VIETNAM NATIONAL UNIVERSITY, HO CHI MINH CITY
UNIVERSITY OF TECHNOLOGY
FACULTY OF COMPUTER SCIENCE AND ENGINEERING

MULTI-DISCIPLINARY PROJECT (CO3087)

Semester 222

AIoT applications for Smart Home

Advisor(s): Dr. Cuong Pham Quoc

Students: Lý Gia Huy - 2053038
Trần Phạm Minh Đăng - 2052070
Lê Quang Minh - 2053217
Nguyễn Quang Vinh - 2053591

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1 Introduction

1.1 Smart home

Security, privacy, temperature, and electronic tax are the most important wonders about the home. For example, citizens forget to turn off the lights before going out, they waste a lot of electricity or they must waste time to back home due to turning off the lights. These are the reason why we need smart homes.

In the era of industrial revolution 4.0, when everything is gradually becoming simpler for us, we not only hope that everything will develop only in industry but also in the quality of life of each individual. Humans have successfully used the idea of "**Smart homes**" for a very long time, and the outcomes had a significant impact on our daily lives.

Home automation or domotics is building automation for a home, called a smart home/house. Lighting, temperature, humidity systems, and appliances are just a few examples of house features that a home automation system may monitor and/or regulate. It could also contain elements of home security like anti-theft systems and door access control. Home appliances that are online are a crucial component of the Internet of Things ("IoT").

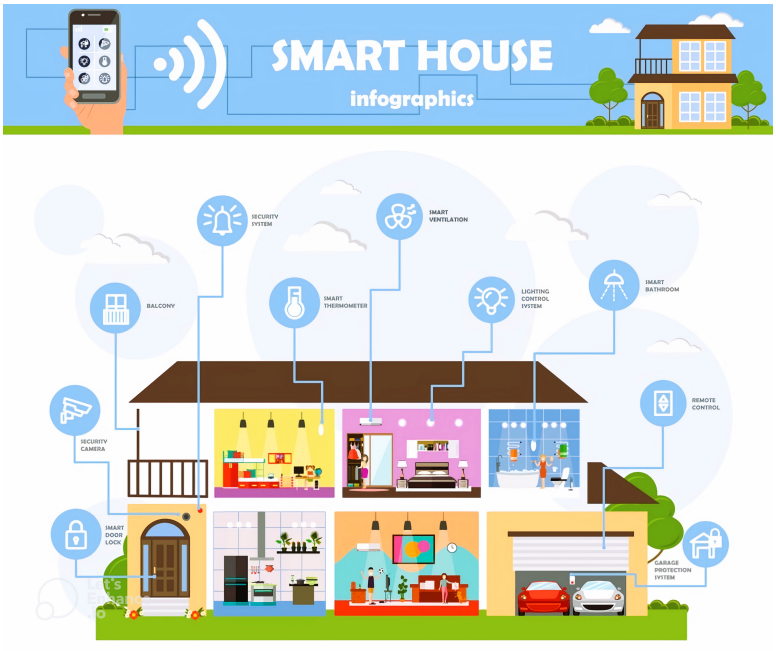
Typically, a home automation system links controlled items to a main smart home hub (sometimes called a "gateway"). Wall-mounted terminals, tablet or desktop computers, mobile phone applications, or Web interfaces that may also be available off-site over the Internet are all options for the user interface for system control.

Despite the fact that there are several rival suppliers, open-source solutions are receiving more attention. The current state of home automation, however, has drawbacks, such as the absence of standardized security measures and the deprecation of older devices without backward compatibility. Home automation offers significant potential for data exchange between family members or trusted people for personal security and might eventually lead to energy-saving solutions that have a good environmental impact.

In this project, we intend to build a smart home with some features mentioned above.

1.2 AIoT

The Artificial Intelligence of Things (AIoT) is the combination of **Artificial intelligence** (AI) technologies with the **Internet of things** (IoT) infrastructure to achieve more efficient IoT operations, improve human-machine interactions and enhance data management and analytics.



Hình 1: *Smart house*

2 User requirement

2.1 Functional requirement

- The lighting system works automatically on each floor 1 or 2 and can turn on all lights that can be controlled remotely by mobile phone. There is also a stair light feature to make it easier to navigate at night.
- The system detects and automatically locks the door on behalf of the user based on the motion sensor.
- Smart door lock/unlock interacts with the push button through the phone.
- The LCD screen displays multiple pieces of information from the sensor such as temperature, humidity, or percentage of light for easy user interaction.
- Users have the ability to interact with the smart home through the system with a UI/UX interface on the app via the internet, the sensor system, and view data on Adafruit.

