Main

Name(s): Kevin Pineda, Tasfia Reza, Sahed Saad, Edgar Sanchez
Date: 3/16/2026
Writing for Engineering 21007

Note Ideas 3/16
- In case of prevention failure, a failsafe would be to contact the fire department
- Instead of instantly cutting off power, we could use AI to monitor the voltage and decide whether to cut it off.

Engineering Innvovation Presentation ← PRESENTATION SLIDES

Research Question
1. How reliable are smart power strips if WIFI goes out or the system crashes?

Smart power electrical fire prevention strip

Introduction: Discuss the need for this innovation and how it affects the technical environment. (**@Done**)

Compare-Contrast with similar innovations (How it's better etc.) **@Tasfia**
- Include detailed background and history of similar innovations
- Detailed comparison of our innovation with prior ones
- Why did previous innovations fail? What were they lacking? What new stuff are we including?

Technical Description of the Innovation: **@Kevin**
- Body of technical description (Interior, Exterior, Top, Bottom, Middle)
- Pictures, Graphics, Specs sheet

Building the Innovation: **@Saad** **{Mine's is in the "Building" tab in this doc}**
- **Materials, along with Description:**

Heat sensors made up of Copper and Zinc since these are highly sensitive; chips for the main board; plastic to make a shell that covers inner cores.
- **Cost**: (Funding?) Since it's a small device, it should be around $50; but if we manufactured it in industry, the cost could be lowered to $20.
- **Time**: Roughly about 5 days to a week to design it manually.
- **Labor-Power**: Designing, Testing, Coding, integrating with circuit

Detailed Process of the Innovation Itself (Details on how it works) **@Edgar**

Conclusion **@Edgar**

And labor. Edgar still working on detailed process of innovation, and kevin has a layout of the technical description, and is elaborating on it in more details. We have got some pictures as part of graphics but we do plan to include a custom technical design from other similar device. Presentation we gonna break equally among us.

Main Intro:

In New York City, particularly within the traditional infrastructure of existing buildings, electrical fires are a persistent and deadly threat; the technical environment in these neighborhoods is defined by old copper wiring behind plaster walls, that was installed long before the era of modern electronics. The lack in current safety technology is that standard power strips are reactive. They rely on simple metal breakers that only respond after a massive surge of electricity. This creates a dangerous gap where a wire can slowly overheat, and melt its insulation and spark a fire behind any substance, without ever pulling enough current to trigger a traditional fuse.

Our group is proposing the Smart Power Electrical Fire Prevention Strip to address this specific vulnerability in New York City housing landscape. Instead of waiting for a drastic failure, our design uses heat sensors and current monitoring to detect the problem at the source. By tracking the actual temperature at the plug, our device differentiates between a normal power surge, and dangerous heat buildup of an overloaded circuit. For a civilian living in an older building wiring system, this innovation creates an active warning system that cuts the power before the first accident ever happens.

Detailed Process:

Our project focuses on designing a Smart Power Electrical Fire Prevention Strip that actively prevents electrical fires before they even start. Unlike traditional power strips that only react after a major surge, our device constantly monitors both current and temperature at each outlet. If it detects abnormal heat buildup or unsafe electrical flow, it can immediately shut off power or send an alert to the user. This is especially important in older buildings, where outdated wiring can slowly overheat without ever triggering a standard breaker, creating a hidden fire risk.

The way our prototype works is by combining hardware and software into one system. Similar to existing smart power strip designs, our device would include sensors and a small microcontroller that continuously measures electrical activity at each socket. . Instead of just tracking energy use, our version focuses on safety by identifying dangerous patterns like rising temperature or overloaded circuits. The system could also communicate data to a simple interface, allowing users to see what's happening in real time and understand which devices might be causing risk.

Overall, our design improves on current power strip technology by shifting from a reactive system to a preventative one. While other smart strips mainly focus on saving energy or remote control, our prototype is centered on safety and early detection. By stopping electrical issues at the source, this device has the potential to reduce fires in everyday environments like homes, offices, and construction sites, making it a practical and meaningful engineering solution.

—---------

Sources-

1) **Smart power strip:** https://odr.chalmers.se/server/api/core/bitstreams/e957a065-2a16-4518-8dfd-77e47d9ec339/content
2) **What is an Electric Fuse:** https://battlebornbatteries.com/what-is-electric-fuse/?srsltid=AfmBOooBNmSHk46uT7NLH_F4NWd1XzwollX4_m39Z6hpy9FLTLnM_QByh-how-fuses-work

   https://www.allaboutcircuits.com/textbook/direct-current/chpt-12/fuses/

   https://en.wikipedia.org/wiki/Fuse_(electrical):~:text=Low%2Dvoltage%20high%20rupture%20capacity%20(HRC)%20fuses%20are,rated%20to%20interrupt%20current%20of%20120%20kA.

