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AMAR TELIDJI UNIVERSITY LAGHOUAT

FACULTY OF SCIENCES
COMPUTER SCIENCE DEPARTEMENT

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Filière : : Computer Science

Option : : Computer Systems and Networks

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Theme :

Conception and realization smart home with UML

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TABLE DES MATIÈRES

TABLE DES FIGURES

ABSTRACT

The Internet of Things (IoTs) can be described as connecting everyday objects like smartphones,Internet TVs, sensors and actuators to the Internet where the devices are intelligently linked together enabling new forms of communication between things and people, and between things themselves. Home automation is the set of connected objects that make the house itself connected, or communicating. We sometimes even speak of a smart home, the various connected objects allowing the home to react automatically according to events (opening / closing) the doors, turning (on / off) the light remotely during an unforeseen absence, etc.). Our work is in the field of lot and will consist in creating a mobile application as well as a home automation box whose role will be to manage the various lot of the house.For the realization, we worked with the languages Android and Arduino.

GENERAL INTRODUCTION

Home automation therefore brings together all the techniques and technologies allowing the automation and improvement of tasks within a house or apartment. But today home automation does not only concern homes, we see more and more people domotizing their workshops, their farms, etc. Home automation is the extension of our smartphones and the future of home comfort offered by technology.You can access home automation by purchasing a home automation box in the market or through automation contrôle boxs placed in domotized buildings when they were built.In Algeria today, you can access the internet from home via a router connected to the phone cable or via a 4G router connected by a SIM card to the mobile network. We decided to create a tool that fits into this existing structure. We decided to create a home automation box controlled by a mobile application. Our home automation box manages any device with an integrated wifi board (wifilamp, wifi socket, sensor box, etc.).
We worked with the wemos, which is a programmable wifi board, to make our box. To program the board we had to work under the Arduino environment. Finally, the application was developed in the Android environment. This document is structured as follows :

— We will have a first chapter of definitions and generalities.
— Then, we will have the design and realization chapter .
— Finally, we will conclude with a general conclusion and the perspectives.

In this memory we have presented our work which focuses on the realization of a home automation box and a mobile application to manage it.The goal of the project was to realize a home automation device adapted to Algerian wifi structures. To do this we used a Wemos D1 R1 board including ESP8266 technology that we programmed with Arduino. The purpose of this board is to communicate with the smart device to receive the orders and send them to the appropriate devices. To allow users to control the board we made a mobile application with the Android environment.We can say that this project allowed us to familiarize with different technologies and to discover two new aspects :microcontroller programming and electronics.

FIGURE 1 – Future home[6]

As perspectives of our project, we plan to make a 4G home automation box and as well as programmable wifi devices including wifi lamps, wifi sockets, wifi rolling shutters, etc.

CHAPITRE 1

GENERALITIES

1.1 Wemos D1 module definition and Material

1.1.1 Wemos D1 R1

WEMOS D1 : is a WIFI development board based on ESP8266 12E. The functioning is similar to that of NODEMCU ,except that the hardware is built resembling Arduino UNO. ... R1 , R2 boards look like Arduino UNO board but version is not printed on board.

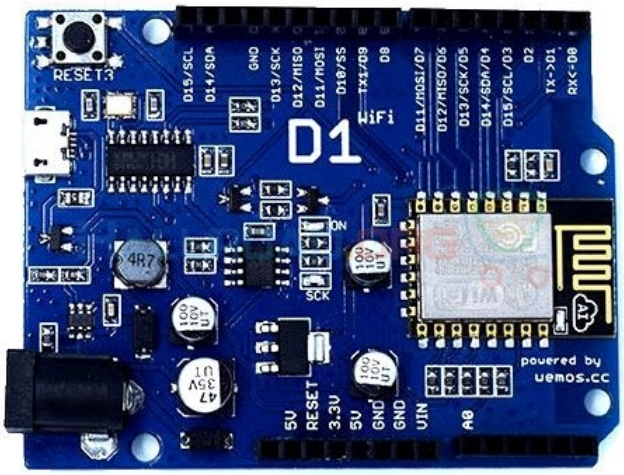


FIGURE 1.1 – Wemos D1 R1 Card[5]

— an analog input (3.2V max)
— a Micro USB connector
— compatible with Arduino
— compatible with NodeMCU

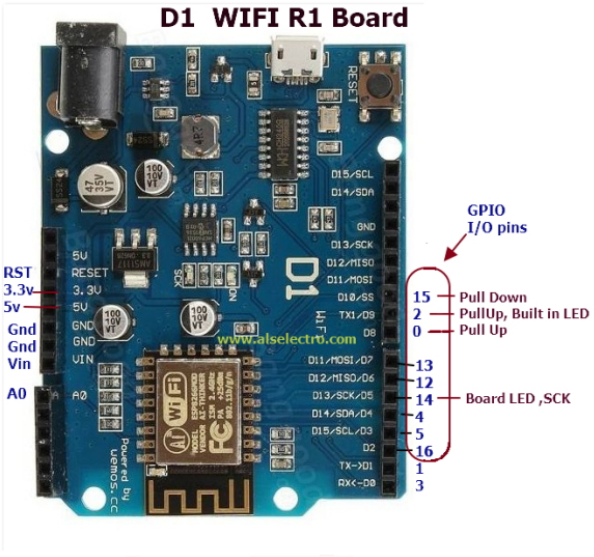


FIGURE 1.2 – Wemos D1 R1 pinout[8]

— Diagramm of pins :

Wemos D1	ESP8266 Pin	Functions
D0	16	GPIO
D1	5	GPIO, **I2C** SCL
D2	4	GPIO, **I2C** SDA
D3	0	GPIO
D4	2	GPIO
D5	14	GPIO, **SPI** SCK (Serial Clock)
D6	12	GPIO, **SPI** MISO (Master in, Slave out)
D7	13	GPIO, **SPI** MOSI (Master out, Slave in)
D8	15	GPIO, **SPI** SS (Slave select)
A0	A0	Analog in, via ADC
RX	3	Receive
TX	1	Transmit

