**Giôùi thieäu chung**

**Mục tiêu:** Tạo ra hoàn thiện mộ t sản phẩm công tắc wifi CA-SW2 cơ bản. Bao gồm việc có thể thiết lập mạng khi mới sử dụng, có thể dùng trực tiếp bằng cách nhấn chạm vào công tắc cảm ứng và điều khiển qua ứng dụng di động.

**Hệ thống chức năng và flow-work sản phẩm:**

|  |  |  |
| --- | --- | --- |
| STT | Hoạt động – chức năng | Hoàn thiện |
| 1 | Sử dụng sản phẩm với việc kết nối dây nóng, dây lạnh và 2 dây tín hiệu ra (nóng) điều khiển thiết bị. |  |
| 2 | Sau khi lắp đặt và kết nối hệ thống dây điện vào sản phẩm, có thể sử dụng điều khiển offline cho thiết bị ngay. | 🗶 |
| 3 | Bắt đầu thiết lập mạng cho sản phẩm bằng cách nhấn giữ nút bấm vật lý bên trong thiết bị khoảng **5 giây** cho đến khi đèn báo 2 nút bấm chuyển chớp nháy xanh đỏ liên tục tức là đã vào được chế độ thiết lập mạng.  *( \* ) hiện tại chưa thiết lập được chế độ sử dụng offline ngay lập tức nên ban đầu kết nối điện cho sản phẩm, chờ khoảng thời gian timeout* ***10 giây*** *để thiết bị kiểm tra thông tin wifi trước đó có được lưu trong bộ nhớ flash hay không rồi nó sẽ tự chuyển qua chế độ thiết lập mạng cho người dùng thiết lập.* |  |
| 4 | Bắt đầu thực hiện SmartConfig thông tin wifi gia đình cho sản phẩm từ ứng dụng di động và chờ đợi.  + Nếu thiết lập thành công, đèn báo công tắc sẽ ngừng chớp nhanh và chuyển đồng thời sang đỏ tức đã thành công và có thể sử dụng công tắc được như bình thường.  + Nếu thiết lập thất bại, đèn báo công tắc sẽ chớp nháy chậm hơn trong vòng **3 giây** để báo thất bại và người dùng sẽ phải tiến hành SmartConfig lại. |  |
| 5 | Trong quá trình sử dụng công tắc, nếu thiết bị **bị ngắt nguồn đột ngột**, khi khởi động lại công tắc sẽ kết nối lại với mạng gia đình trong khoảng **6 – 8 giây**. |  |
| 5.1 | + Nếu kết nối trở lại thành công, hãy để ý đèn hiệu công tắc sẽ chớp nháy chuyển trạng thái 2 lần tức đã kết nối mạng thành công và khôi phục lại đúng trạng thái thiết bị trước khi bị mất điện hoặc trạng thái đã được thay đổi từ ứng dụng di động. |  |
| 5.2 | + Nếu trong thời gian mất điện, chẳng may mạng gia đình cũng mất điện và công tắc kết nối tới wifi nhưng chưa có mạng thì đèn hiệu sẽ chớp nháy chuyển trạng thái 1 lần tức đã kết nối wifi thành công. Người dùng cần chờ cho đèn hiệu chớp chuyển trạng thái 1 lần nữa tức đã có mạng trở lại và có thể sử dụng như bình thường. |  |
| 5.3 | + Nếu trong thời gian khởi động lại bình thường nhưng mạng wifi gia đình bị mất hoàn toàn hoặc có wifi nhưng không kết nối mạng thì công tắc sẽ kiểm tra trong khoảng thời gian 20 giây để trở về chế độ sử dụng offline bình thường. | 🗶 |
| 6 | Khi công tắc đang sử dụng ở chế độ offline, để có thể cho công tắc kết nối lại mạng gia đình khi có lại mạng, người dùng chỉ cần bấm nút reset trên công tắc và nó sẽ tự kết nối trở lại tới mạng wifi gia đình. |  |
| 7 | Khi đang sử dụng mà người dùng muốn thay đổi thông tin mạng wifi cho công tắc, bấm giữ nút thiết lập mạng và cài đặt lại mạng cho thiết bị từ đầu. |  |