Introduction

Smart Power Electrical Fire Prevention Strip

In New York City, particularly within the traditional infrastructure of existing buildings, electrical fires are a persistent and deadly threat; the technical environment in these neighborhoods is defined by old wiring system behind plaster walls, which were installed long before the era of modern electronics. The lack in this current safety technology is that standard power strips are reactive and they rely on simple metal breakers that only respond after a massive surge of electricity. This creates a dangerous gap where a wire can slowly overheat, and melt its insulation and spark a fire behind any substance, without ever pulling enough current to trigger a traditional fuse.

The Smart Power Electrical Fire Prevention Strip can address this specific vulnerability in the New York City housing landscape. Instead of waiting for a drastic failure, our design uses heat sensors and current monitoring to detect the problem at the source. By tracking the actual temperature at the plug, our device differentiates between a normal power surge, and dangerous heat buildup of an overloaded circuit. For a civilian living in an older building wiring system, this innovation creates an active warning system that cuts the power before the first accident ever happens.

Comparison @Tasfia

Compare contrast with similar innovations –

Before the development of modern smart safety devices, electrical protection systems evolved through several stages. Early systems such as fuses were designed to stop excessive current by breaking the circuit when a limit was exceeded. Later, circuit breakers replaced fuses by allowing circuits to reset instead of being permanently damaged. As technology advanced, surge protectors were introduced to protect devices from sudden voltage spikes such as lightning or grid fluctuations.

In the late 20th and early 21st centuries, more advanced devices such as GFCI (Ground Fault Circuit Interrupters) and AFCI (Arc Fault Circuit Interrupters) were developed to prevent electric shock and detect wiring faults. More recently, smart power strips have been introduced, focusing on energy efficiency and remote control through internet-based systems.

Despite these advancements, existing technologies still have significant limitations. Most traditional systems, including fuses and circuit breakers, are reactive, meaning they only respond after a dangerous threshold has already been reached. This creates a critical gap where slow overheating can occur without triggering any protection.

Surge protectors focus only on voltage spikes, ignoring gradual heat buildup caused by overloaded circuits or aging wiring. Similarly, GFCI and AFCI devices are often not portable or user-level solutions, making them less accessible for everyday use. Even modern smart power strips mainly emphasize energy saving and convenience, rather than actively preventing electrical fires.

In contrast, our Smart Power Electrical Fire Prevention Strip introduces a preventative approach rather than a reactive one. While traditional devices wait for failure conditions, our system continuously monitors both temperature and electrical current in real time. This allows it to detect hidden risks such as gradual heat buildup that other devices fail to identify.

Unlike existing smart strips that focus on remote control or energy efficiency, our innovation prioritizes safety and early detection. It can differentiate between normal usage and dangerous conditions, providing warnings or automatically shutting off power before a fire hazard develops.

Overall, our innovation improves upon previous technologies by combining monitoring, analysis, and response into a single device. It addresses the major weaknesses of earlier systems by focusing on early detection, user accessibility, and real-time decision-making. By preventing electrical hazards before they escalate, this device offers a more reliable and practical solution for both modern and aging electrical systems, especially in environments like older New York City buildings.

Technical @Kevin

Technical Description:

I. Overall Device Description

The Smart Power Electrical Fire Prevention Strip is a redesigned power strip that reduces the risk of electrical fires before they start. Unlike typical power strips, which mainly serve as outlet extenders, this device combines power distribution with active safety monitoring. Its design integrates the usual functions of a standard power strip with sensors and features that detect potential hazards, such as unusual heat buildup or abnormal electrical loads. This way, it operates not only as an outlet extender and power source but also as a safety system embedded in a common household item.

The device looks like a typical rectangular power strip, ensuring familiarity and practicality for daily use. Beneath this familiar exterior lies a modified internal structure that supports sensing, monitoring, and proactive responses. It is meant for environments where outdated wiring, overloaded outlets, or unnoticed heat buildup could pose a higher risk of electrical failure. By incorporating these features, it offers extra security and safety in homes, offices, and industrial settings. The design philosophy emphasizes not just reacting to electrical emergencies after they happen but proactively detecting patterns, learning regular usage, and providing early warnings to prevent hazards.