FIGURE 1.3 – diagramm of pins in Wemos D1 R1[4]

1.1.2 the ranges of the Wemos D1 card

— ESP-01 : The ESP-01 is a very small module based on the ESP8266 microcontroller.
— ESP8266E-12 (NodeMCU) :The NodeMCU board got his name from an open source IoT platform. The platform
— includes firmware which runs on the ESP8266 WiFi SoC from Espressif Systems, and hardware which is
— based on the ESP-12 module.
— WeMos D1 Mini :The Wemos D1 Mini with integrated ESP8266 is a development board for connected
— objects based on the ESP8266 ESP-12E module developed by the Wemos CC company.
— LOLIN Wemos D1 mini :is an upgraded version of the popular ESP8266 development platform which can be
— programmed using Arduino IDE

1.1.3 Why Wemos D1 ?

— WeMos D1 ESP8266 WiFi development board compatible Arduino IDE
— a clear and simple programming environment.
— Open source and extensible software.
— Open source and extensible hardware.clear and

1.1.4 the constitution of the Wemos D1 card

— Wemos D1 card specifications :

In this lab we will explore the functionalities of the Wemos D1 card. This card is very compact but it can be supplemented by numerous extensions (sensors, actuators) which are easy to implement.

The processor of ESP8266 is much faster than the AVR of the Nano / Uno card, and its RAM memory and EEPROM are 10/20 times larger.

The card incorporates a WiFi modem operating, as desired, in Station or access point mode - Access Point.

1.2 Servomotor

— Power supply : 4.8 to 6 Vdc
— Stroke : 2 x 60 °
— Torque : 1.6 kg.cm at 4.8 Vdc
— Speed : 0.12 s / 60 °

FIGURE 1.4 – Servomotor 9g[6]

— Dimensions : 24 x 13 x 29 mm
— This involves controlling an angular displacement ranging from –45 ° to + 45 °.
— The motor must therefore be able to turn in both directions of rotation and to follow the position
— instructions with the additional constraint of having a displacement proportional to the command.
— The ability to follow an instruction is obtained by grouped techniques

1.3 Flamme Sensor

FIGURE 1.5 – Flamme Sensor 5g[10]

— 760nm-1100nm Flame Light Infrared IR Sensor Module for Arduino.
— Detection module
— Flame detection sensor module Most sensitive sensor for infrared flame wavelengths between 760nm and 1100nm. It has two outputs :

1. AO : analog output, output voltage signals on thermal resistance in real time,

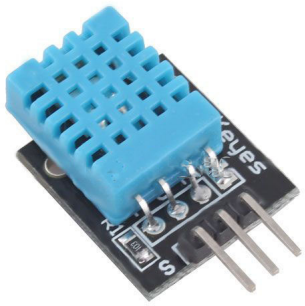


FIGURE 1.6 – Humidity Sensor 2g[11]

2. DO : when the temperature reaches at a certain threshold, high and low output threshold signals is adjustable by potentiometer.

— 60 degree detection sensor Suitable for Arduino DIY project

— Voltage : DC 3 5.5V

The flame detector detects any rise in temperature or the presence of products resulting from combustion.

The flames produce radiation characterized by a more or less intense flicker frequency in specific spectral bands.

The principle of the flame detector is to respond to electromagnetic radiation emitted by a flame, distinguishing it from interfering radiation present in the environment of use.

Optical flame detectors consist of UV and / or IR sensors to detect these radiation

1.4 Humidity Sensor

DHT11 Temperature and Humidity Sensor features a temperature and humidity sensor complex with a calibrated digital signal output [11] 1.6.

— Power supply + 5V (3.5 - 5.5V)

— temperature : from 0 to 50 ° C, precision : +/- 2 ° C

— Humidity : from 20 to 96

1.5 Gaz Sensor MQ6

— Power supply : 5 V

— Easy to use gas sensor (LPG)

— Can be used in gas leak detection equipment in consumer and industrial applications

— Type of interface : analog

— High sensitivity to LPG, isobutane, propane

— Low sensitivity to alcohol, smoke

FIGURE 1.7 – Gaz Sensor MQ6[6]

— Quick response
— Stable and durable
— Simple pilot circuit

The MQ-6 LPG, Isobutane and Propane Gas Sensor is a semiconductor gas sensor that detects the presence of LPG, Isobutane and Propane gas at concentrations from 300 ppm to 10,000 ppm, a suitable range for leak detection gas. The sensor's simple analog voltage interface only requires one analog input pin from your microcontroller.

1.6 Motion Sensor

FIGURE 1.8 – Moton Sensor[6]

— Dimensions : 32 x 24 x 27H mm
— Voltage : 5-12VDC
— Output : 3.3V TTL
— Detection Distance : 3-7mt (approx, adjustable)
— Delay Time : 5-200s (adjustable)

The PIR (Passive Infrared Sensor) motion sensor is an electronic sensor that measures infrared (IR)light radiating from objects in its field of view. They are very often used in alarm

