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Aitbayeva K.Zh.
master student

Asainova A.Zh.
Candidate of Pedagogic Sciences, Associate Professor

S. Toraighyrov Pavlodar State University
Kazakhstan, Pavlodar

IMPLEMENTATION OF THE PROJECT OF MANAGEMENT AND CONTROL OF HOUSEHOLD APPLIANCES IN A SMART HOME

The article deals with implementation of the project of management and control of household appliances in a smart home on the example of controlling the on and off of the electrical outlet. There are limitations when using ready-made smart home solutions. The hardware and software components of this project are described in detail. The device advantages are examined.

Key words: *Internet of Things, smart home, debug board, relay module, mobile application.*

Today, the number of mobile devices with high technological capabilities has increased. The mobile Internet is developing at the same high rate and cloud computing is increasingly used. These trends are most consistent with the concept of “Internet of Things”. According to one of the most cited definitions, the term “Internet of Things” means a fully automated cycle of operation of devices and systems due to their connection to a wireless network [1].

The concept of smart home is closely connected with the Internet of things. Many devices automatize routine tasks and allow you to monitor the state of the house via the Internet. For example, you can control the light in the apartment from your smartphone.

On the ground of the Internet of Things, all sorts of «smart» applications can be implemented in various fields of activity and human life.

Experimental sets of «Internet of Things» implement projects of their own smart home. Thus, it is possible to develop your own additional settings, and at the same time do not depend on the supplier.

In spite of significant number of manufacturers of equipment for smart home, there are problems for the end user, which limit the use of such solutions. These restrictions include:

1. The closedness of communication protocols with system elements, which limits the choice of elements to the assortment of a single supplier.
2. The need to change the batteries of wireless modules with a frequency of once every six month, or annually.
3. Price characteristics that make the payback period of the equipment by saving resources comparable to the useful life of the system.
4. Binding to the WEB resources of a particular company for managing the system and its elements.

5. Power dependency of wireless devices.

6. The need to use metering devices with specialized output. Accordingly, the analysis of the problems of introducing smart home systems and the Internet of things in the house has formed scientific and technical tasks that are planned to be solved as part of the implementation of the proposed project and which determine the novelty of the solutions being developed.

The article deals with practical and demonstration implementation of the project to manage and control household appliances in a smart home. This project consists of a hardware and mobile platform. To implement the hardware platform of this project, the following equipment is needed:

• controller;
• relay module;
• external power outlet;
• prototype board and connecting wires;
• compact power supply.

A microcontroller is used to connect devices over a Wi-Fi standard wireless connection. The debug board **ESP8266 NodeMcu Lua Wi-Fi V3 CH340**, equipped with Wi-Fi, was chosen as the master controller. The ESP8266 is designed for use in various devices, for instance: wireless sensors, wearable electronics, smart sockets, and so on. Thus, it can be said that the ESP8266 module will be an important component of the «Internet of Things» (Figure 1).

In this project, the ESP8266 module is used as an independent brain of the project with its I / O ports, that is, all logic is processed directly by the ESP8266 module. The debug board is located on the prototype board Breadboard. Connecting wires are used to connect.

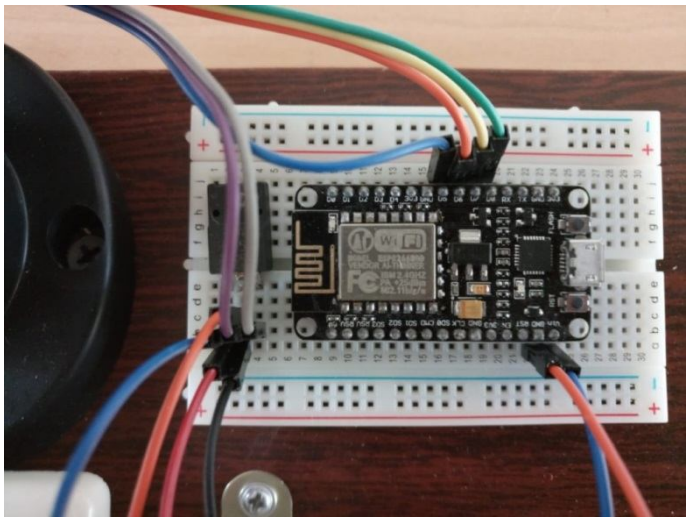

Figure 1. Board ESP8266 NodeMcu

The controller connects to the Wi-Fi home network. The mobile application, while in the same home network as the ESP8266, sends commands to it. ESP8266 accepts commands and controls relay modules that disconnect and connect supply voltage to outlets [2]. The control of electrical loads, namely the supply of power to the sockets and the switching on and off of devices, is carried out by means of a relay.

