Application of IoT Technologies for Smart home system

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Abstract: *Currently, research and application of embedded systems and IoT technology is a new paradigm that has changed the traditional way of living into a high tech life style, for example Smart city, smart homes, pollution control, energy saving, smart transportation, smart industries are such transformations due to IoT and embedded systems. In which, home and building automation is a potential and practical solution.*
The article presents the design of smart home application with the Smart Mirror. In addition to the usual functions such as displaying time, weather, news updates, etc., MagicMirror also has voice interaction with humans in the smart home system. The entire MagicMirror system is controlled by the Raspbery Pi.
Keywords: *Internet of Things, Blynk, Application control, Magic mirror, Smart home.*

I. INTRODUCTION

A smart home is a house equipped with intelligent automatic systems with a reasonable layout. These systems are capable of self-coordinated activities in the house according to users' living habits and needs. We can also understand a smart home as a complete system in which all home electronic devices are linked to a central control device and can coordinate with each other to accomplish the functions. These devices can come up with a pre-programmed response on their own, or be controlled and monitored remotely.

Most of medium to high-class apartments use remote controls to control air conditioners, televisions, etc., the rest are mostly other devices such as lighting systems, water heaters, etc. must be controlled manually. We develop the system for clients to be more comfortable and convenient with just one touch on your smartphone or tablet to watch TV and control the other devices in their home.

Traditional smart home usally has been controlled by application in touchable device. But users always want to experience new devices or applications for convenience and speed. It is better to own an object like a miror which we can use to look in and help to do some utitities in the house, is also home decoration.

We also design a Smart Mirror which can provide a variety of information, for example weather, time, traffic conditions. In addition, we can control all of items in the house with this Mirror by touch or voice.

In this paper we focus on building the magic miror using IoT technology which is home decotative items and also use to control the house. Magic mirror was developed to bring convenience to users in managing furniture and controlling the use of electrical appliances in the home with network connection between lights and devices. The user has to give instructions to the system verbally and the system sensors will recognize the consumer's voice to receive instructions and respond to the user's needs.

II. COMPONENTS DESCRIPTION

2.1 Raspberry pi 4 embedded computers

Raspberry Pi 4 is s low cost, small computer**.** It can be used to plug into a computer monitor, television, keyboard and mouse. It can be programmed in Scratch, a simple visual interface that allows young people to design digital stories, games, and animations. besides, programmers can also develop script or program by many kinds of programming language in Raspbian operating system.

2.2 Nano pi Neo Core embedded computers

Nano pi Neo Core is one of ARM board developed by FriendlyElec. This board is small and has rich-on board resources: wifi and Bluetooth module, Ethernet and 2 USB ports. It is suitable in IoT application becasuse of high-speed and large throughput data transmission and high performance computing.

2.3 DW2-RF 433MHz wireless door sensor

DW2-RF 433MHz wireless door sensor can remind people when door or window is opened.

2.4 MQ-9 Fire Warning

The MQ-9 sensor can detect concentrated CO in places ranging from 10 to 1000ppm. This sensor with high sensitivity and fast response time has analog and digital output signals. The sensor can operate at

temperatures ranging from -10C to 50C and consumes a current of about 150mA at 5V. Sensors used in fish gas leak detection system in the home and technology.

2.5 GSM GPRS SIM800A Circuit

GSM GPRS SIM800A integrated pulse source and signal level transfer communication with UART communication compatible 3.3/5VDC (because of the built-in signal level switch), suitable for SMS, GSM, GPSR,...

III. IMPLEMENTING THE SYSTEM

3.1. Implementing the smart home architecture

To build a system to control a smart home consists of three main parts, the first part is the home control application, the second part is the blynk server using Nano Pi core, the last part is the smart home model. For construction, we use Raspberry pi 4, Nano Pi Core, ESP8266 module, Blynk, IFTT, JavaScripts, C++, ect and the weather data set from openweathermap.org.
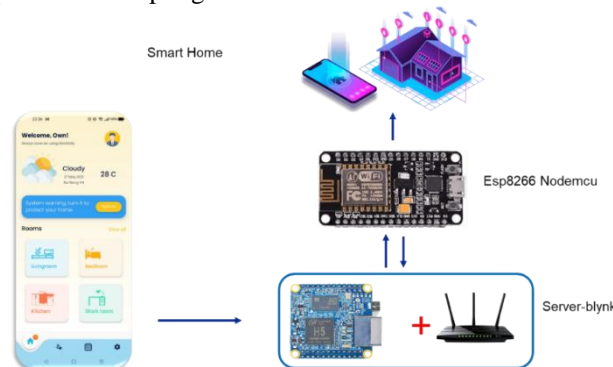
Figure 1 Smart home system architecture