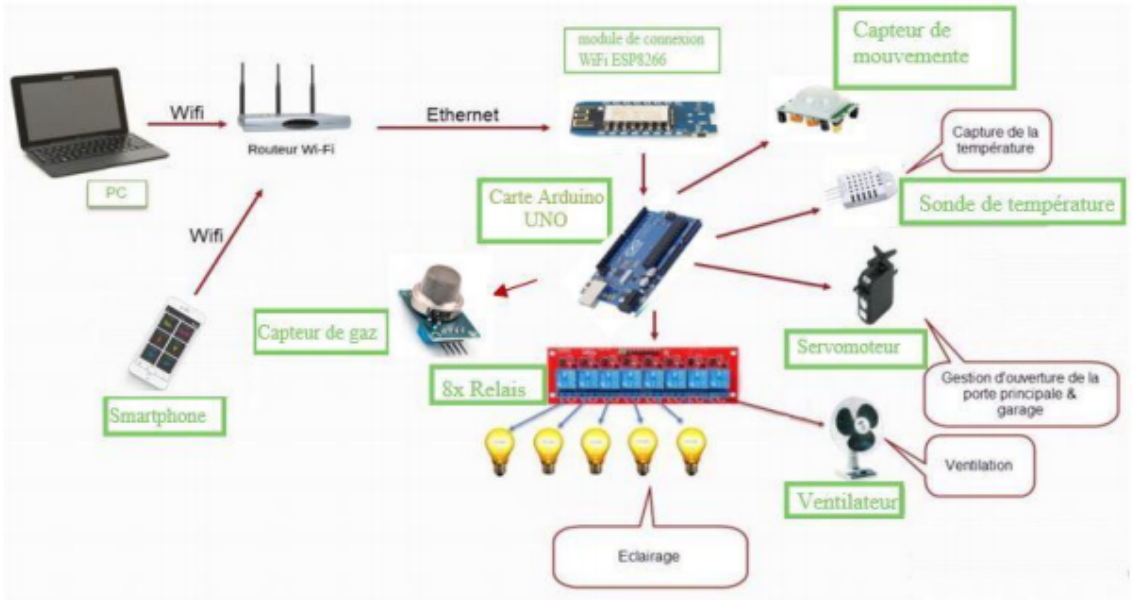


FIGURE 1.9 – Light Control[6]

or presence detection systems for their low cost and efficiency.

1. the Appliance of PIR are :

— Motion detection and activation of an interactive work.
— Passage/intrusion detection.
— Control of an automated cat flap.
— Detector for home automation system control

CHAPITRE 2

REALISATION

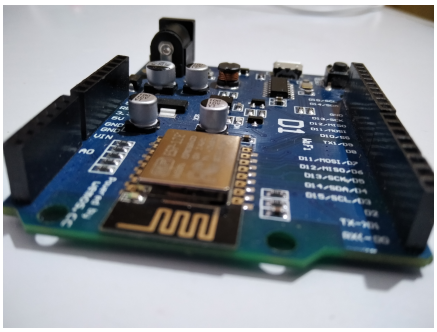
2.1 Introduction

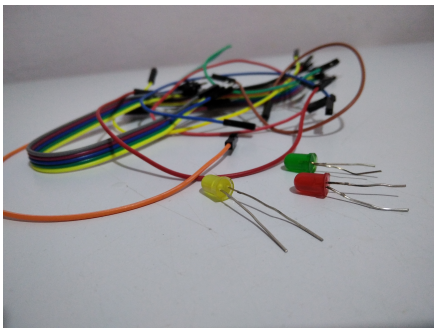
In this chapter, we will present in detail the different stages of the realization of our project as well as the design of the frame, the grouping of the electronic parts used, the assembly diagrams of the latter as we will also present the programming part.
First, this project based on a Wemos D1 R1 card allows us to build and program a box with LED and to control it remotely by the Wifi network using a smartphone and which also allows us to consult I the state of the LED on our box.
After having given in the previous chapter a theoretical description of the Wemos D1 R1 module,it's development environment and the description of the components used, we going to proceed with realization of the box for this reason, several blocks were necessary to achieve such a combination.

1. Our pratical realizaton was made in five parts :

— Application design with UML.
— Realization of the application with Android.
— Design of the box and it's circuit and the it's construction.
— Programming of the box Arduino.
— Connection of th e box with smartphone which will communicate with the router.

The first part of our project : we tried to make a design of a box that allows our house to become connected and controlled remotely.
The pictures below represent in detail the stages of construction of the box.





At this section user will be able to control the light in SH by smart phone it will be on/off option in our study we try to connect Wemos D1 R1 module by USB cable to pc with 3 LED which their output is pin14 ,pin2 and pin 4 and we execute the code Arduino then give us the IP adress we take that IP in the Android code and it connect to the server which give us good resultes like Figure shown below

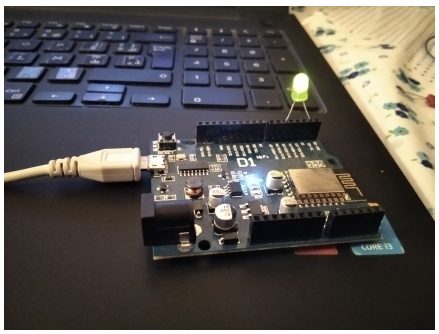


FIGURE 2.1 – Light Control

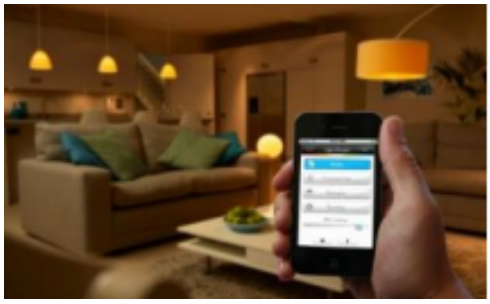


FIGURE 2.2 – Smart Home Lighting Control Systems[5]

2.2 UML Diagramms

2.2.1 Use case diagramm

To give an overview of the functional behavior of our system, we used the use case diagram. This diagram shows the interactions that will allow actors to achieve their goals using our system as shown Figure below .