2.2 Non-Functional requirement

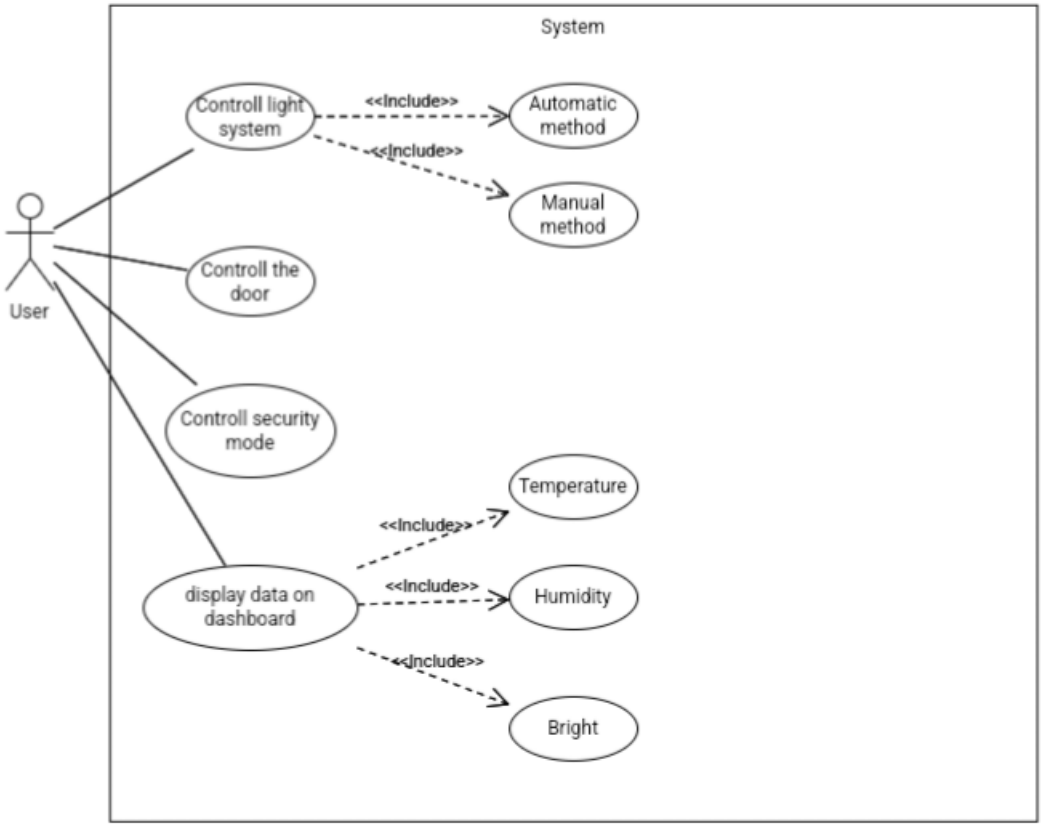
- **Performance**: The system must perform well, with fast response times and minimal latency, to ensure a smooth and seamless user experience. Information is updated from the sensor continuously and fully operational 24/24
- **Scalability**: The system must be scalable to accommodate future expansion or modification of the smart home system, such as the addition of new sensors or devices.

- **Reliability**: The system must be reliable and operate without errors, ensuring user safety and security. Multiple device interactions must work properly with low errors, and sensor information can have errors but should not exceed 1 second.
- **Usability**: The system must be user-friendly and easy to use, with a clear and intuitive interface, to ensure that users can interact with the system easily and efficiently.
- **Compatibility**: The system must be compatible with a wide range of devices and platforms to ensure seamless integration and user accessibility.
- **Maintainability**: The system must be easy to maintain, with clear documentation and support, to ensure that any issues or errors can be addressed quickly and efficiently.

