Smart Stove Project Proposal

Project 75
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1. Introduction

1.1

Objective: People, especially old people, tend to forget that they have left their stove on. If there are children in the house, it gets worse. If fire starts while they are not attending the stove or if people are outside, the materialistic loss would be catastrophic. The goal of this project is to prevent hazards on the electric stove, specifically fires, from becoming disasters, and if they do happen, users should be informed so they can react quickly. The system needs to be cost-efficient, as well as applicable for most households.

Our solution would be to create a system that can detect carbon monoxide and fires using an IR detector and Gas sensor. These sensors will send information to a mobile application. There are three main functions we would like to accomplish with this. Firstly, users could remotely turn the stove off through the application. Next, users would be informed if they left their houses and power to the stove will be automatically cut. Lastly, if a fire starts while they are away from the stove but still in the house, their stove will automatically turn off and the user will be notified to extinguish it.

1.2

Background: As the technologies develop more and more, companies make their appliances to be controllable by mobile devices. For example, Samsung has an application called Samsung Smart Home which controls all the home appliances that are made by Samsung. Another one is from GE and is called kitchen- GE Appliances. They can control the time, temperature, alarms, etc. However, we thought that they can only be used if the customers were using the companies' brand. If there was a device that can control for any companies' device, it would be very convenient for the user.

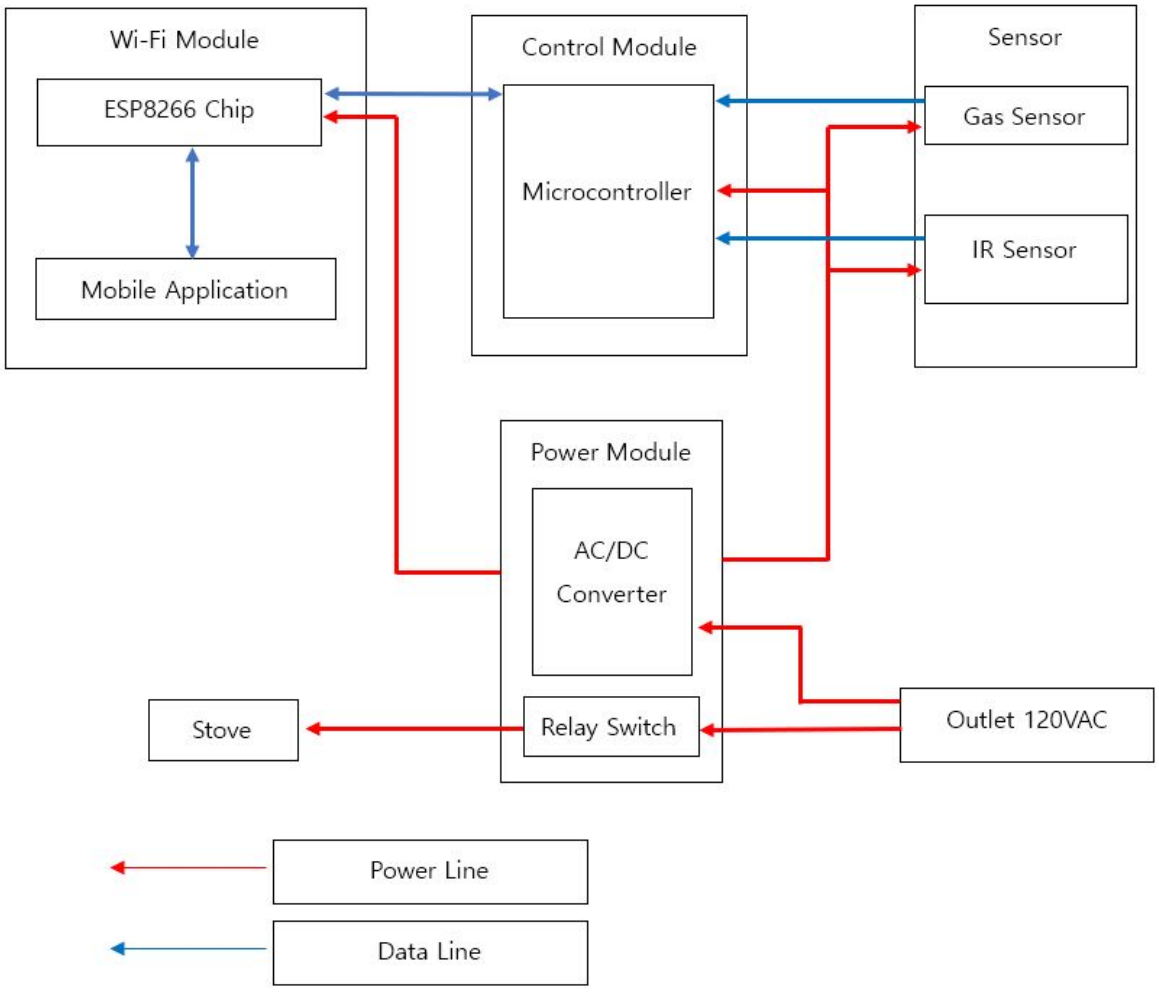
Among all the appliances, we thought that the stove was the most important thing out of all the appliances in the kitchen because it is directly related to fire, which could potentially damage the owner's property by a lot. If the user can control their stove from the mobile application, it will be safer, and users don't have to worry about not turning off the stove ever again. In addition, since it can be used for all electric stoves, users don't have to spend money on new stove in order to control their appliances.

1.3

High-level requirements list:

- Should be able to detect a fire when it emits light wavelengths above the visual spectrum as well as when smoke starts coming out.
- There needs to be a wireless connection and communication between the stove, sensors, and application using a ESP chip.
- Our system needs to be able to stop power to electric stove when fire starts or user remotely turns stove off.