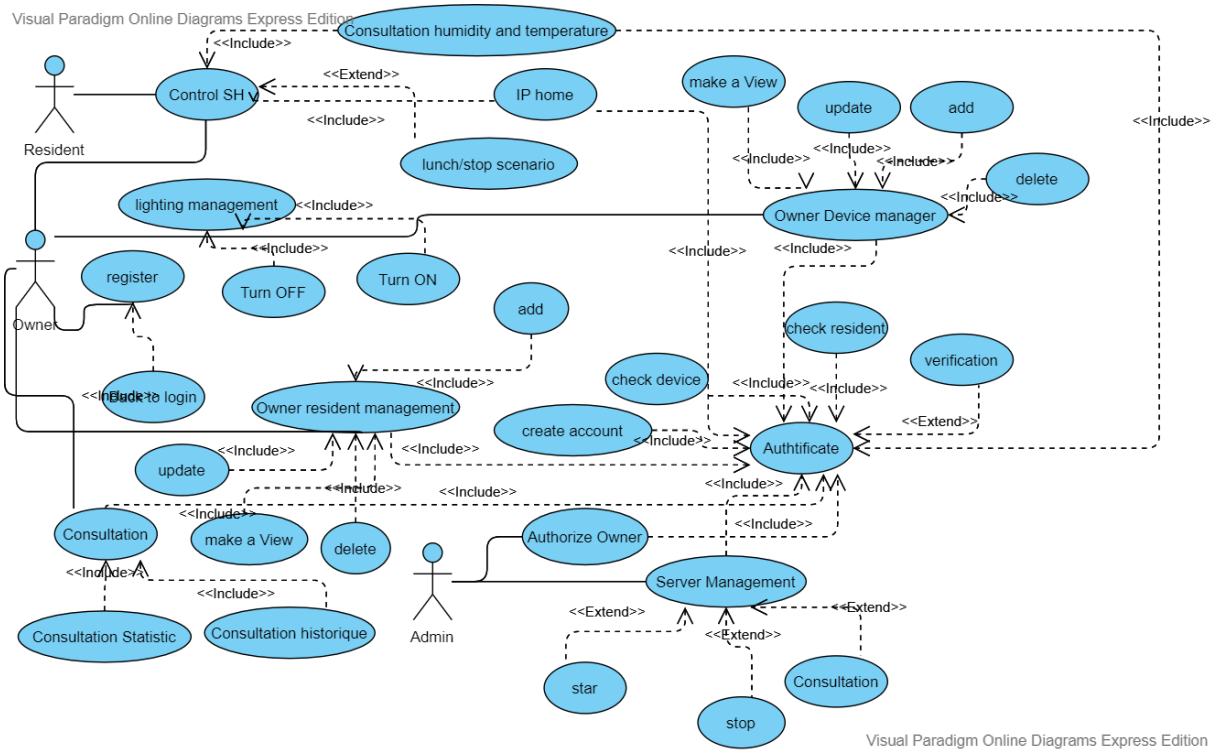


FIGURE 2.3 – use case diagramm

Actors :

— Owner : he is the main user and officially refers to him the House. So he's a smart home administrator.

— Resident : he is the secondary user, he can be a member of the family as it can be a friend or whatever.

2.2.2 Class diagram

Class diagrams are one of the most useful types of diagrams in UML as they clearly map out the structure of a particular system by modeling its classes, attributes, operations, and relationships between objects,[9] as shown Figure below.

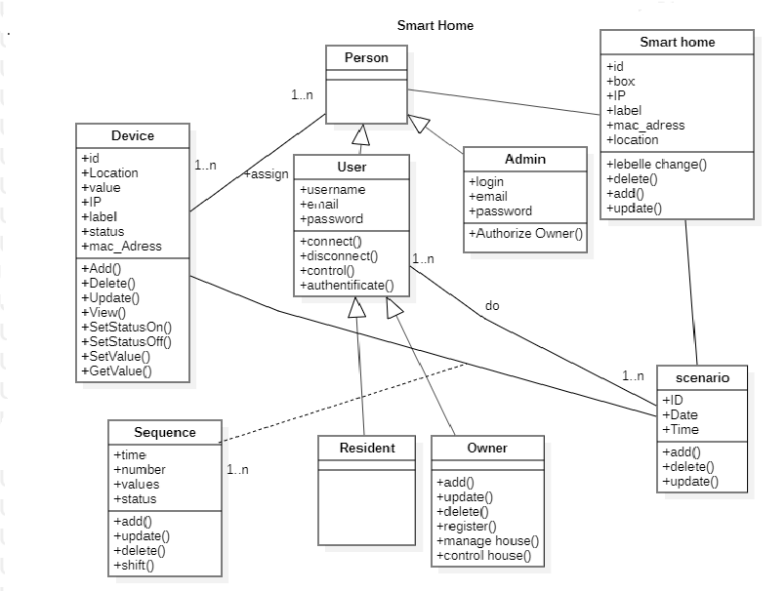


FIGURE 2.4 – class diagram

2.2.3 Sequence diagramm

"Register"

First, the user asks the system to allow them to register. Once the requested interface is displayed, he enters the necessary fields and validates the scenario for Register as shown Figure below 2.5

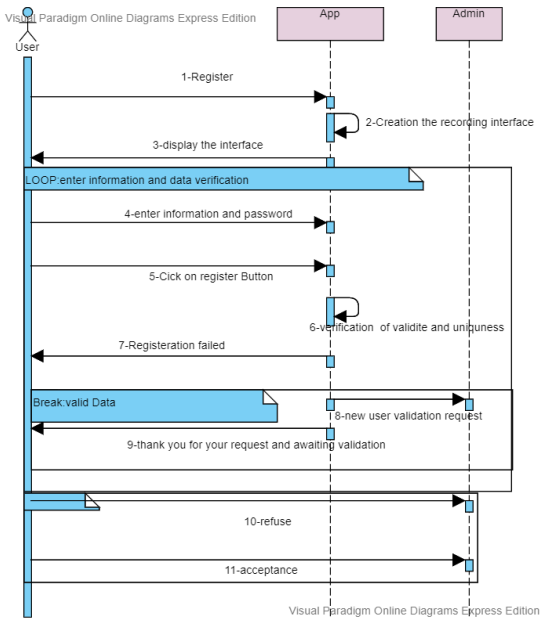


FIGURE 2.5 – sequence diagram Register

"Authentificate"

The system displays the authentication form following the request the user, who fills in his login details and sends the form. The system then performs the necessary checks.The following figure illustrates a detailed description of the scenario for the Authentificate as shown Figure 2.6.

