring - Nikhil Agarwal, 2012 ICEDSP
- Sensor based home automation and security system - M. H. Assaf, R. Mootoo, S. R. Das, E. M. Petriu, V. Groza and S. Biswas, 2012 IEEE
- Room Temperature Control and Fire Alarm/Suppression IoT Service Using MQTT - Do-Hun Kang, Min-Sung Park, 2017 PlatCon
- Messaging Queue Telemetry Transport IOT based Messaging Protocol - Suvam Mohanty & Sagar Sharma , Vaibhav Vishal, 2016 IRJET
- IoT real time data acquisition using MQTT protocol - R A Atmoko & R Riantini , Vaibhav Vishal, 2016 ICoPLA

### **Change History**

This section describes the details of changes that have resulted in the current low-level Design document.

#	Date	Document Version No.	Change Description	Reason for Change
1.				
2.				
3.				

## **1.0 Introduction**

### **1.1 Overview**

This document relates to the background and surrounding information regarding our project - Emotion detection using voice data. It deals with the scope, shortcomings, risks, architecture, etc. of the project and is meant to serve as documentation to the end-user who wishes to understand the project in detail and modify it to achieve better results.

### **1.2 Purpose**

Low Level documentation explains the internals of the product and the functionalities of all the classes and methods.

### **1.3 Scope**

With the digitalization of almost and everything the previous decade saw the rise of automating houses and offices with the advent of IOT and Industrial IOT.

Being a fairly new industry there is a scope for widespread innovation from scratch.

The modules can be used independently also as separate products.

Development of facial recognition systems, automatic heating, cooling, access control and leakage detection systems.

## **2.0 Design Constraints, Assumptions and Dependencies**

The assumptions made is -The system never experiences WiFi and power failure.

Dependencies -

- No power failures
- Constant Uninterrupted WiFi

Risks -

- Hardware Failures
- Pests biting wires
- Power Failures

### **3.0 Design Description**

This section describes the design with respect to functional modules.

#### **3.1 Access Control**

##### **3.1.1 Access Control**

###### **3.1.1.1 Class Description**

The class represents functionalities of the access control module, which includes locking and unlocking the doors by department wise as well as in specific.

###### **3.1.1.1.1 Lock the Door**

- Purpose  
When the user toggles the button that appears in the GUI the door will be locked.
- Input  
Toggling the switch through GUI(Digital Input).
- Output  
Magnetic lock gets activated, hence the door gets locked.
- Logging Parameters  
Lock count  
Out time
- Exceptions  
If any gap has been created between the magnetic bar and the steel bar(door) then the door will remain unlocked though the lock is activated.
- Pseudo-code  
digitalWrite(<door number>,HIGH)

###### **3.1.1.1.2 Unlock the Door**

- Purpose  
When the user toggles the button that appears in the GUI the door will be unlocked.
- Input  
Toggling the switch through GUI(Digital Input).
- Output  
Magnetic lock gets deactivated, hence the door gets unlocked.
- Logging Parameters  
Unlock count  
In time
- Exceptions  
If any network error occurs the MQTT protocol may fail and it affects the functionality.
- Pseudo-code  
digitalWrite(<door number>,LOW)

### 3.1.2 Facial Recognition

#### 3.1.2.1 Class Description

The facial recognition module helps in recognizing the registered user and detects others as guests likewise this module also can be used for the access control.

##### 3.1.2.1.1 Identify Users

- Purpose  
The visitors will be classified whether they are registered or new users.
- Input  
Images of visitors.
- Output  
Identification of users.
- Exceptions  
Before using the users have to register themselves in the database.
- Pseudo-code
- ```
boxes = face_recognition.face_locations(rgb,  
    model=args["detection_method"])  
encodings = face_recognition.face_encodings(rgb, boxes)  
names = []  
...
```