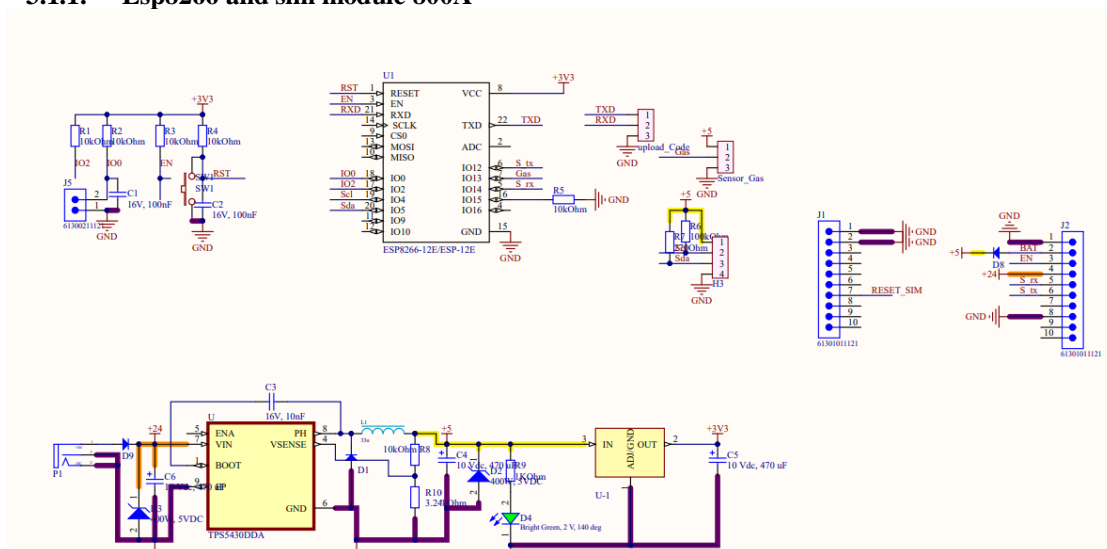#### 3.1.1.   Esp8266 and sim module 800A

Figure 2 Circuit principle of smart home system

3.1.2.   Implementing peripherals in a smart home

- **Analysis of the requirements and functionality of the smart home:**
  - Use the Blynk app to turn electrical or voice devices on and off via Magic mirror
  - Fully meet the basic requirements and functions of a smart home.
  - Close Gmail notifications, voice calls and messages about your employer's phone using DW2-RF Wireless Door Sensor
  - Fire warning sensor, helping owners to be more aware and flexible.
- **Installation and execution steps:**
  - Esp 8266 library installation, Blynk into Arduino IDE
  - WiFi connection and Blynk Server

o Build LED lights for each room
o Build gas and CO sensors to alert users, when there is a fire
O Build Sonoff's DW2-RF wireless door sensor
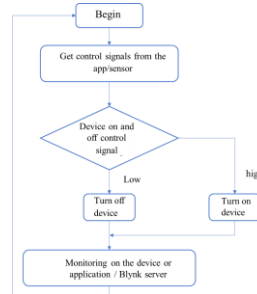
- **Algorithm flowchart:**

Figure 3 Algorithm flowchart Smart Home

- **Operating principles:**

Control the device with the Blynk app: when we execute the command through the application, then point to the Blynk server from the server will transmit the command to NodeMCU ESP8266. Here NodeMCU ESP8266 will process the data to stimulate the relay corresponding to the logical levels to turn the device on and off according to the user's on-off sentence and sync the state up to the touchoff.

The standard communication door with a frequency of 433Mhz when it detects closing (opening) the door sensor will send a code with the address of the device to the RF bride (receiver and control device with RF433) and RF bride will connect to Blynk server via email warning Wifi network. In addition, the user can use the sim module 800A to send messages as well as call the owner to warn of intruders.

3.2. Implementing a smart home control Android application

The application is built to help users control devices more easily and intuitively, to better secure the home each user is registered an account and will be provided with an apk file to download the application to use. The application will be changed and designed according to the number of devices as well as the functionality of the home that the customer desires. In addition, the application has built-in job notifications to help users not miss work or appointments.

- **Analysis of application requirements and functionality**
  o What's the use of devices in the house via wi-fi
  o User-friendly interface
  o Account login provided by the developer
  o Create a to-do list and show notifications when an appointment arrives
- **Installation steps**
  o Install the Android Studio tool.
  o Implement firebase libraries.
  o GET-POST link from Blynk server.