**Danh saùch linh kieän vaø chi phí thöïc hieän**

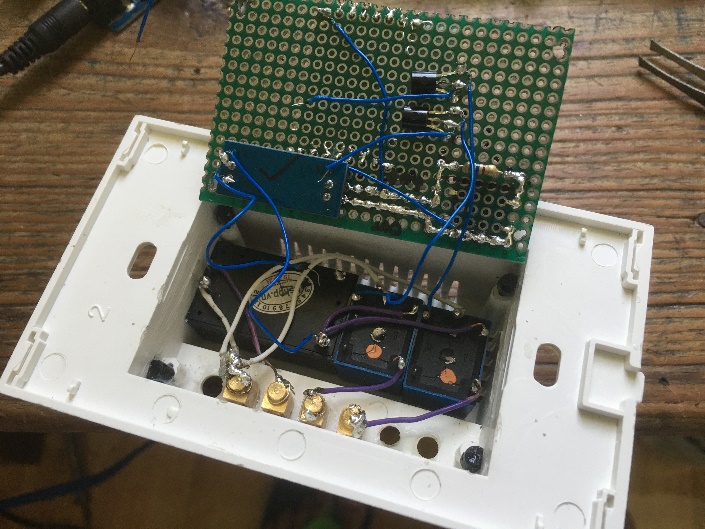
Ảnh có chứa trong nhà, bàn, sàn, máy tính

Mô tả được tạo tự động

*( \* ) sản phẩm demo ban đầu lắp đặt thủ công – chưa đặt làm PCB*

|  |  |  |  |
| --- | --- | --- | --- |
| STT | Tên linh (phụ) kiện | Số lượng | Chi phí |
| 1 | Bộ vỏ hộp nhựa | 1 | 25.000 |
| 2 | Mặt kính công tắc | 1 | 35.000 |
| 3 | Breadboard hàn 2 mặt 7x9cm | 1 | 15.000 |
| 4 | Module ổn áp AMS1117 3.3V | 1 | 15.000 |
| 5 | Mạch nguồn xung 5V 3W Hi-link | 1 | 65.000 |
| 6 | Relay SRD-03VDC-SL-C | 2 | 14.000 |
| 7 | Nút bấm cảm biến điện dung 6 – 24V | 2 | 80.000 |
| 8 | Module ESP12F | 1 | 55.000 |
| 9 | PCB gắn chân Module ESP12 | 1 | 7.000 |
| 10 | LED nhỏ | 4 | 20.000 |
| 11 | Transistor | 4 |
| 12 | Điện trở các loại 220, 560, 2k, 10k | - |
| 13 | Nút bấm vật lý nhỏ | 2 |
| 14 | Dây nối – hàn chì – trụ đồng x4, … | - |
| **Tổng cộng** | | | **335.000 – 355.000** |

**Nguyeân lyù hoaït ñoäng – Kieán thöùc löu yù**

Ảnh có chứa thiết bị điện tử

Mô tả được tạo tự động

**Nguyên lý hoạt động rút ra:**

* Thiết kế công tắc có 4 trụ đồng gắn dây bao gồm 2 trụ đầu tiên liên kết dây nóng và dây lạnh từ mạng lưới điện gia dụng. 2 trụ còn lại là đầu ra output điều khiển thiết bị tương ứng với 2 công tắc cảm ứng.
* Từ nguồn điện gia dụng 220 – 250V, mạch nguồn xung nhận điện và tạo ra xung điện 5V cho hệ thống mạch sử dụng, trong đó chủ yếu dùng điện áp 5V cho việc liên kết nguồn cho relay và các led cảnh báo hoạt động *(tuy nhiên sau khi thực hiện chế tạo mạch thực tế cho thấy không cần sử dụng đến điện áp 5V vì có relay 3V và led báo cũng không cần tới 5V, chỉ cần giảm trở và sử dụng 3.3V là vẫn hoạt động tốt, vậy nên nên mua mạch nguồn xung 3.3V – 3W thay thế để có thể tiết kiệm chi phí, không phải dùng đến module ổn áp nguồn AMS1117 3.3V)*.
* Tiếp đến nguồn 5V sẽ được đi qua module ổn áp nguồn AMS1117 3.3V để cấp nguồn điện cho module wifi hoạt động.
* Ảnh có chứa văn bản, bản đồ