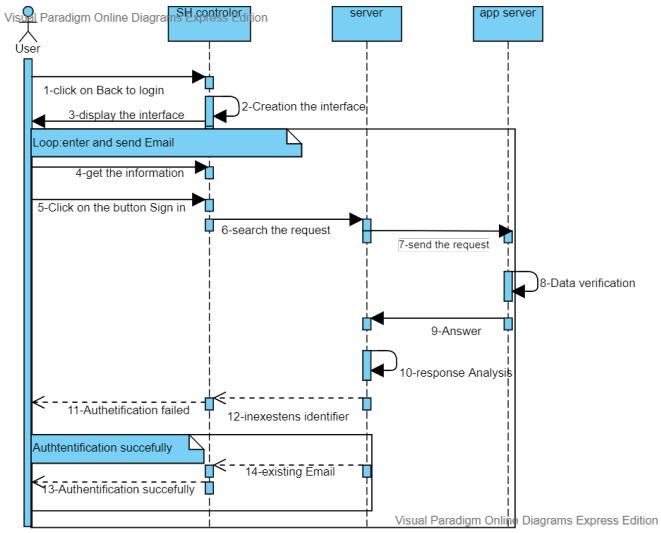


FIGURE 2.6 – sequence diagram Authentificate

"Add Resident"

Through this diagram, we will describe the scenario of "add resident" , Owner he is the only one who allows an inhabitant to control his house.For this he must start with the selection of the inhabitant the owner add a resident after he fills his identity information like figure shown below2.7.

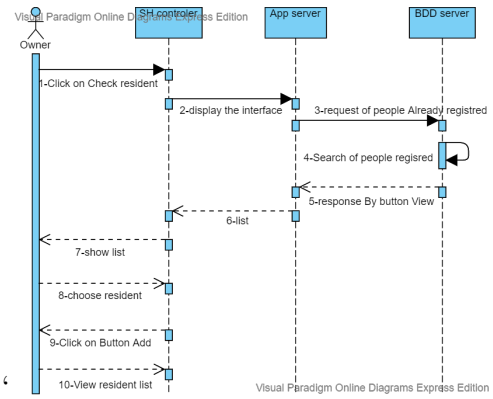


FIGURE 2.7 – sequence diagram Add Resident

"Light"

Through this diagram, we will describe the scenario of the "light" allowing a user to turn on/ off an LED to specify a room, bathroom, kitchen, etc..of his Smart Home. After successful authentication, the user begins by selecting their IP Address and then identifies the desired room. Then the system offers him a way to order this Led to either turn on or off.like figure shown below

to turn ON/OFF the light, an HTTP POST request is sent to the resource .

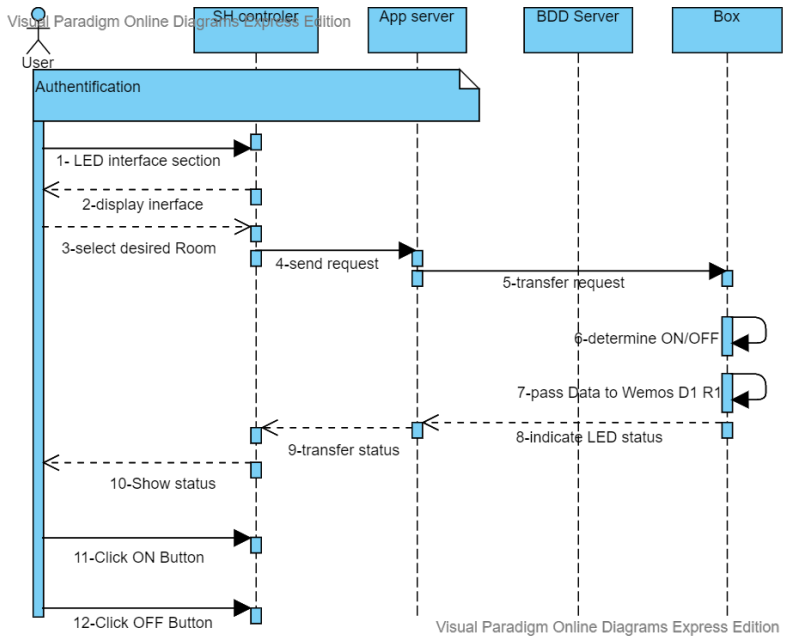


FIGURE 2.8 – sequence diagram light control

2.3 Android App

2.3.1 Interface design

Authentification interface

A user with the Smart House application can explore its different interfaces, but in order to benefit from its functionalities, it is necessary to authenticate. The interface as shown Figure below prompts the user to log into the system while entering a valid email and password as shown figure 2.9

Register interface

To register the user has the choice to go through the authentication interface by clicking on "Create one" This last action displays an interface in the form of a registration form allowing our user to enter all information in order to have an account such as Figure below 2.10

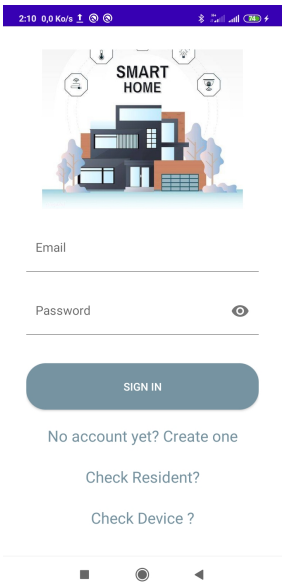


FIGURE 2.9 – Authentication interface

At the end of the form validation that we have just described, the inserted data is saved in the database.Likewise, the validation of this form leads to the automatic sending of an activation request to the system administrator. The latter, following receipt of an email requesting validation, takes place based on the information provided.Only "Owner" users who are the managers of smart homes connected to our system can register. Other qualified "Resident" users such as family members, relatives and friends are registered by the "Owner" who will be responsible for all future work on his house.