3.3. Implementing a Blynk Server System
- **Analysis of requirements and functionality of the Blynk server system**
  o Receive Google commands through IFTT and blynk and process and push back to the esp8266 module for device processing
  o Manage users, in one user there may be multiple devices
  o Instead of using local, Blynk servers have many benefits.
  o Server Blynk is the place to receive and return processing information to Esp 8266
- **Installation steps**
  o Install FriendlyCore operating system based on Ubuntu core core
  o Install Server Blynk for Nano pi
  o Nat port for server
  o Arduino IDE + library blynk
  o Install the Esp driver into Arduino IDE
  o Go to the Blynk Administration page
  o Install Blynk on your smartphone

3.4. Implementing Smart Mirror and integrating Google Assistant
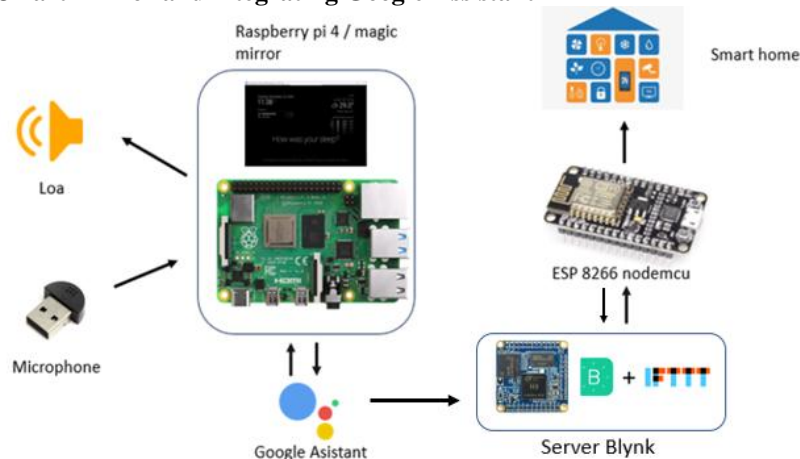

Figure 4 Build smart mirrors and integrate Google Assistant

- **Magic Mirror's requirements and functionality analysis integrated Google Assistant**
  - o Display date and time information, notification calendar, reminders, news and weather
  - o Google Assistant integration to be able to communicate with users.
  - o Electrical device control by voice in Vietnamese and English.
- **Installation steps**
  - o Install the Raspbian operating system for rapsberry pi4 embedded computer.
  - o Install external devices such as speakers and microphones, and displays for Raspberrypi4.
  - o Wifi settings for embedded computers.
  - o Download and install the node for Raspberry with appropriate version.
  - o Download and add the Magic Mirror library.
  - o Editing has a module displayed on the mirror in accordance with the user requirements in the Config file.js.
  - o Install Google Assistant in MagicMirror's modules file, install an account, and select the language of use.
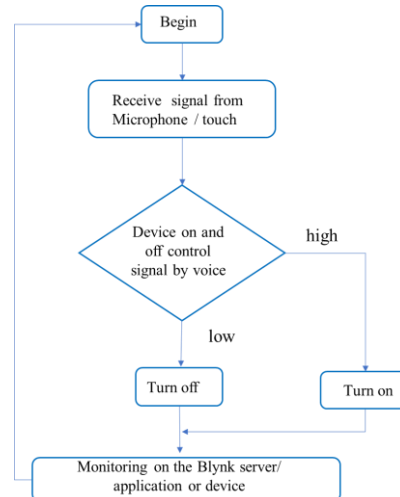
- **Algorithm flowchart**

Figure 5 Algorithm flowchart

IV. RESULTS

We have built a smart home and a smart mirror with some basic functions with below figures.

