

Midterm PROJECT TITLE	Candle Monitor and Extinguisher	Category: Circle One	Grad Undergrad
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I. INTRODUCTION Central problem being addressed; Topic of study related to problem

[1.0 Points]

Unattended candles (those that are lit, of course) are a fire hazard. This project proposes an IoT-based solution that can monitor lit candles and send notifications when they have been left unattended. A flame sensor detects when a candle is lit, an ultrasonic sensor tracks room occupancy, and a timer ensures the candle does not exceed the recommended four-hour burn limit. When the timer runs out, a motorized fan will extinguish the candle.

II. BACKGROUND AND SIGNIFICANCE Problem details; Rationale; Problems addressed; Research methods and sources.

[1.0 Points]

Candles help freshen the scent of a room while also being a decorative item that can provide light. However, they are also a fire hazard when the correct practices are not applied. One of the most common misuses is leaving a candle lit for a considerable amount of time. This is not usually done on purpose, as people tend to forget they lit a candle in the first place. Yet it still happens, and it creates a potentially dangerous situation. This is where my device comes in. Sometimes, candle-lovers need reminding that their candle is still burning. They will get a notification if they leave the room while a candle is lit. Even if this notification is missed, the candle will be blown out after a set amount of time by a motorized fan as a last resort.

There is guidance laid out by various associations that must be followed when using candles. This will be a key part of my research that will be used to drive the design decisions of my device.

III. LITERATURE REVIEW Cite, Compare, Contrast, Critique, Connect

[2.0 Points]

The National Fire Protection Association (NFPA) reports that between the years 2018-2022, "U.S. fire departments responded to an annual estimated average 5,910 home structure fires started by candles. These fires cause an annual average of 74 civilian deaths and 558 civilian injuries, as well as \$257 million in property damage" [1]. Notifying the user when a candle has been left unattended will remind them of this potential hazard so they can take the necessary steps to ensure candle safety.

Additionally, the NFPA states that "over one-third of candle fires (36%) started in the bedroom. Sleep was a factor in 10% of home structure candle fires, 15% of candle fire deaths, and 18% of candle fire injuries" [1]. The IoT device will also feature a failsafe that will extinguish the fire automatically after a certain period of time in case the user is unable to respond to the notification. The National Candle Association advises against burning candles for more than four hours [2]. This will be the default time before the auto-extinguisher is activated.

There is a similar product on the market from Airy Fairy [3]. The product consists of a base to put the candle on with an adjustable arm from which the air blows from to extinguish the candle after four hours. However, my device will be able to notify the user when they leave the vicinity to give them the opportunity to extinguish the candle themselves rather than wait for the timer.

IV. PROJECT DESIGN AND METHODS Figure out what you need for the project; Think about potential obstacles

[1.5 Points]

Hardware Components:

- Flame Sensor – Detects when the candle is lit.
- Ultrasonic Sensor – Placed at the room entrance to monitor room occupancy. A second one may be required to differentiate between someone entering the room and exiting the room.
- Motorized Fan – Blows out the candle automatically after 4 hours.

Potential Challenges:

- Ensuring accurate flame detection (avoiding false positives).
- Fine-tuning fan strength to effectively extinguish the candle.

V. PRELIMINARY SUPPOSITIONS AND IMPLICATIONS Task division; identify who is doing what if you are in a team of two

[2.0 Points]

As an individual project, my tasks include:

- Testing the flame sensor to ensure proper integration
- Determine the best way to code the ultrasonic sensor(s) to accurately reflect the room occupancy
- Figure out how the fan will be mounted in relation to the candle
- Code and connect these sensors to each other and the internet

Candle-related fires are a serious issue that pose a significant safety concern. What starts out as a small, aromatic flame can end up in a total and sometimes fatal tragedy. The proposed IoT device will help stop the potential disaster at the source by monitoring who is in the vicinity of the candle and notifying the user when it is left unattended. For additional safety measures, a motorized fan will be triggered to blow out the candle after the recommended 4 hours from the moment the candle is lit.

- [1] National Fire Protection Association, "Candle Safety," NFPA, 2025. [Online]. Available: <https://www.nfpa.org/education-and-research/home-fire-safety/candles>. [Accessed: Feb. 10, 2025].
- [2] National Candle Association, "Your Foolproof Guide to Burning a Candle Correctly," candles.org, Jul. 27, 2018. [Online]. Available: <https://candles.org/your-foolproof-guide-to-burning-a-candle-correctly/>. [Accessed: Feb. 10, 2025].
- [3] MyAiryFairy, "MyAiryFairy," *myairyfairy.com*, 2025. [Online]. Available: <https://myairyfairy.com/>. [Accessed: Feb. 10, 2025].