Any electrical appliance that does not exceed the maximum load of the selected relay can act as a load. The relay can be used both contact and solid. The advantage of a solid-state relay is that it has a compact size compared to the contact. The project was selected solid-state relay **OMRON 4-x G3MB-202P 240B 2A, module ssr solid state relay**. A voltage of 5V controls this relay. Input voltage levels: 0-1.5V, low level, relay on, 2.5-5V, high-level relay off. Lights control is carried out by using of this relay (Figure 2).

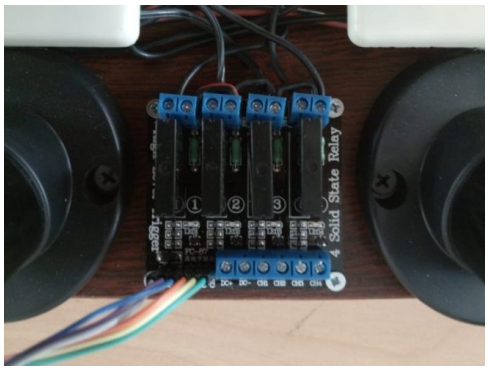

Figure 2. Relay module OMRON G3MB-202P

A solid-state relay unit is capable of switching up to 4 channels of AC load up to 2A per channel. The board has all the necessary matching elements, namely, the current amplifier on the transistor, which ensures accurate relay operation using high voltage logic levels. A light emitted diode induces the activity of each channel. The wires that control the relays are connected through screw terminal blocks, as are high voltage power wires. This is done to improve the reliability of the circuit, because the DuPont connectors do not always provide reliable contact and cannot conduct high current. Pinout of all connectors is signed with silk-screen on the board. The main advantages are increased compared with traditional relays switching reliability, the absence of extraneous switching sounds, almost unlimited resource [3].

Relay module connects to GPIO2, GPIO3, GPIO16, GPIO17, GPIO18, GPIO19 pins. Similarly, one can connect the relay to other terminals. To connect a solid-state relay G3MB-202 and debugging tools, appropriate connectors are provided. A transformer is used to convert voltage and AC current at a constant frequency. This transformer is used to reduce the voltage to 6V (Figure 3).

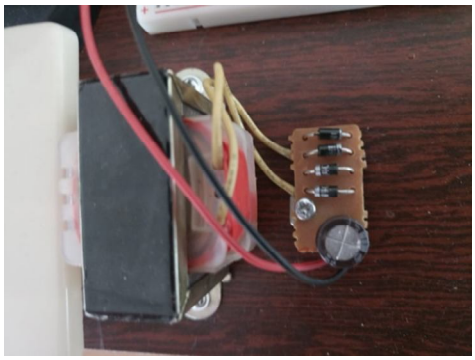

Figure 3. Transformer

For power supply, a power connector is used, more precisely, a manual connection with a voltage of 220V (Figure 4).

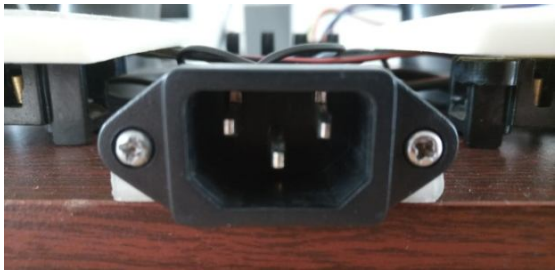

Figure 4. Power connector 220B

Figure 5 shows the hardware implementation of the project for managing and controlling household appliances in a smart home.

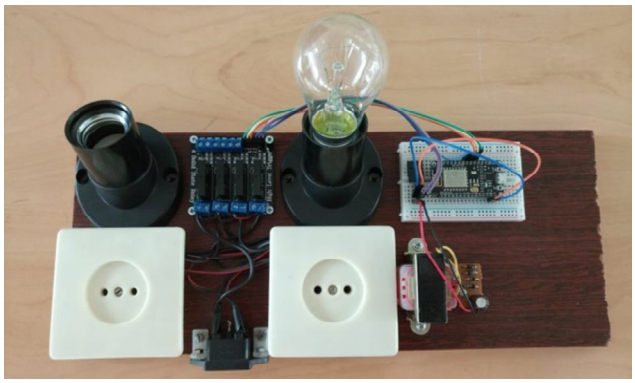

Figure 5. Ready layout project of management and control of household appliances in a smart home

The layout uses 2 lamps (lamp sockets) and 2 sockets, a sufficient number of devices for demonstration.