Figure 6 Smart home model
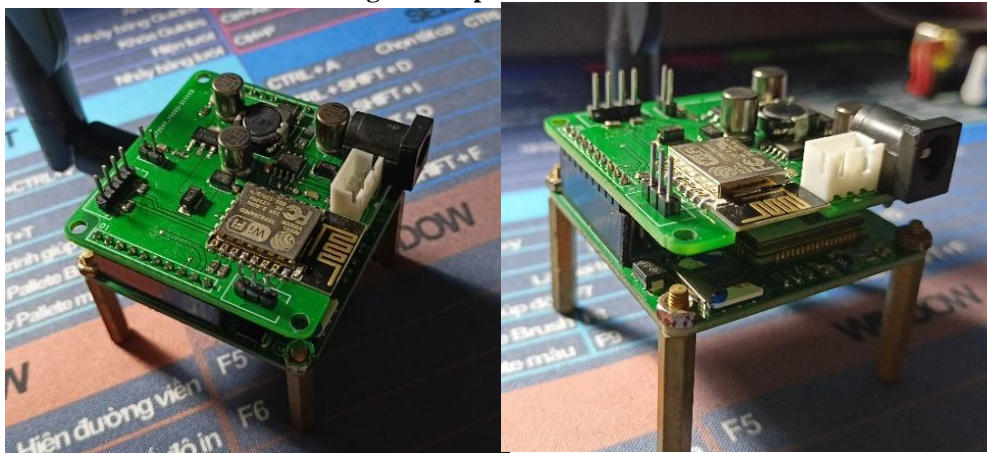

Figure 7 Esp8266 and sim module 800

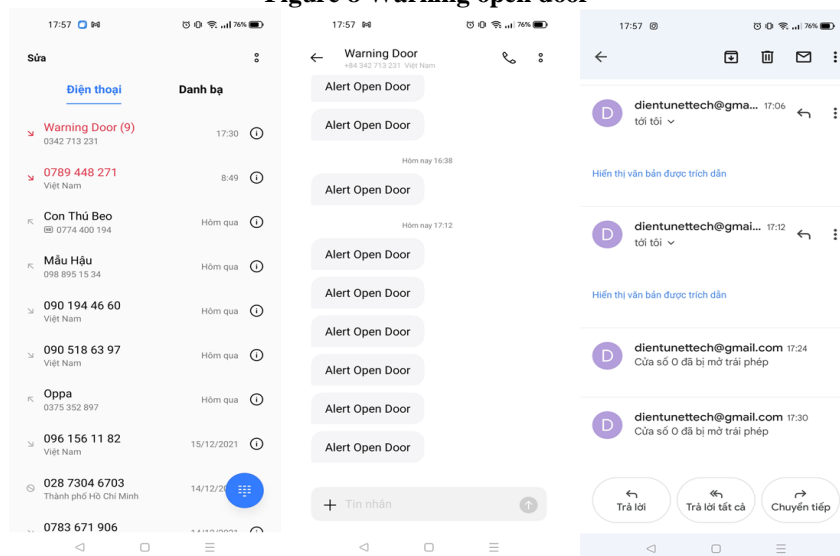**Figure 8 Warning open door**

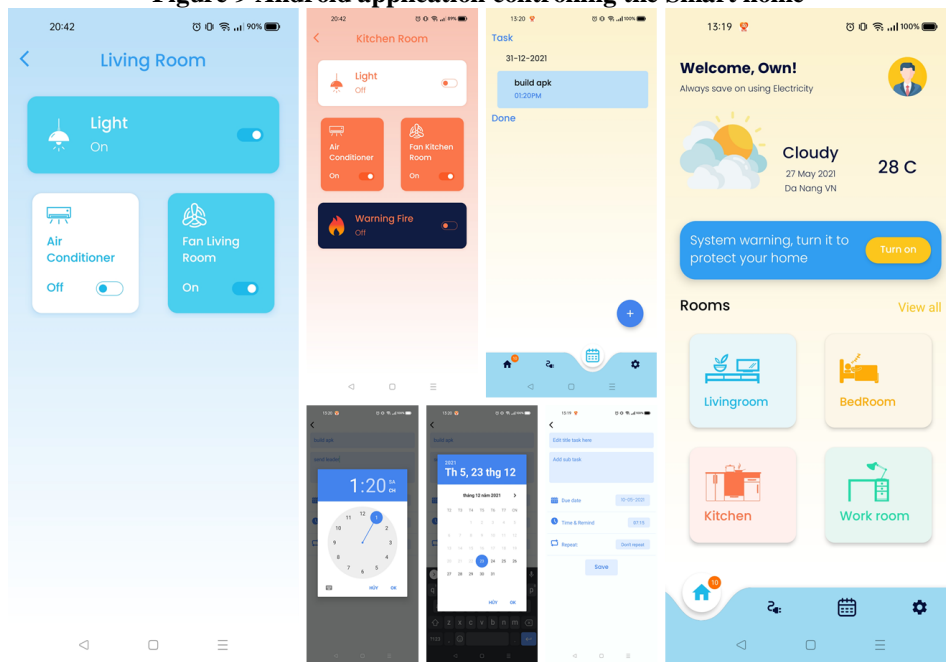**Figure 9 Android application controlling the Smart home**

Figure 9 Smart Mirror

V. CONCLUSION

In this paper, we presented the design and implementation of a smart home with the Magic mirror. We designed a simple smart home with a few periphrals. Some demo of periphrals such as light, fan, ect can be controlled by android application in the smart home and the system can dectect the gas or unauthorized door opening and give audible warning on the spot and warning via message to the phone. We also develop the smart home with the Smart Mirror. We can control all the items in the Smart home with some touches and voice at the Mirror.

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