3 Use-case

3.1 Use-case diagram for the whole system

AIoT for Smart Home



3.2 Use-case Description

3.2.1 Use case for Light system

Use case ID/ Name	Manuallly light system
Primary Actor	User
Secondary Actors	None
Description	User can tum on/off the light when they want
Trigger	press button in application
Preconditions	the database is connnected, the sensor is working
Postconditions	the light is on or off as user wants
Normal Flow	press button in application->the light is on/of
Alternative Flow	None
Exception	the wrong in hardware (ex: LED bulbs are dead) and error in software

Use case ID/ Name	Automatically light system
Primary Actor	None
Secondary Actors	User
Description	tum off the light automatically
Trigger	the sensor is in the dark over 30s
Preconditions	the database is connnected
Postconditions	the led is turned off
Normal Flow	the light turns off
Alternative Flow	None
Exception	the wrong in hardware (ex: LED bulbs are dead) and error in software

3.2.2 Use case for Door system

Use case ID/ Name	Controll the door
Primary Actor	User
Secondary Actors	None
Description	Open/close the door
Trigger	press button in app
Preconditions	the database is connnected
Postconditions	the door works in expectation
Normal Flow	after press button, the door will be opened or closed
Alternative Flow	None
Exception	Errors in dynamic system in servo motor cause false rotation angle. The lost of connection between software and hardware

3.2.3 Use case for Security mode

Use case ID/ Name	Turn on/off security mode
Primary Actor	User
Secondary Actors	None
Description	User controll security mode
Trigger	Press button in dashboard
Preconditions	the database is connnected,the sensor is working
Postconditions	the security is working as expectation
Normal Flow	Turn on/off security mode by pressing in dashboard
Alternative Flow	None
Exception	the hardware can not connect to software and the error in working of sensor PIR

3.2.4 Use case for Display Data in Dashboard

Use case ID/ Name	Display the data in dashboard
Primary Actor	None
Secondary Actors	User
Description	User can see all the temperature,humidity,bright in home
Trigger	None
Preconditions	the database is connnected
Postconditions	the data are displayed in correct
Normal Flow	the data are updated automatically
Alternative Flow	None
Exception	the wrong in collecting data from hardware and the lost of data

4 System devices

DEVICES LIST	
INPUT	**OUTPUT**
Light Sensor	Grove shield
Flame sensor	Module 4 led rgb
PIR sensor	LCD 1602
DHT20	Servo motor

4.1 INPUT devices

- **Light Sensor**: A light sensor is a device used to detect and measure the intensity of light in the surrounding environment. It is suitable for basic applications such as detecting light, knowing whether it is day or night, and many other interesting applications.

- **Flame sensor**: The flame sensor module has 5 channels, allowing it to detect flames from 5 different directions. Flame sensors are commonly used in creative applications such as firefighting robots, smart homes that automatically trigger alarms when a fire is detected, and many other similar applications.

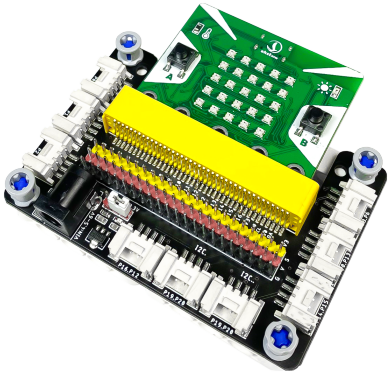
- **PIR sensor**: The PIR (Passive Infrared Sensor) is used to detect the movement of objects that emit infrared radiation (such as human or animal movement, heat-emitting objects, etc.). This sensor is also known as a motion detector or motion sensor. You can adjust the

sensitivity of the sensor to limit the range of motion detection at a far or close distance, as well as the intensity of the desired object's radiation.

- **DHT20**: The DHT20 temperature and humidity sensor uses the I2C output protocol. This sensor has high accuracy and low cost, making it suitable for applications that require temperature and humidity measurement. Applications of this sensor can be used in automated control projects, to record data on temperature and humidity in the surrounding environment, for dehumidifiers, and many other projects.

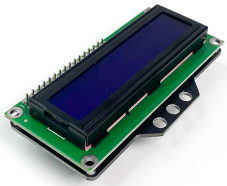
4.2 OUTPUT devices

- **Grove shield**: The Grove shield is an expansion shield compatible with Yolo: Bit, which allows you to expand an additional 9 Grove standard connection ports, making it easy for you to connect Yolo: Bit with external sensors.



- **Module 4 led rgb**: The 4 RGB LED module consists of 4 ws2812 RGB LED lights, each capable of displaying a full range of colors. With an integrated chip, you can control each LED individually or all of them at once.

