Cool Fire Alarm

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Goal

❑ The main goal of the Cool Fire Alarm™ is to provide robust smoke detection with remote notifications at a reasonable cost. The Cool Fire Alarm™ aims to be competitive and cost-efficient. The main features of the Cool Fire Alarm™ are photoelectric smoke detection and a WiFi/BT remote alarm service. Rather than settling for a general purpose microcontroller, the Cool Fire Alarm™ implements the ESP32 microcontroller in order to minimize cost for this smoke detecting application.

Motivations and Objectives

❑ Motivations

- Current market solutions are expensive.
- Ionization smoke detection is starting to lose favor due to its inherent radioactivity and environmental harm. France and New Zealand have already banned ionization smoke detectors
- Someone decided to thaw a frozen pipe using fire from a match, but actually set the pipe on fire, so a cool fire alarm is for keeping people safe from fire hazards.

❑ Objectives

- Develop a competitive system with <$30/unit cost
- Implement effective and consistent photoelectric smoke detection

Research Challenges

❑ Choosing cost-effective components to reach targeted design budget

❑ Developing for WiFi/BT communication and cell phone interaction

❑ Designing an original PCB to integrate the system with a 9V battery

❑ Implementing smoke detection algorithm with photoelectronics

Acknowledgement

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Market Research and Planning

❑ Power Delivery Network

- There are 3 ways fire alarms are powered: direct powerline connection, 10 yr non replaceable batteries, and 9V batteries. For this design, cost and user accessibility were prioritized. The 9V battery seemed best to accommodate these considerations.

❑ Photoelectric Smoke Detection

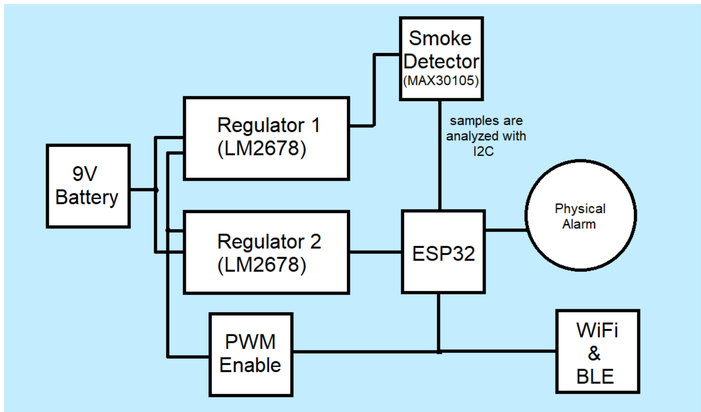
- In photoelectric smoke detection, an IR emitting photodiode/transistor is paired with a IR sensor. The sensor samples the intensity of the IR emitter and uses light scattering based particle detection to identify the presence of smoke.

❑ WiFi/BT Communication and MCU

- With an incredibly large selection available, choosing the most effective option for the design proved challenging. General purpose solutions such as the Raspberry-Pi and Arduino were considered, but their cost efficiency left much desired for our application. Several $1-$3 microcontrollers were also considered, but many did not accommodate for any wireless communication protocols such as WiFi or Bluetooth. However, the ESP32 manages to provide for all of our design criteria for under $4/unit.

Design

❑ Block Diagram



❑ PCB Design (preliminary application concept):

- A smoke alarm obviously must not be powered by USB, so a PCB must be designed to power the device. A 9V battery can provide a sizeable battery life for a low power application. Since the ESP32 and the MAX30105 operate at a much lower voltage level, the design necessitates buck switching regulators for optimal power delivery.
- The available demo uses manufacturer designed development components to showcase our proof of concept

References

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