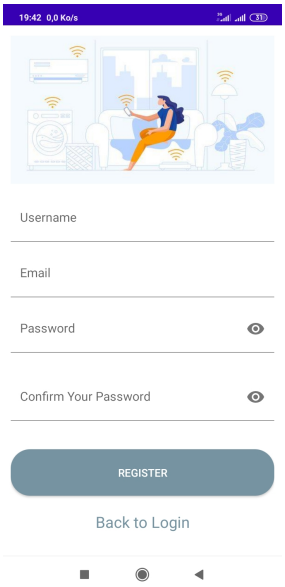
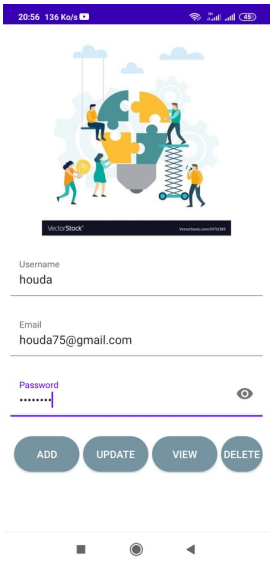


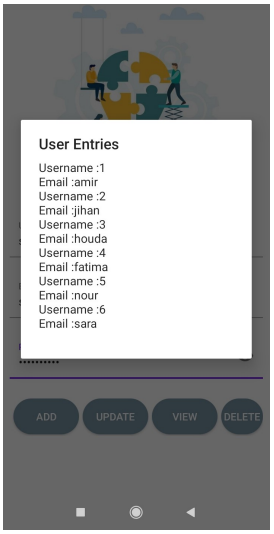
FIGURE 2.10 – Register interface

Resident Interface

To allow "Owner" to add a member to his group, our system provides him with the following "Resident" interface form.



(a) resident interface



(b) View List of Resident

FIGURE 2.11 – Global resident interface

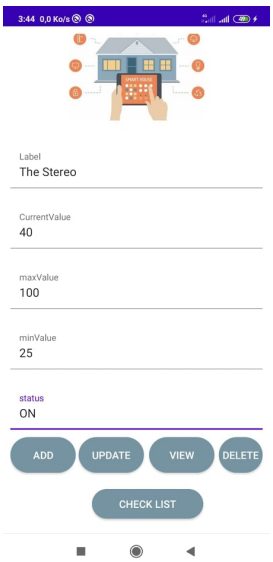
After filling in the identification information of a member, are saved in the database and Owner can add, delete or make a view like figure shown above.

Device Connected

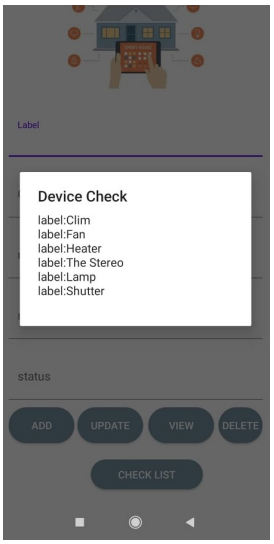
Often, smart home devices are controled by one of the family members and associated with the same family member's account, yet are use by all other residents in the home,owner can add devices to his smart home.

After adding devices to our smart home network, the user can control the device and read data originating from it (depending on whether the device is a sensor or an actuator). If the user is in the same local network as the fan, requests for reading data or commands to the devices in the smart home network are sent using our App

To allow Owner to add a device to database, our system provides him with the following "Device interface" form like figure shown below.



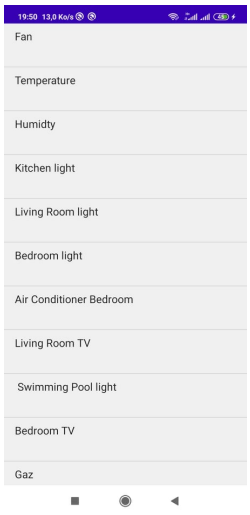
(a) the device interface



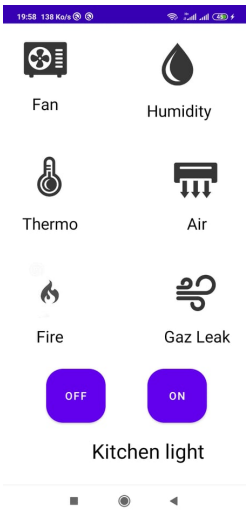
(b) View List of Devices Connect

FIGURE 2.12 – Globale Interface Device

After the User fill the identity information of a device,they are saved in the database and he can add, delete,update or make a view like figure shown above 2.12b.



(a) Device List



(b) Device Location

FIGURE 2.13 – Globale interface location

he can also click on check list to verify devices in his home then he select device (item selected),after that the system display the item selected as previous interface and show the device location (Bedroom Light,Living Room TV) like figure shown above. 2.13b

IP Adress interface

The access to Web services has to be easy you have to type your IP adress which arduino IDE give you like figure 2.14

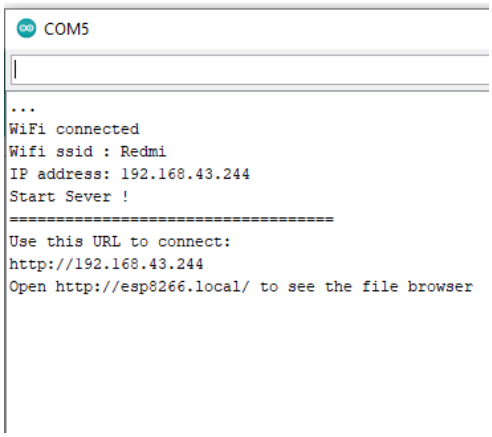


FIGURE 2.14 – the IP Adress in Arduino IDE

you fill your IP Adress and which port are connect,after filling click on the button Connect

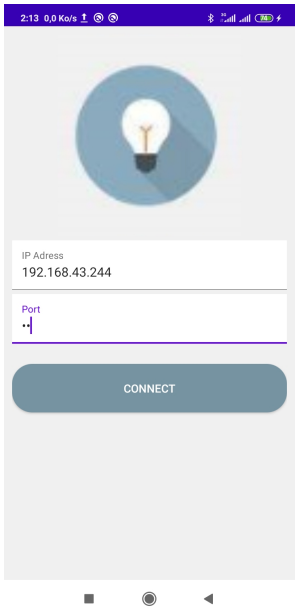


FIGURE 2.15 – IP Adress Interface

LED interface

Once the user, whether owner of a house or living there is privileged to connect to our system,he can control and order the house to which he belongs.

