

SecurDooris

Project Report

Internet of Things Laboratory

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Introduction

This project is a door security system. The system aims to be intuitive, allowing for real-time monitoring of anyone attempting to enter and exit, eliminating the need for a key for access.

Objectives

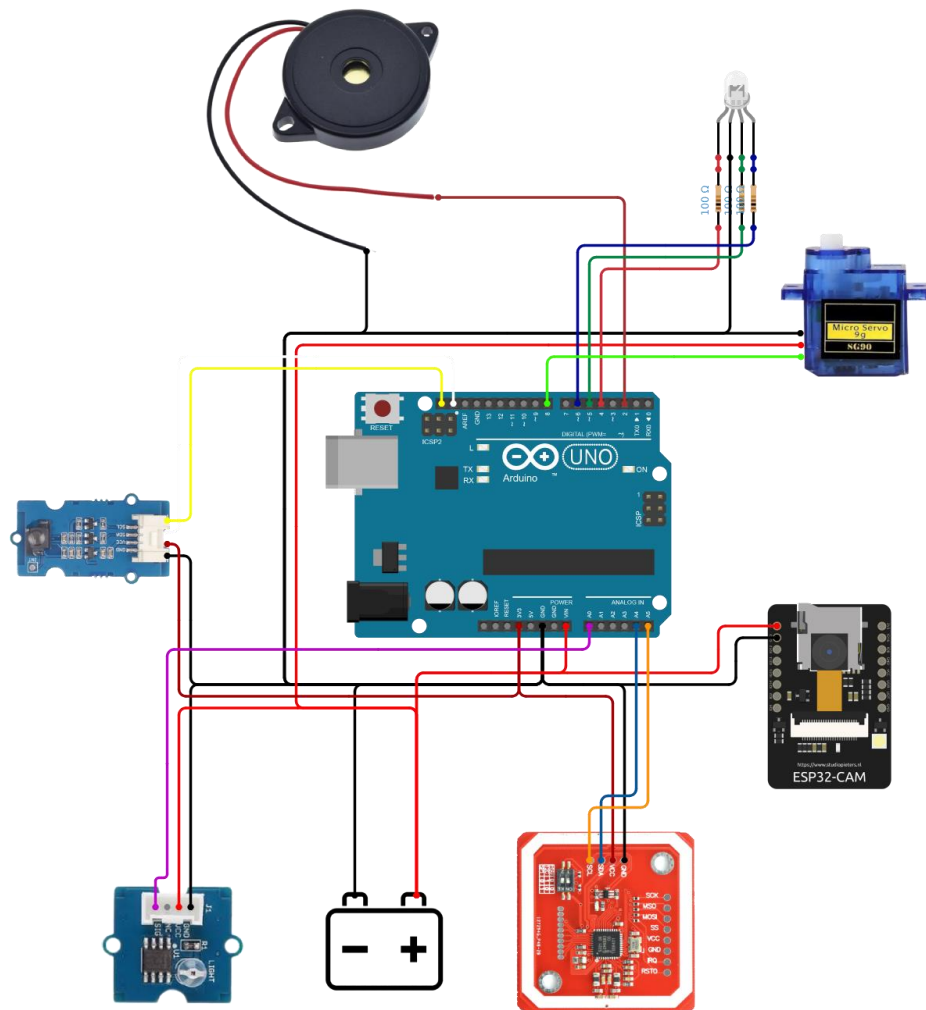
The purpose of this system is to open the door using other security elements instead of a standard key. To achieve this, several technologies are combined.

To gain entry, the user must use a card or cell phone with RFID technology to unlock the door. Additionally, they must make a sequence of numbers with their fingers so the camera can see them to unlock the door with the corresponding code.

If someone tries to enter and enters the code incorrectly multiple times, the system detects them as an intruder, records the incident in the database, and the owner can view it on the dashboard.

The system owner can, through a dashboard, view statistics on entry attempts, view photographs of potential intruders, analyze graphs, and receive notifications and alarms when an intruder is detected.