  Mô tả được tạo tự độngModule wifi được kết nối phù hợp để cấp nguồn và hoạt động được với một cách riêng được mô tả như sơ đồ bên dưới, tuy nhiên nếu sử dụng bản PCB ra chân sẵn thì chỉ cần cấp nguồn 3.3V và GND cho mạch là module wifi đã có thể hoạt động bình thường mà không cần thiết thực hiện việc thiết kế mạch nhiều như hình bên dưới:
* Từ module wifi ESP12F, ta sử dụng hệ thống các chân như sau để thực hiện việc tạo mạch công tắc:

|  |  |  |  |
| --- | --- | --- | --- |
| GPIO | PIN | I/O | Chức năng |
| 4 | 19 | Input | Kết nối nhận tín hiệu từ công tắc cảm ứng |
| 5 | 20 | Input |
| 12 | 6 | Input | Kết nối tín hiệu tới nút bấm Thiết lập mạng |
| 14 | 5 | Output | Điều khiển tín hiệu ra tới relay |
| 16 | 4 | Output |
| 10 | 12 | Output | Điều khiển tín hiệu đèn led báo hiệu |
| 2 | 17 | Output |
| VCC | 8 | Input | Cấp nguồn 3.3V |
| GND | 15 | Input | Cấp GND |
| RST | 1 | Input | Kết nối nút bấm reset module |

* Sau khi kết nối các phần với module trung tâm ESP12F, ta thực hiện việc tạo các khối mạch chức năng cho các thành phần **input** và **output**.
* Hệ thống thành phần **Input** bao gồm:

**+ Công tắc cảm ứng:** Kết nối nguồn và GND cho đầu Vin+ và Vin- cho công tắc, giữa 2 đầu Vout+ và Vout- lắp một điện trở 560Ω và lấy tín hiệu output từ công tắc từ chân Vout- rồi kết nối tới **PIN\_input** của ESP12.

**+ Nút bấm thiết lập mạng:** Một chân (1) của của nút bấm liên kết tới nguồn mạch chung 3.3V, chân còn lại (2) liên kết với một điện trở 560Ω rồi nối xuống GND của mạch. Lấy tín hiệu input cho ESP12 từ điểm nối giữa chân (2) và điện trở 560Ω, khi nút bấm được giữ thì sẽ có tín hiệu HIGH đổ về chân input của ESP12.

**+ Nút bấm reset mạch:** Một chân của nút bấm kết nối tới chân RST (PIN 1) của ESP12F, chân còn lại nối với GND của mạch. Khi nút bấm được ấn giữ, tín hiệu LOW về chân RST sẽ làm mạch được reset trở lại.

* Hệ thống thành phần **Output** bao gồm:

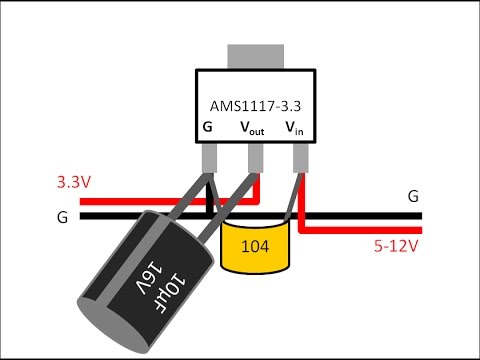
+ **Điều khiển relay:** Kết nối tín hiệu với *mạch relay riêng. ( \*\* )*