II. Exterior Structure

The exterior design of the Smart Power Electrical Fire Intervention Strip is crafted to appear familiar to the average user, while also showcasing features that set it apart from standard power strips. Its external shape remains an elongated rectangle, a familiar form often seen in household outlet strips. This familiarity allows users to place the device seamlessly on floors, desks, or walls without needing special installation. Such a design is crucial because the device is meant to integrate smoothly into both residential and industrial settings, quietly advancing safety and protective features. The top surface hosts multiple grounded outlets arranged in a straight line, accommodating several electrical devices simultaneously.

In addition to the outlet arrangement, the top surface includes control and indicator features that communicate the device's operating condition. These may include the main power button, a reset button or test button, and several stacked LED status lights that indicate whether the strip is functioning as intended, detecting a warning condition, or actively responding to a fault. The outer casing surrounding these components is designed from fire-retardant material and a protective insulated shell that encloses the main electrical hardware and gives the strip its structural durability. At one end of the housing, the main power is located and enters through a reinforced connection point that helps reduce wear and tear from constant bending or movement. Altogether, the exterior structure is designed to balance functionality, usability, and safety by presenting a standard power strip form while visibly supporting the added monitoring and protective features of the innovation.

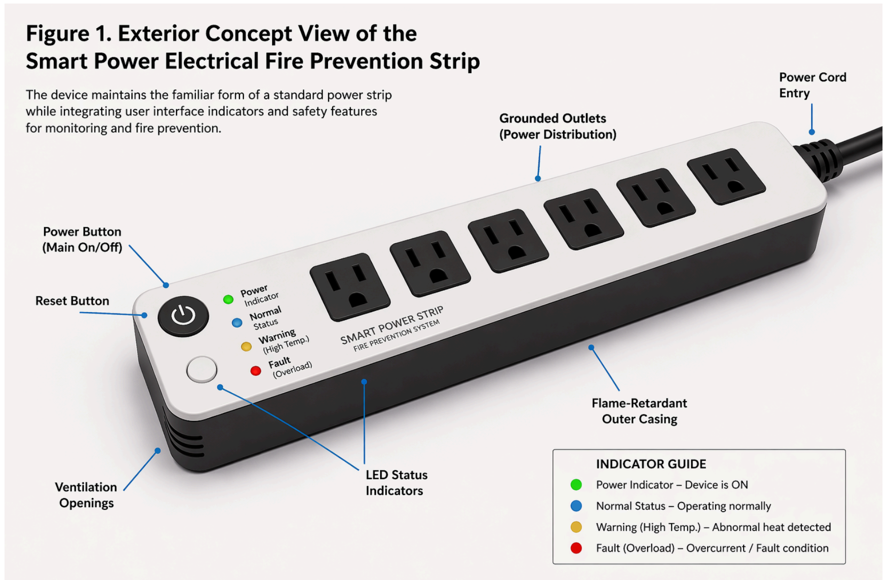


Figure 1: *Concept view of Smart Power Strip detailing all exterior*

III. Internal Layout and Main Components

Beneath its outer casing, the strip contains a compact internal arrangement of electrical and electronic components that work together to be able to support both the distribution of power and the active hazard monitoring. At its core, the internal structure is a printed circuit board (PCB), which serves as the main area that will house the devices' sensing, control, and response hardware. The PCB organizes the internal system into a practical and efficient layout that allows the components to remain securely positioned in the bed of the housing while maintaining electrical communication with one another. This piece of the device is key to supporting the main function of the innovation; in short terms, it acts as the brain of the device. Surrounding this central board are multiple conductive pathways that distribute all types of incoming power from the main cord to each outlet, as well as giving power to the monitoring components that are essential to observe temperature and electrical conditions within the strip.

Among the main internal components are a series of copper conductors that carry an electrical current, the temperature and current sensors positioned around the high-risk zones, and the microcontroller that receives and interprets all the data from said sensors. The system also includes a type of switch or relay components that will automatically cut off power if the sensors detect a hazard coming into play. This is installed in the internal circuit of the device. These components are placed in such a way that allows the strip to act in its own function within the overall design. Rather than functioning as a hollow casing with a simple wiring template, the interior of the strip is structured in such a way that, as an integrated system, it can house and distribute power, sensing, and protective controls combined into a single enclosure.