##### 3.1.2.1.2 Verify Users

- Purpose  
The sensor(camera) will capture the images of the visitors and this will be used for identification of registered users and verification.
- Input  
Images of visitors.
- Output  
Registered users will get access to the resources.
- Pseudo-code  
For encoding in encodings:  

```
matches = face_recognition.compare_faces(data["encodings"],  
    encoding)  
name = "Unknown"  
if true in matches:  
    matchedIdxs = [i for (i, b) in enumerate(matches) if b]  
    counts = {}  
    for i in matchedIdxs:  
        name = data["names"][i]  
        counts[name] = counts.get(name, 0) + 1  
    name = max(counts, key=counts.get)  
    names.append(name)  
...
```

## **3.2 Automatic Heating and Cooling Systems**

### **3.2.1 Temperature Sensor**

#### **3.2.1.1 Class Description**

The DHT sensor will get the temperature readings from different zones of the room. Based on the final calculation decides to turn on/off the fan/AC.

##### **3.2.1.1.1 Calculate Temperature**

- Purpose  
To get the temperature readings from different zones and calculate the average.
- Input  
Analog Input through temperature sensor.
- Output  
Average temperature of the room.
- Pseudo-code  
zonea = temperaturesC[0];  
zoneb = temperaturesC[1];  
zonec = temperaturesC[2];  
zoned = temperaturesC[3];  
meantempC = meantempC / numberOfDevices;

##### **3.2.1.1.2 Turn On Fan/AC**

- Purpose  
If the temperature of the room exceeds certain threshold Fan or AC of the room will be switched on automatically.
- Input  
Room temperature(Analog Input).
- Output  
Fan or AC will be switched on.
- Exceptions  
If any temperature sensor is giving an wrong readings then the system may behave in unexpected way.



- Pseudo-code

```
if (meantempC >= 28) {
    Serial.println("Turning fan on");
    ctrl.forward();
}

if(meantempC<=18){
    Serial.println("Turning heater on");
    digitalWrite(heater,HIGH);
}
```

#### **3.2.1.1.3 Turn Off Fan/AC**

- Purpose  
If the temperature of the room falls below certain threshold Fan or AC of the room will be turned off automatically.
- Input  
Room temperature(Analog Input).
- Output  
Fan or AC will be turned off.
- Exceptions  
If any temperature sensor is faulty and giving an wrong readings then the system may behave in unexpected way.
- Pseudo-code

```
if (meantempC >= 28) {
    Serial.println("Turning fan on");
    ctrl.forward();
}
else {
    Serial.println("Turning fan off");
```

### **3.3 Leakage Detection**

#### **3.3.1 Water Sensor**

##### **3.3.1.1 Class Description**

As a part of leakage detection module the water sensor will detect water leakage and the pump will be turned on/off.

##### **3.3.1.1.1 Detect Water Leakage**

- Purpose  
The sensors will be fixed at different heights to read the water level of the tank and also the pump will be turned on/off.
- Input

Analog readings from the sensor(water level).

- Output

Water pump will be turned off if water is leaking, will be turned on if tank is empty.

- Pseudo-code

```
if(watValue >=0 && watValue<2800){
    Serial.println("Turning pump on");
    digitalWrite(pump,LOW);
    client.publish("Stat",a);
    leakage += 0;
}
if(watValue >=2800 && watValue <=4095){
    Serial.println("Waterleaking");
    leakage += 1;
    digitalWrite(pump,HIGH);
    client.publish("Stat",s);
}
```

### 3.3.2 Gas Sensor

#### 3.3.2.1 Class Description

As a part of leakage detection module the gas sensor will detect gas leakage and the user will get the notification in case of LPG leakage.

##### 3.3.2.1.1 Detect Smoke

- Purpose

Sensors will be set-up at various locations and will detect the LPG leakage. Also in case of leakage the user will get the notification about the same.

- Input

Analog Input(combustible gas and smoke).

- Output

Alert Notification to the user if leakage detected.

- Parameters

Presence of combustible gas, natural gas, LPG and smoke.

## 4.0 Traceability Matrix

| CRS Reference Section No. and Name | DESIGN / HLD Reference Section No. and Name | LLD Reference Section No. Name |
|------------------------------------|---------------------------------------------|--------------------------------|
|                                    |                                             |                                |
|                                    |                                             |                                |
|                                    |                                             |                                |