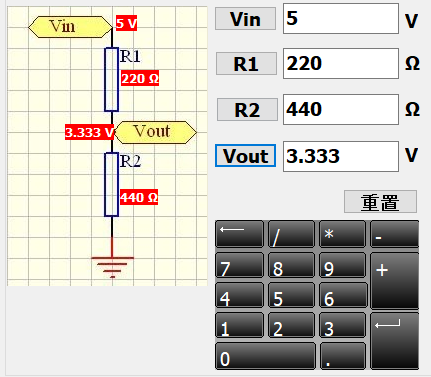
**+ Điều khiển mạch led trạng thái:** Kết nối tín hiệu với *mạch điều khiển led trạng thái riêng. ( \*\* )*

*( \* \* ) : sẽ được trình bày trong phần kế tiếp vì một số lý do đặc biệt.*

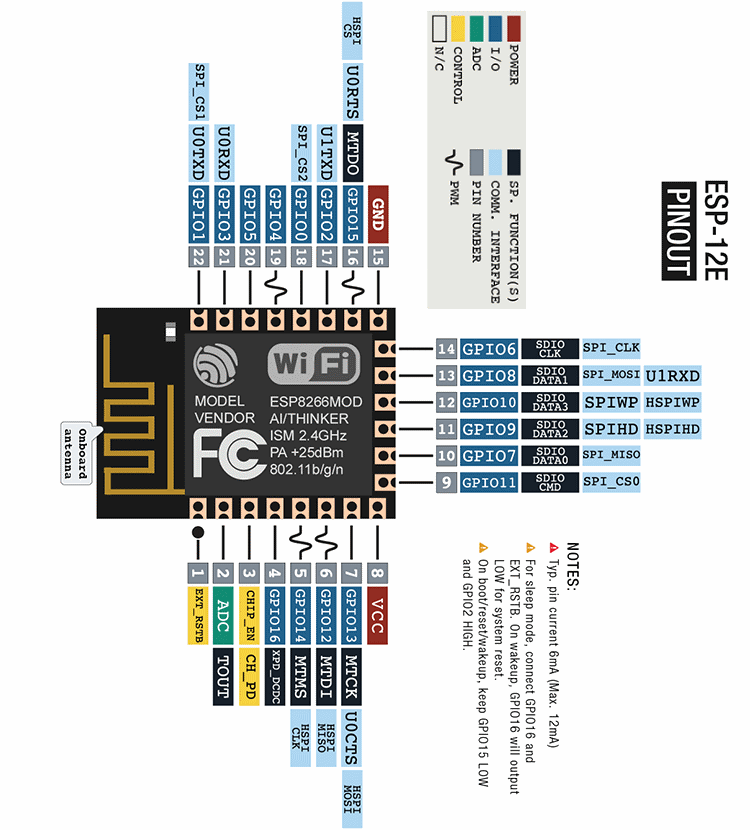
**Các kiến thức được lưu ý rút ra sau quá trình thực hiện:**

* Việc sử dụng cầu phân áp để cung cấp nguồn 3.3V cho một module (mạch bất kì) hoạt động là bất khả thi vì việc chia áp dẫn đến 2 vấn đề: dòng không đủ và mạch không ổn định. Vì thế giải pháp rút ra là dùng một loại IC ổn áp và cung cấp nguồn dòng cho mạch là AMS1117 loại 3.3V. Cách sử dụng và lắp mạch hoạt động với IC này có thể tham khảo các sơ đồ mạch bên dưới. Hoặc nếu không chắc chắn về hiệu năng hoạt động của IC khi tự chế tạo mạch, ta có thể sử dụng thay thế một module nguồn ổn áp AMS1117 3.3V. AMS1117 là một loại IC rất thông dụng trong tất cả các loại mạch phổ thông có sử dụng các module cần cấp một nguồn nhỏ, như trên mạch Arduino hoặc NodeMCU đều có loại IC này.