Architecture



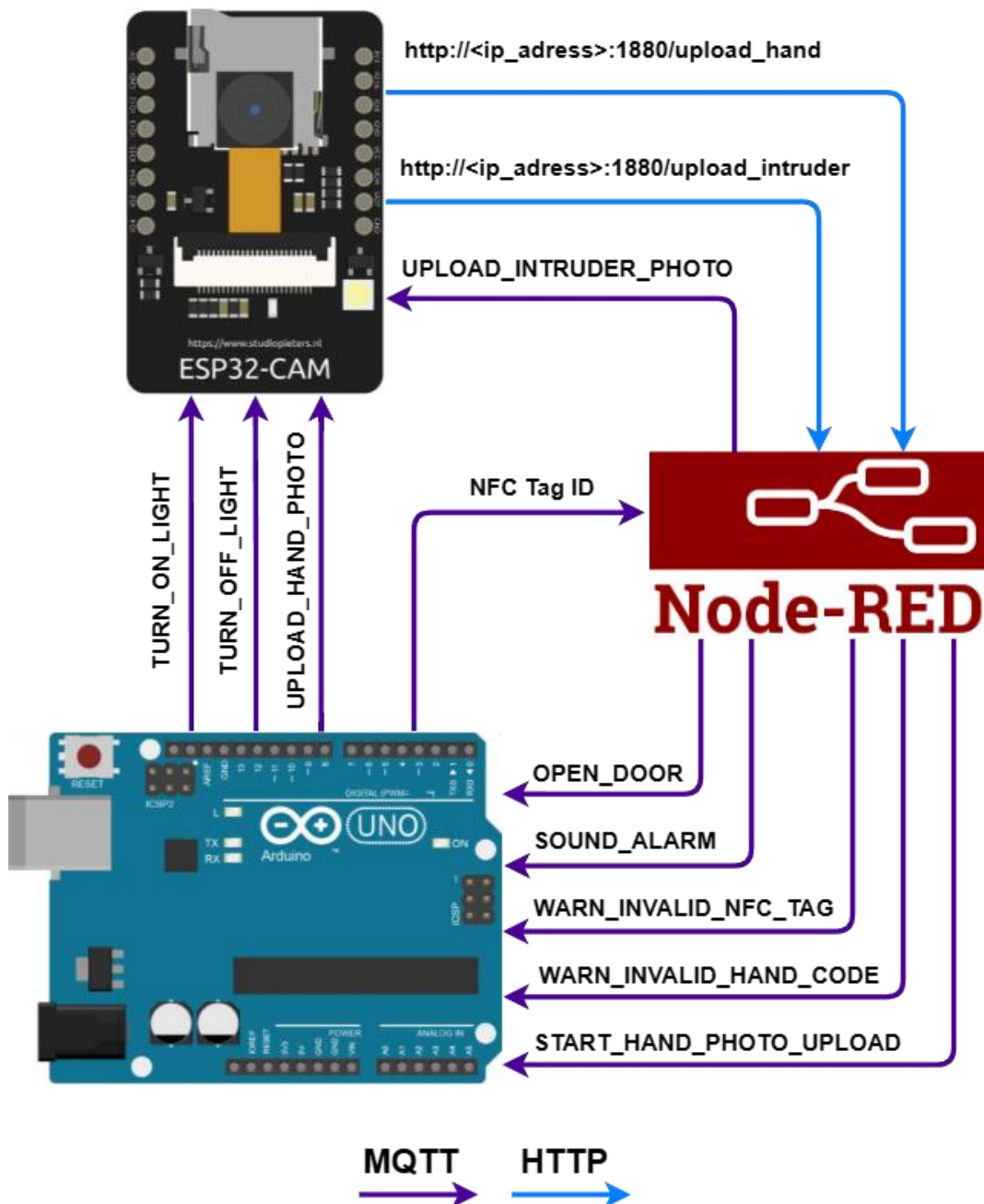
Hardware

- Arduino Uno
- ESP32-Cam
- Buzzer
- RGB LED
- Light Sensor
- Human presence sensor
- NFC Reader
- Servo Motor

Communication

The Arduino is connected to Wi-Fi to transmit messages via MQTT and HTTP. Hand photos are sent to Node-RED via an HTTP channel, while photos of potential intruders are sent via another HTTP channel.

All other communication is handled through an MQTT broker. The system uses three MQTT topics: "arduino_commands," "camera_commands," and "nfc_readings." The first two allow commands to be sent to the Arduino and the camera, respectively. The last topic is used to send the IDs of NFC tags read by the Arduino to Node-RED.



Dashboard

The dashboard developed in Node-RED includes different types of visualizations that allows monitoring and analysis in real time. There is a bar chart that displays the number of accesses made by different users, sorted in descending order. This allows the administrator to quickly identify the most frequent users in the system.

The dashboard also includes a table showing NFC reads and hand codes entered. Additionally, an intruder table has been created that records the error (if RFID or hand code failed), including a photo of the intruder.

Finally, a widget was implemented that displays real-time information about the user attempting to log in. This widget displays the user's name and the hand code being entered, updating in real time.

Additional Features

General:

- Provides additional security through a hand code after NFC scanning. This optional mechanism prevents unauthorized access if an NFC card is lost. A hand code is a sequence of five numbers from 0 to 5 (e.g., "10531"). To enter the code, the user must sequentially raise 0 to 5 fingers of their hand in front of the camera.

Arduino and camera:

- Turn on the ESP32Cam lamp if the light level is low enough and there has been recent user interaction, ensuring the quality of the photos taken;
- Turn off the lamp if the brightness level increases or there is no activity for a while;
- Provide feedback to the user using different LED colors and short buzzer beeps;

- Sound an alarm (with the buzzer) after multiple incorrect attempts of hand codes or NFC code by the same user;
- Rotate the servo motor to simulate opening the door.

Node-RED:

- Register users in the database. Each user has a name, NFC code, and hand code;
- Record IDs of read NFC tags, hand sequences made by users, photos of possible intruders;
- Ability to change users' passwords;
- Detect the number of fingers raised by the user using a Python script that applies a computer vision algorithm;
- Define how many times the user can present an incorrect RFID code and how many times the hand code can be entered incorrectly;
- Enable/disable the need for a hand code.