Among the possible control figures offered by our system we mention :

— The lighting control of any room in the smart home is switched on or off.
From the list you can select or consult the bedroom, kitchen, living room, WC and swimming pool which are lit while the other rooms are not.

— Consulting the temperature and humidity data and Gaz

— you can also turn on / off the fan and the air conditioner and open / close shutter

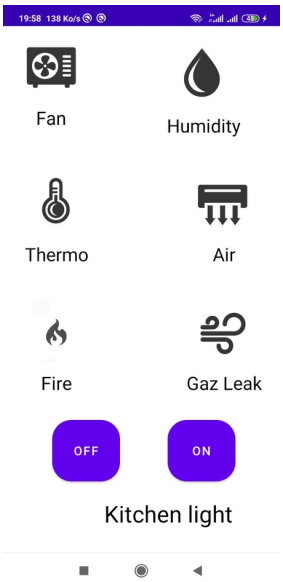


FIGURE 2.16 – LED intrface

2.4 Fritzing Diagramm

Fritzing is an open-source project for developing computer-aided design software for professionals and enthusiasts of designing electronic circuits. It helps designers and technicians to easily draw and install electronic circuit models with automatic path correction and also supports network connectivity for joint projects.It was developed at the Potsdam University of Applied Sciences [7]

— Gaz Detector :

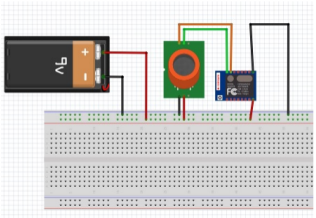


FIGURE 2.17 – Gaz Sensor Diagramm

— Door Lock :

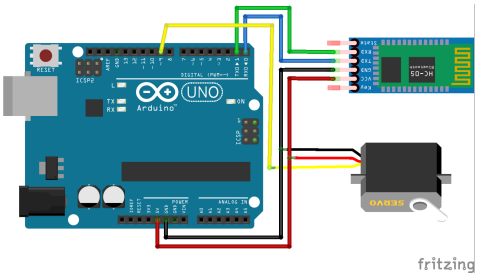


FIGURE 2.18 – Servomotor Diagramm

— Light :

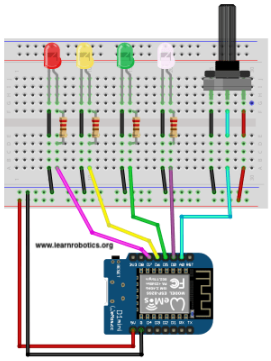


FIGURE 2.19 – Led Diagramm

— Humidity andTemperature :

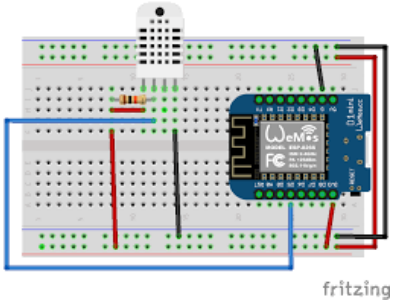


FIGURE 2.20 – DH11 Diagramm

— Flamme Detector :

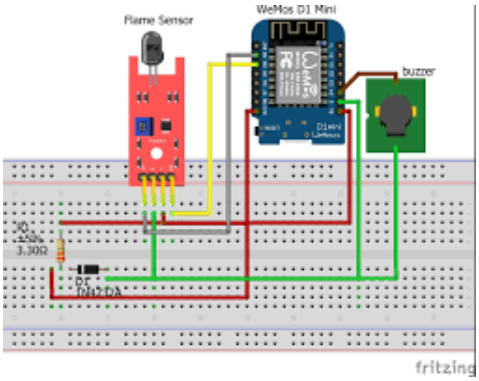


FIGURE 2.21 – Flamme Sensor Diagramm

— Motion Detector :

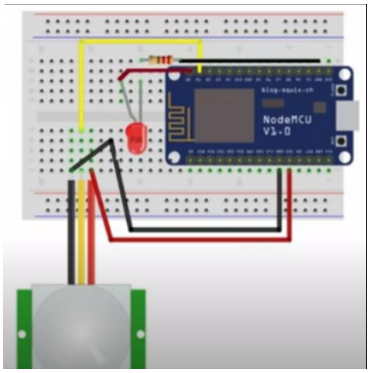


FIGURE 2.22 – Motion Sensor Diagramm

2.5 the programming part

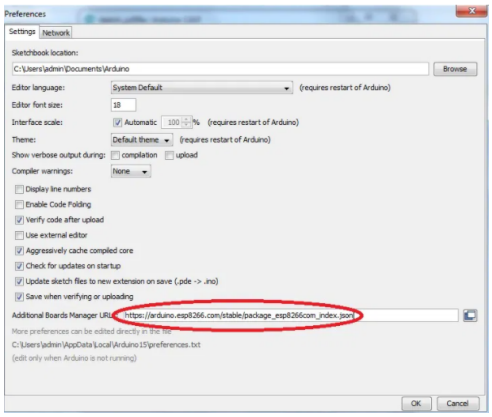
Such an acquisition card which is based on its construction on a microcontroller must be equipped with a programming interface as is the case with our card.
The open-source programming environment for Arduino can be downloaded for free (for Mac OS X, Windows, and Linux).