Ảnh có chứa văn bản

Mô tả được tạo tự động

* Số lượng các chân GPIO có thể sử dụng được từ module ESP12F là có hạn, một số chân GPIO khả dụng nhưng không có chức năng kết nối, nếu dùng sẽ dẫn đến việc xung đột xung nhịp hoạt động của mạch. Chi tiết sơ đồ chân và các chân khả dụng của bộ chip này như các hình mô tả dưới đây:



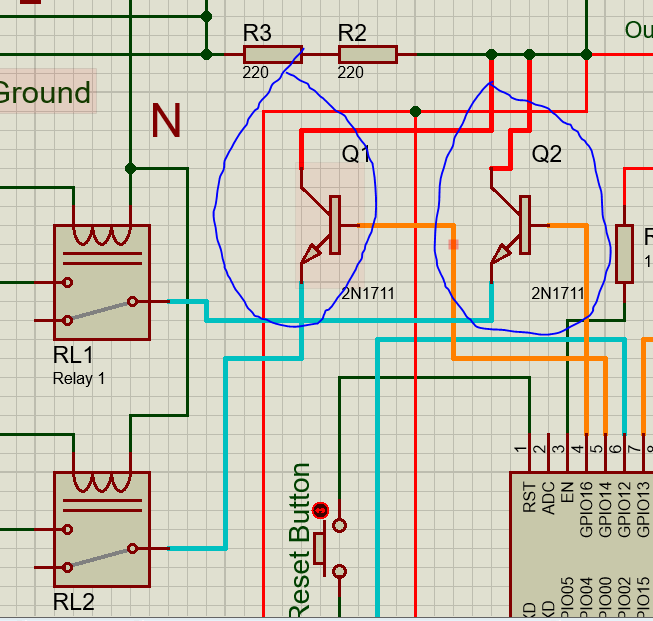


* Chính vì số lượng các chân I/O của module ESP12F có giới hạn, tức là chỉ có nhiều nhất 10 PINs có khả năng sử dụng, vì vậy việc liên kết và tạo ra hệ thống đèn hiệu 2 trạng thái (đỏ – bật; xanh – tắt) cung cần phải xem xét lại để có thể tối ưu hóa việc sử dụng các chân I/O.
* Như có thể thấy, với việc các đèn hiệu trạng thái chỉ cần sử dụng sáng 1 trong 2 loại trong một lần (hoặc là đỏ - hoặc là xanh). Nên có nghĩa là nếu đèn xanh sáng thì đỏ sẽ phải tắt và ngược lại. Vì nguyên lý đó nên cần đến việc thiết kế **một mạch điều khiển led trạng thái** riêng nhờ việc dùng transistor như sau:

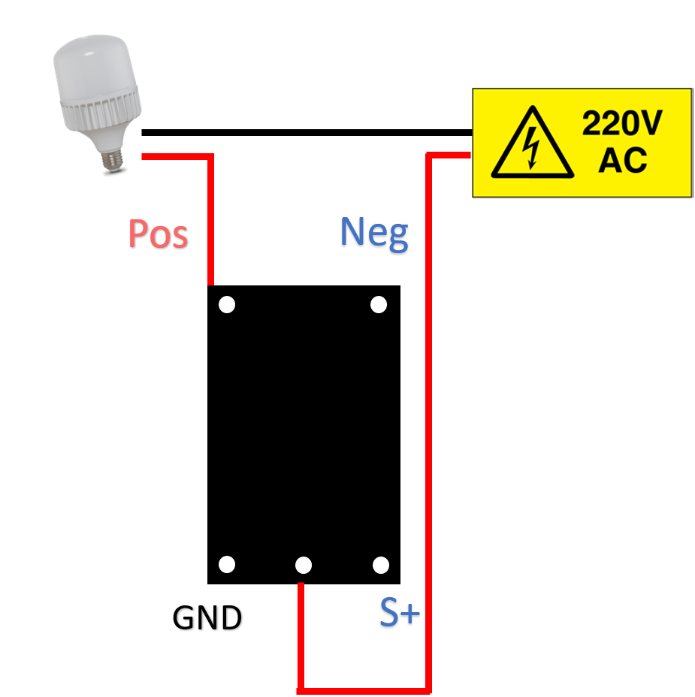
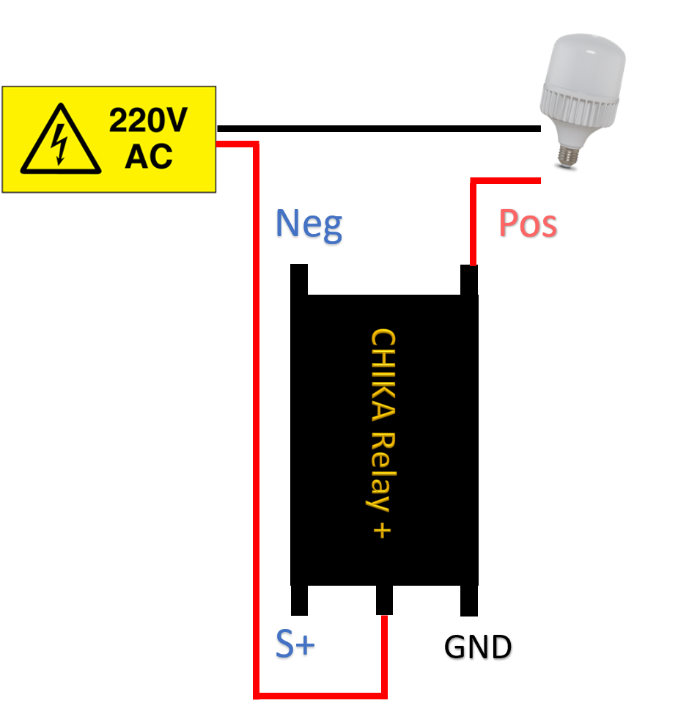
![Ảnh có chứa văn bản, bản đồ