- **LCD 1602**: The 1602 LCD screen comes with an I2C module that uses the HD44780 driver. This module has the ability to display 2 lines with 16 characters per line. The LCD 1602 has high durability and is very popular (with many sample codes available). If you are a beginner and working on a project, this will be a suitable electronic device thanks to its ease of use. The LCD screen integrated with the I2C communication module makes communication much easier and faster.

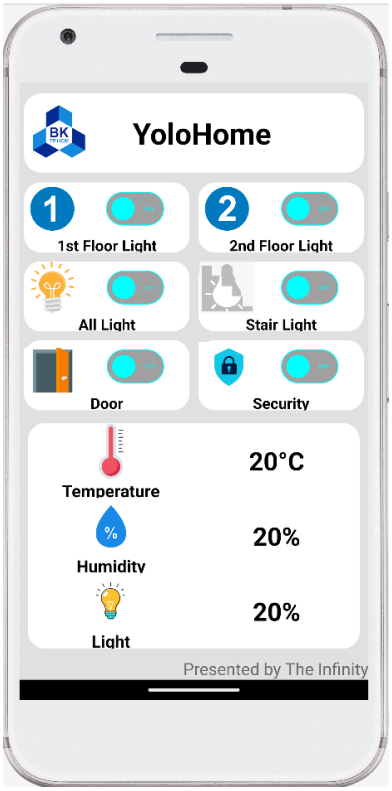


- **Servo motor**: Servo motor SG90S can be controlled and applied to projects such as driving robots, moving robot arm joints up and down, etc. The product has 2 types: 180-degree rotatable motor and 360-degree rotatable motor.

5 User Interface

HOME SCREEN

The home screen of the YoloHome smart device control app, a product of the Ho Chi Minh City University of Technology and the Infinity team, is simple and user-friendly. Upon opening the app, users are greeted with the system name and a list of intelligent features that can be controlled within the house through their mobile devices.



At the top of the screen, users will see two options for each floor of their home. In this case, both the first and second floors have the option to turn the lights on and off. Users can toggle these options by tapping on the corresponding ON/OFF icon. Additionally, there is an "All Liqht" option to turn on all lights in the house at once, and a "Stair Liqht" option to turn on the stair lights for easy movement at night.

In the middle of the screen, users will find two options for "Door" and "Security". This allows users to turn on and off the automatic door lock feature based on motion detection, helping to protect the safety of their home.

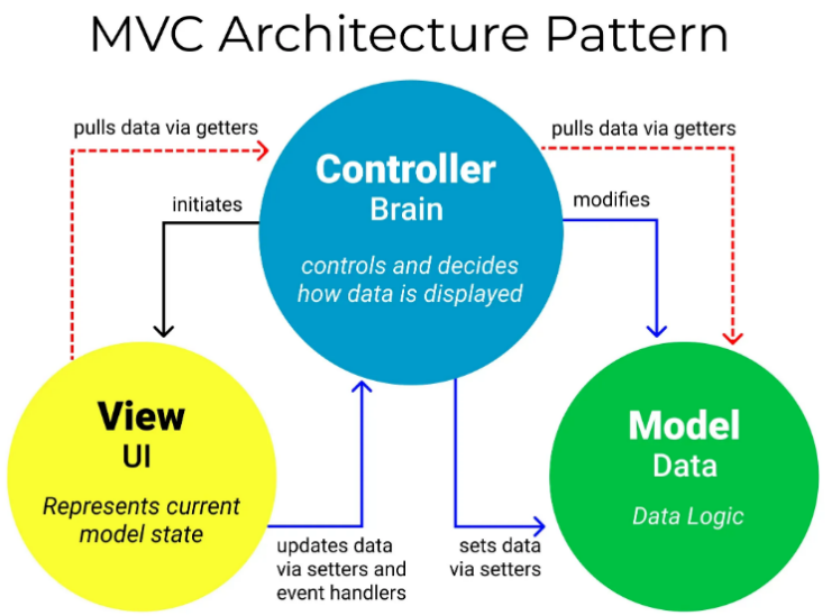
Below that, users can see the current "Temperature", "Humidity", and brightness levels of their homes. These readings are updated continuously by sensors and displayed on the LCD screen. Monitoring these readings can help users adjust their smart devices more accurately.