2. Design


Wi-Fi Module
ESP8266 Chip
Mobile Application
Control Module
Microcontroller
Sensor
Gas Sensor
IR Sensor
Power Module
AC/DC
Converter
Relay Switch
Stove
Outlet 120VAC
Power Line
Data Line

2.1

Power Module

We will be using 120VAC from the outlet. This is the main power source that are to distribute power to other modules such as microcontrollers, wifi chip, and sensors. This will have to be regulated through some device since other modules has some limits on how much voltages that can be put on. Without this, we won't be able to power our system. In addition, in between the line voltage and the stove, we will have a relay to have it act as a switch for our system so that the system could be turned off in case of emergency.

2.1.1

AC/DC Converter

This will be used to regulate the voltage that are to be provided to the sensors, microcontroller, and wifi chip. This will have to regulate the voltage that are to be put into the electronics accordingly to prevent damages to them. For example, the microcontroller will have the maximum voltage to be put in as 5V while the wifi chip will have the maximum voltage to be put in as 3.3V. The gas sensor will also have a maximum voltage of 5V and the infrared detector will have a maximum voltage of 3.6V.

2.1.2

Relay

This will be used as a switch for the stove. The data from the microcontroller will control the switch of the stove. Whenever the fire is on or the user acts on the application, the switch will be switched to off position so that the stove will be turned off.

Requirements: The relay will have to support at least 1000W since portable stove requires at least 1000W. In addition, relay will have to be compatible with the microcontroller and the PCB.

2.2

Sensors

The purpose for this module is to be able to respond to outside stimulus. Each of the sensor will check with each other so that they wouldn't cause a false signal to be sent out through the microcontroller. This module will serve as a crucial component for our design because these will have to detect the actual fire in case it happens.

2.2.1

IR Sensor

The Infrared detector will visually detect the fire at an infrared level. When the fire displays certain wavelengths, the sensor will send a signal saying that a fire exists.

Requirements: Will detect wavelengths at around 4.4 μm and operate at a max of 3.6 V.

2.2.2

Gas Sensor

The gas detector will detect the smoke that fires produce, much like most smoke alarms. An LED will shine in a straight line through the room; the smoke will deflect this light into another chamber holding this photoelectric sensor. This triggers the gas sensor.
Requirements: Will operate below 150 mA at 5V and will detect smoke at 300 ppm onwards.

2.3

Control Module - Microcontroller

The control unit will be responsible for determining whether the stove is on. In addition, it will be able to tell if the stove is on fire based on the information from the two sensors. This will be a real-time data into the mobile application through the usage of ESP8266 chip and then let the user decide to take action accordingly.
Requirements: The microcontroller will have to have at least three inputs so that the data from the two sensors and the wifi chip can come in. In addition, it must operate under 5VDC as the incoming voltage from the regulator will be 5V for the microcontroller.

2.4

Wifi Module

This module is responsible is for all wireless data transfer. Wireless communication will be between microcontroller, ESP chip, and a mobile application. This will allow wireless control of the stove.

2.4.1

ESP Chip

A ESP8266 chip will be used for this project. It is responsible for communicating all data between mobile application and the controller. So if a fire has been detected, it is the chip's job to communicate that to the application, and then when the user wants to turn the stove off through the app, the chip must tell that to the controller so the power module can be adjusted accordingly.
Requirements: It will have a operating voltage of 3.3V and a operating current of 80mA. Transmission speed should be around 2.4Ghz and range should be around 100ft.

2.4.2

Mobile Application

This will be the primary module for user to communicate with the stove indirectly. The application should be able to relay message to microcontroller to cut power from the stove through the ESP chip. It should also give notifications when a fire has occurred.

2.5

Risk Analysis:

We think the two parts in our block diagram could potentially risk to successful completion of our project. Those are Connection from the microcontroller to the wifi so that it would successfully transfer from/to the device. In addition, successfully stopping the machine when the device tells the controller to do so will be crucial to our project since stopping the machine when the fire is present will be critical to the safety our project.
Our primary focus of the project is the safety of the people who are to use our devices. If the stopping doesn't work, user could potentially be in danger, thereby, creating a failure in our project even if the other parts worked. In addition, connection between the device and our hardware will be the most crucial part as well because without the communication between those two, the user won't be able to control the stove even if the hardware, itself, was working.

3

Safety/Ethics:

There will be many safety concerns with this project because of the involvement of the electric stove, which can be a fire hazard. The problem with electric stoves is that there are less physical indications compared to a gas stove [1]. Electric stoves do not use gas, thus it is harder for the user to realize if they have left it on, because there is no gas for them to smell. Compared to a gas stove that has a very visible burning flame, the coil of an electric stove is not always evident of its temperature. Often times, it is difficult for a user to gauge the heat of a coil as the only sign of its temperature is whether or not the coil turns a red color, which is not characteristic of all stoves. Aside from the fire hazard of the stove, we will be doing voltage transformation from a 120V outlet. Dealing with high voltages can be very dangerous if handled properly. We will follow lab standards [2] and check for damages on outlets and wires, and make sure there are no liquids around that can damage electronics.

When working with this project, we must address all ethical concerns. When using the 120 VAC outlet power, we must ensure that utilizing will be safe and will not damage any circuits we use, such as the PCB or the stove that the circuit will be connected to, or harm any persons using this mechanism, following section one of IEEE code of ethics [3]. Section six of the IEEE code of ethics requires anybody working with this project to have the technological competence and qualifications, which we will follow when dealing with the power and circuits. We will also follow section seven, seeking and correcting errors that might occur when working with this mechanism.

References

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[3] Ieee.org, "IEEE IEEE Code of Ethics", 2016. [Online]. Available: http://www.ieee.org/about/corporate/governance/p7-8.html

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