Mô tả được tạo tự động](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAAAAAAAD/4RCyRXhpZgAATU0AKgAAAAgAAodpAAQAAAABAAAIMuocAAcAAAgMAAAAJgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAFkAMAAgAAABQAABCAkAQAAgAAABQAABCUkpEAAgAAAAMwMAAAkpIAAgAAAAMwMAAA6hwABwAACAwAAAh0AAAAABzqAAAACAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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* Với sơ đồ mạch như trên, một mạch điều khiển led trạng thái cần tối thiểu 1 transistor và 3 điện trở 220Ω. Mạch sẽ bao gồm 3 dây nối: Vcc; GND và dây tín hiệu được nối với module ESP12F. Với sơ đồ chức năng như trên, khi tín hiệu input vào mạch là LOW thì đèn xanh sẽ sáng và ngược lại, khi tín hiệu input là HIGH thì đèn đỏ sẽ báo sáng và đèn xanh sẽ tắt.
* Việc sử dụng relay cũng trở thành một vấn đề cần lưu ý khi thiết kế mạch chức năng này. Vì một tín hiệu output từ ESP12F là 3V – dòng tối đa đạt được chỉ là 40mA. Đối với 1 relay lại cần ít nhất một dòng 120mA để có thể kích hoạt relay đóng hoặc mở. Vì thể cũng không thể nối trực tiếp output tín hiệu từ module ESP12F ra relay được mà cũng phải thiết kế một **mạch điều khiển trạng thái relay riêng**. Và cũng tương tự, để thực hiện được điều này, chúng ta tiếp tục phải sử dụng đến transistor với sơ đồ mạch được mô tả như sau:



* Trong trường hợp này, cực thu của relay được nối với nguồn chính của toàn mạch (3.3V – 150mA), cực nền nối với chân tín hiệu nhận từ module ESP12F và cực phát đẩy qua chân tín hiệu của relay. Như vậy, khi không có tín hiệu (tức mức LOW) thì transistor sẽ ngưng dẫn và không có chuyện gì xảy ra. Khi chân tín hiệu phát mức HIGH, dòng transistor dẫn và dòng điện sẽ đổ trực tiếp từ nguồn chính tới chân kích hoạt của relay, với việc này ta gián tiếp kích hoạt mức hoạt động của relay bằng chính nguồn của toàn mạch.
* Phương pháp sử dụng Relay SRD-03VDC-SL-C loại hàn mạch cũng khác với các loại relay thông thường với việc liên kết được mô tả bằng sơ đồ như sau:



**Sô ñoà – PCB – Source code**

Ảnh có chứa văn bản

Mô tả được tạo tự động