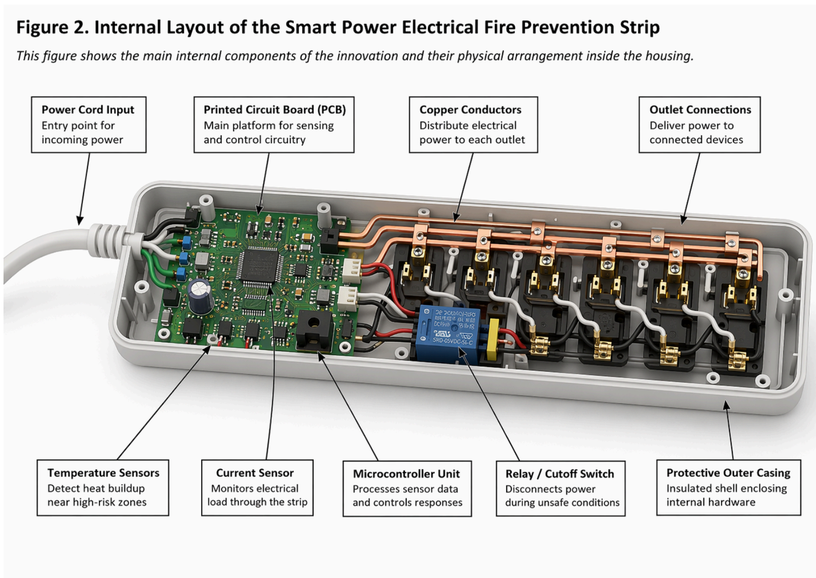


Figure 2. *Concept view of the internal structure of the Smart Power Strip*

IV. Monitoring and Protective Features

The Smart Power Electrical Fire Intervention Strip is designed as more than a passive outlet extension, with our incorporation of a monitoring system that observes unsafe electrical and thermal conditions during everyday use. One of the device's main protective features is the meticulous use of temperature sensors placed near the outlets and other potential high-risk internal areas where heat buildup is most likely to begin. These sensors allow the strip to be able to pick up on rising temperatures that may result from various factors such as overloading, poor plug contact, damaged wiring, or prolonged electrical stress. By having the right mechanisms to be able to detect abnormal heat before visible failure occurs, the device can make a decision earlier than the conventional strip or fuse based desgin.

Additionally, alongside thermal monitoring, the strip also includes current-sensing modules that actively track the electrical load moving through a device. This allows the system to observe the levels of current being drawn by connected appliances and be able to pick up on unusual patterns and unsafe operational conditions. Allows these two components to work simultaneously, which allows the device to form a more accurate picture of electrical hazards. Instead of reacting to a sudden surge, the device is designed to be able to recognize the gradual buildup of issues over time, which is a crucial component in especially in older homes with outdated electrical wiring, without immediately triggering the breaker or fuse.

Once an abnormality is detected, the system is designed to activate a protective protocol that responds to the intended control hardware. Depending on the severity of the situation, the strip may indicate with the LED lights the status, shift into a fault state, or disconnect power through a relay or cutoff switch. As an additional failsafe feature, the device may also contain a communication module that is capable of sending an emergency alert if the system detects a critical fire risk or if the primary shutdown response fails in any way. In a more advanced development of this innovation, the device could alert emergency services, such as the fire department. While also alerting the user remotely. This added layer of protection strengthens the strip's role as a fire-protection and prevention device by extending beyond the internal shutdown.

