“Hausu Sentinel”

Home Security Device

by

“Embedded Fumi” group

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Tools&peripheral

- STM32F411
- ESP8266
- Infrared sensor
- Microphone
- Speaker

Project overview

Pain point:

Nowadays, living in a single house not connected to other buildings is riskier than in the past. Many homeowners want a surveillance system to help detect unusual activities from malicious people trying to break in while you are away

Solution:

We want to use the motion sensor to detect when a door is opened or closed. When such an event is detected, the light should be turned on along with a noise to scare off intruders and the owner should be notified of the event from their phone with the information of the event being recorded on a website.

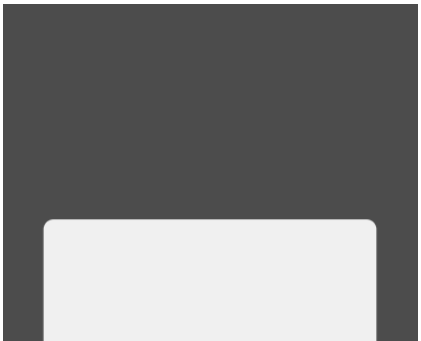
How to use

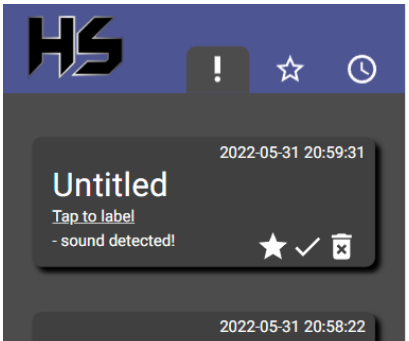
To install the device, the infrared sensor should be placed facing the door directly and both microphone and speaker should be placed in a manner that each can receive or emit sound clearly while not interfering with each other. The device itself should also be in a place where it can receive a wifi signal.

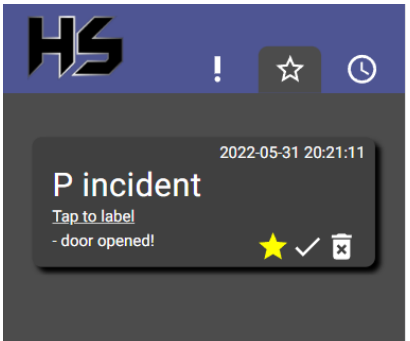
System Design

The system design is made with mobile usage in mind, since the app/device itself is more likely to be used when the user is outside of their residence, so a vertical scrolling design is preferred. The aesthetics of the website is minimal to keep it simple and easy to use. Each event detected by the device is divided and put into its own box showing its info including date and event type to make it easier to read. And because the event list can pile up over time, we added the navigation bar so the user can view certain events easily, this includes the “unchecked” section and the “favorite” section. Each event can also be labeled by the user in case they need to make notes, or deleted if the user wants to ignore it.