2.6 the programming environment

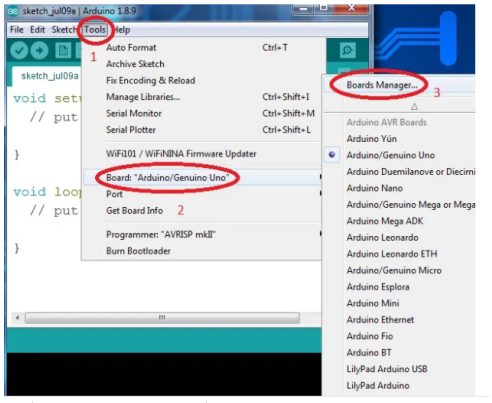
The programming software of the Arduino board serves as a code editor (language close to C). Once the program has been entered or modified on the keyboard, it will be transferred and stored in the card through the USB link. The USB cable supplies both power to the board and also carries information to this program called IDE Arduino.

2.7 Setting Up the Arduino IDE for the WeMos D1

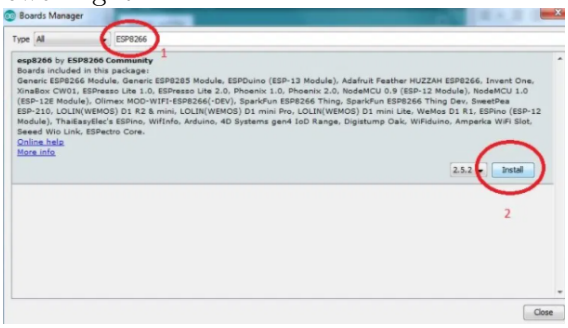
— the Arduino IDE : Arduino IDE go to file ¿ preferences : This will bring up the Preferences window. On the Additional Boards Manager URLs field, paste this



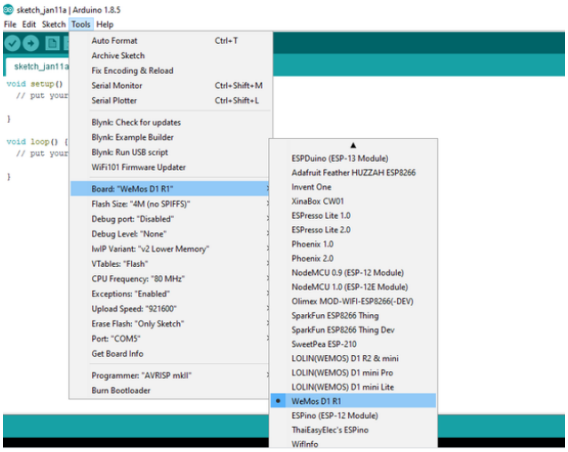
— Jason File :The Json file will give the IDE information about the WeMos D1 Mini and other ESP8266-based boards. -Next, go to Tools ¿ Board ¿ Boards Manager.. to open up the Board Manager windows.



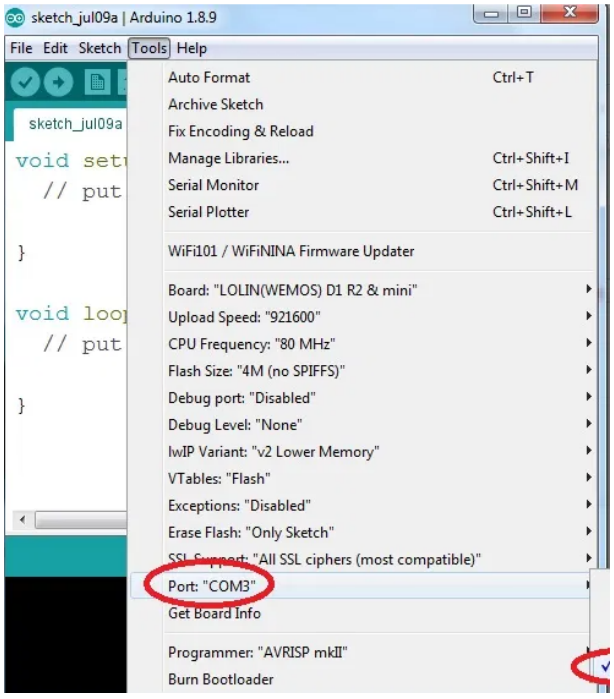
— ESP8266 : On the search field, type ESP8266 and one result should appear. Click the install button on the lower right.



— WEMOS D1 R1 : Wait for the download to finish. After that, you can now use the Arduino IDE to program the WeMos D1 R1.



— Connecting the WeMos D1 R1 :With a microUSB cable, connect the WeMos D1 R1 to your computer then select the correct board on Tools ¿ Board : Port



— ports :

-you might need to install the CH340 driver

-Also, make sure you select the correct COM Port :

Project Perspective

In our work we have proposed a Smart Home project The main goal of the project was to show how to create maximum comfort and energy saving with the help of automation.Then it is enough to have a mobile phone to manage the Smart Home from our app.
The technology is easy to use and targeted for people without technical background. This technology also provides great assistance to handicapped and aged people.The proposed system is better from the scalability and flexibility point of view than the commercially available home automation systems.

Future Work

This is a project which has a wider scope of improvisation compared to any other project. The future work in this field includes implementation of this technique using Wi-Fi module which would increase the range of operation of this system. Also some more functionality can be added to increase the usability of the system like anti-theft alarms, temperature sensors, etc.also anotifies of the power being consumed by every device and all devices together can be added.

Conclusion

In order to implement our smart home, a study of the systems involved has allowed us to understand closely the technologies and components involved in the field of intelligence applied to the home. She introduced us to the environment of mobile applications through the bay of the Android platform, in the mode of openware, especially Arduino hardware, and application server design and commissioning.

The realization of our system was initiated by the study of existing solutions and their criticism in order to fix the functions of the future system. Then, we established a detailed analysis of the projected system modeled in UML language.

Our study deals with the concept of intelligence in a space reduced to that of the house. Let us bring in a larger horizon, we introduce the notion of the intelligent environment and, properly speaking, ambient intelligence.

It is about providing an environment (commercial spaces, hospitals, companies) with the capacity for perception, analysis, treatment and decision-making. So it must imperatively intervene more fields, technology and components

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