Finally, users can use the app's user interface to interact with the YoloHome smart system. With an internet connection, users can control devices in their homes from anywhere and monitor sensor information to ensure safety and convenience.

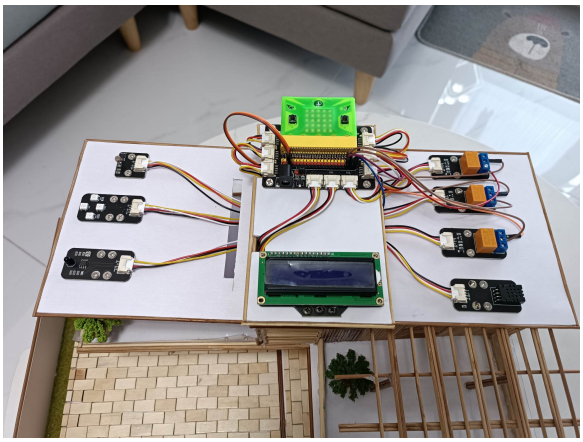
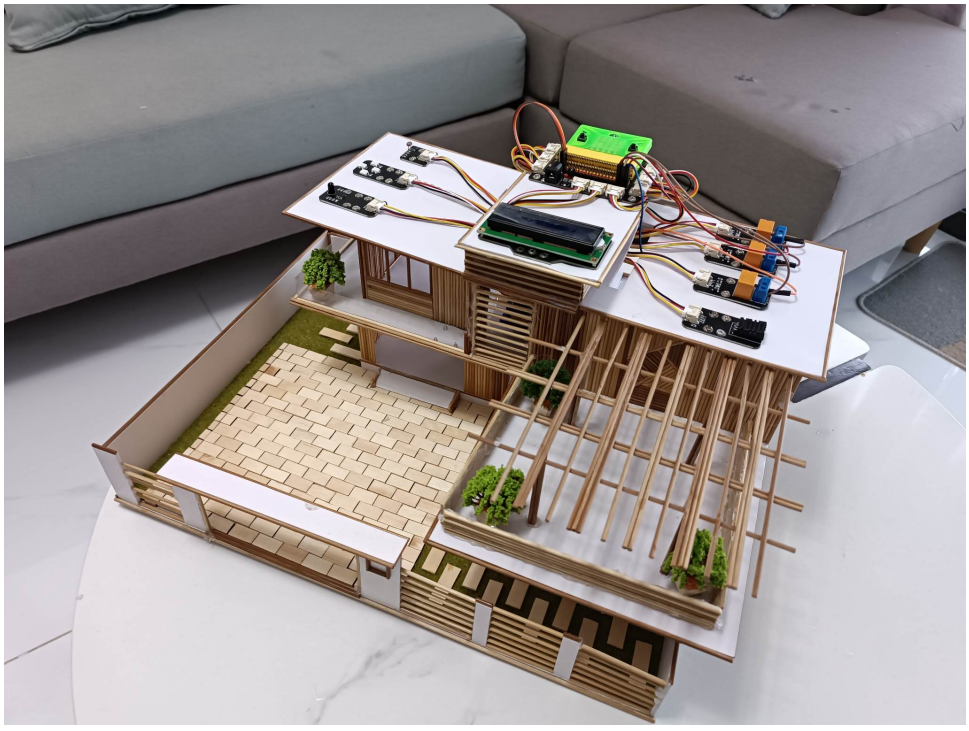
6 Design Pattern

The Model View Controller (MVC) design pattern specifies that an application consists of a data model, presentation information, and control information. The pattern requires that each of these be separated into different objects. MVC is more of an architectural pattern, but not for a complete application. MVC mostly relates to the UI / interaction layer of an application. You're still going to need business logic layer, maybe some service layer and data access layer.

- The Model contains only the pure application data, it contains no logic describing how to present the data to a user.
- The View presents the model's data to the user. The view knows how to access the model's data, but it does not know what this data means or what the user can do to manipulate it.
- The Controller exists between the view and the model. It listens to events triggered by the view (or another external source) and executes the appropriate reaction to these events. In most cases, the reaction is to call a method on the model. Since the view and the model are connected through a notification mechanism, the result of this action is then automatically reflected in the view



7 Final Result

Hình 2: Our model for the design

This is the ending of our report. Thank you for taking the time to read it.

https://github.com/HyHyZhaLee/AIOT_PROJECT_BK2023

END

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