The secondary power supply module consists of a unit that converts an alternating voltage of 220 V to a constant 6 V, and a linear regulator necessary to provide 3.3 V of the microcontroller power supply.

The software part, the module firmware is implemented in the Arduino IDE environment.

Part of the code:

```
// Relay module connected to digital output 3
int Relay = 3;
void setup()
{ pinMode(Relay, OUTPUT);}
void loop()
{ digitalWrite(Relay, LOW); // relay on
 digitalWrite(Relay, HIGH); // relay off}
Sketch check connection to a Wi-Fi access point:
// Importing support library ESP8266
#include <ESP8266WiFi.h>
// WiFi network settings
const char* ssid = "werdis";
const char* password = "75re41ID";
void setup(void)
{ // Serial port initialization
 Serial.begin(115200);
 // WiFi initialization
 WiFi.begin(ssid, password);
 while (WiFi.status() != WL_CONNECTED) {
  delay(500);
  Serial.print("."); }
 Serial.println("");
 Serial.println("WiFi connected");
 // Output of the board's IP address to the terminal
 Serial.println(WiFi.localIP());}
void loop() }
```

To create a mobile application for this project, the Android Studio integrated development environment is used. The application serves as a project control panel. This software application allows you to get information about the current status of the connected devices.

At the development stage, the algorithms of the system, user scripts and schedules are laid. In the case of ready-made solutions, these configurations can only be changed by specialists. The process of implementing a mobile platform consists of several stages. The main goal is to develop a communication protocol between the application and the NodeMCU ESP8266 board (Figure 6).

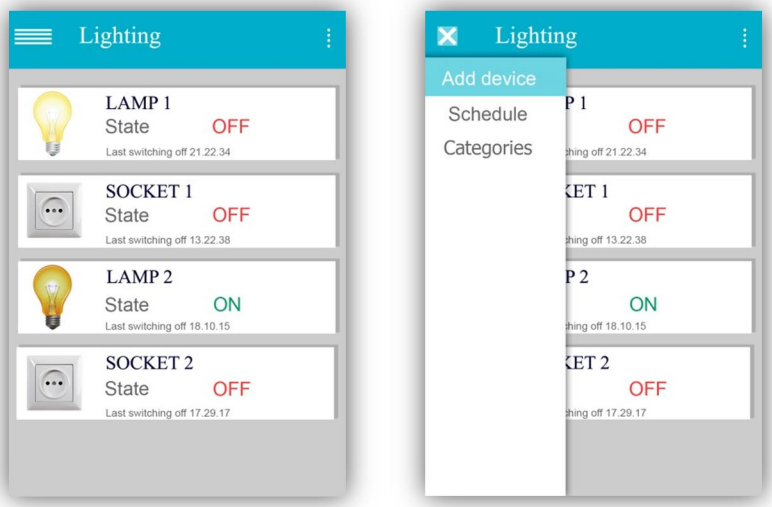

Figure 6. Mobile Application User Interface

Finally, it should be noted that the developed project allows to reduce energy consumption, significantly extend the life of electrical appliances. The modular set of IoT devices allows you to design a solution based on the ESP8266 with an open communication protocol, to implement sufficient functionality of smart home devices in the case of this project, provides information on the status of devices connected to the network and provides the ability to manage them.

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Айтбаева К.Ж.
магистрант

Асаинова А.Ж.
канд. пед. наук, доцент

Павлодарский государственный университет имени С. Торайгырова
Казахстан, г. Павлодар

РЕАЛИЗАЦИЯ ПРОЕКТА УПРАВЛЕНИЯ И КОНТРОЛЯ БЫТОВОЙ ТЕХНИКИ В «УМНОМ ДОМЕ»

В статье рассматривается реализация проекта управления и контроля бытовых приборов в «умном доме» на примере управления включением и выключением электрической розетки. Существуют ограничения при использовании готовых решений для домашних домашних компьютеров. Подробно описаны аппаратные и программные компоненты этого проекта. Рассмотрены преимущества устройства.

Ключевые слова: *интернет вещей, умный дом, отладочная плата, модуль реле, мобильное приложение.*