Web development

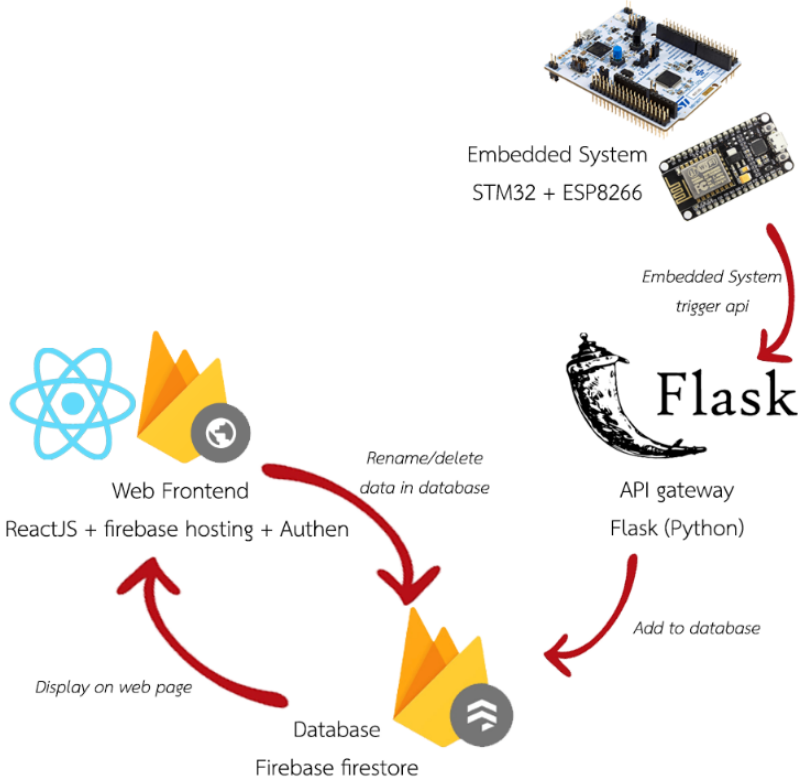






Sign in page Notification page Favorite page

The first page of the website is an authentication page which uses google account to login. When logged in, the user will be shown the main page which contains a list of detected unusual activities, each containing details of its date and time. It can then be labeled, favorited or deleted by the user. The navigation bar at the top-right can filter between viewing recent unchecked activities, favorite/starred activities or view the history of all events.



data flow and technology used

Tech Stack

- Frontend is developed using Typescript language and ReactJS framework to reduce duplicate code. It also uses MUI as the UI library to create components and icons shown on the website.
- Firebase hosting is used to make deploying the website more convenient.
- The authentication system utilizes Firebase Authentication to allow login using Google accounts and to check whether the email being used to login is a valid user.
- The database uses Firebase Firestore as a NoSQL database to collect data and time of detected events.
- The API Gateway uses the Flask framework developed in python to receive data sent from the embedded system to create new documents of events on the database.

STM32 & ESP8266

STM32

- Microphone
    - ADMP401 / Analog omnidirectional MEMS microphone
    - Contains 3 Pins connected to 3.3V, Ground and ADC_input
- Speaker
    - Contains 2 Pins connected to Ground and PWM_output
    - Transmits sound signals through PWM
- Infrared Obstacle Avoidance
    - Contains 3 Pins connected to 5V, Ground and GPIO_input

Overview

Microphone/Infrared Sensor will trigger from events, making the speaker emit a sound and making the STM32 board transfer data to ESP8266 which is then transferred to the device's server.

The output wire is connected to ADC_Input. Then, the input is sampled at the rate of 48kHz. After that, the data is processed to find the volume of the noise by batches every half of an ADC_DMA cycle which contains 64 data. If the noise passes the threshold, it is sent to ESP8266 to be sent to the server.

The speaker is connected to PWM_output by using the predetermined value as the parameter of the different value of PWM. The pulses start being sent when the microphone or infrared sensor/Infrared Obstacle Avoidance is triggered.

The output is connected to GPIO_input, its value indicating whether or not an obstacle is present. The Infrared sensor is placed near a door so that the device is triggered when the door is opened and no obstacle is present within the distance.

ESP8266

Receives the data from STM32 through I2C which is then checked whether the data comes from Infrared or Microphone Trigger to correctly notify the server/database of the event.

Member & responsibilities

Naphat Kosiyaporn

role: Embedded system developer

- Connect STM32 with ESP8266
- Connect peripheral with STM32
- Connect ESP8266 to WiFi and Send response to API
- Process the data from peripheral to fabricate the trigger-condition

Pochara Luangruangwech

role: System designer & Hardware manager

- Designed the website and flow of the system
- Soldered pieces of the device
- Configured ESP8266

Pisut Jirarattanarungsri

role: Web developer

- Developed API gateway and web page
- Manage database and connect database to web page/API gateway