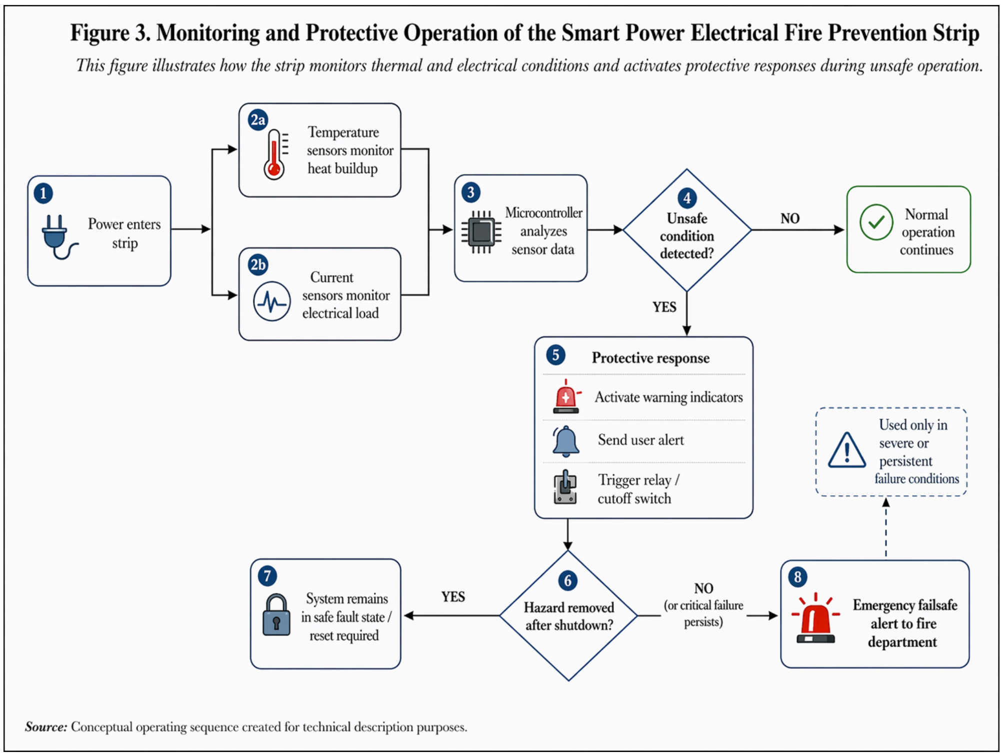


Figure 3. *The process of the brain of the Smart Power Strip follows to keep a safe environment.*

Building @Saad

Materials and Cost Analysis

i) Component Materials

The construction of the Smart Power Electrical Fire Prevention Strip relies on a strategic selection of materials chosen for their thermal and protective properties. The device utilizes high-sensitivity heat sensors fabricated from a combination of copper and zinc, ensuring rapid detection of minute temperature changes. The internal logic is driven by microchips mounted on a central plastic circuit board that acts as the primary data processing hub. To provide a robust defense against external damage and internal heat, the entire assembly is enclosed in a fire-retardant plastic shell designed to insulate the internal electrical cores from the surrounding environment.

ii) Unit and Installation Costs

The financial breakdown of the project includes both individual manufacturing and broader infrastructure requirements. While the base cost to manually assemble a single power strip unit is approximately $50, the total system requires several high-cost overhead components. For example, a dedicated main control panel, which serves as the interface for the strip, costs roughly $200 when purchased from local NYC suppliers.

Further costs are driven by the electrical wiring, which is priced at $100 per 100-foot spool. The total length of wiring required is heavily dependent on the specific architectural layout of the residence. In detached private homes, the installation is often more affordable because the strip can be linked directly to an accessible internal panel. However, in large apartment complexes, costs typically rise if the wiring must be routed to a centralized circuit system located in a different part of the building.

iii) Total Project Investment

Beyond the primary unit and wiring, a complete installation requires a suite of mounting hardware, protective conduits, and specialized fittings, which add $60 to the material list. Data from Contractor Plus indicates that the comprehensive cost for a professional setup in the New York area averages $1100. This total reflects a combination of the raw materials, specialized hardware, and the high cost of skilled labor required to ensure the system meets local safety codes and electrical standards.

iv) Labor and Development Timeline

The timeline for bringing a unit from a design concept to a functional installation varies based on technical experience. For engineering students managing every stage of the process, including design, assembly, and testing in a safe environment, the project would likely span five full working days. In contrast, experienced electrical contractors can streamline this process significantly, typically completing the entire physical installation and safety testing within a single eight-hour shift.

v) Funding and Impact

To acquire the necessary capital for this project, we would present a formal proposal to stakeholders highlighting the critical role of proactive safety technology in urban environments. The proposal emphasizes that this device is a necessary upgrade for aging infrastructure, providing a much-needed layer of protection for modern households. By focusing on the prevention of life-threatening accidents, the project aims to demonstrate its value as a life-saving tool, particularly for families with children who live in buildings with older, high-risk wiring systems.

Process/Conclusion @Edgar

Our Smart Power Electrical Fire Prevention Strip works through a step-by-step system that combines sensing, data processing, and automatic response. The goal is to detect danger early and act before a fire can start. Unlike traditional power strips that only react after a major surge, our device constantly monitors both current and temperature at each outlet. If it detects abnormal heat buildup or unsafe electrical flow, it can immediately shut off power or send an alert to the user. This is especially important in older buildings, where outdated wiring can slowly overheat without ever triggering a standard breaker, creating a hidden fire risk.

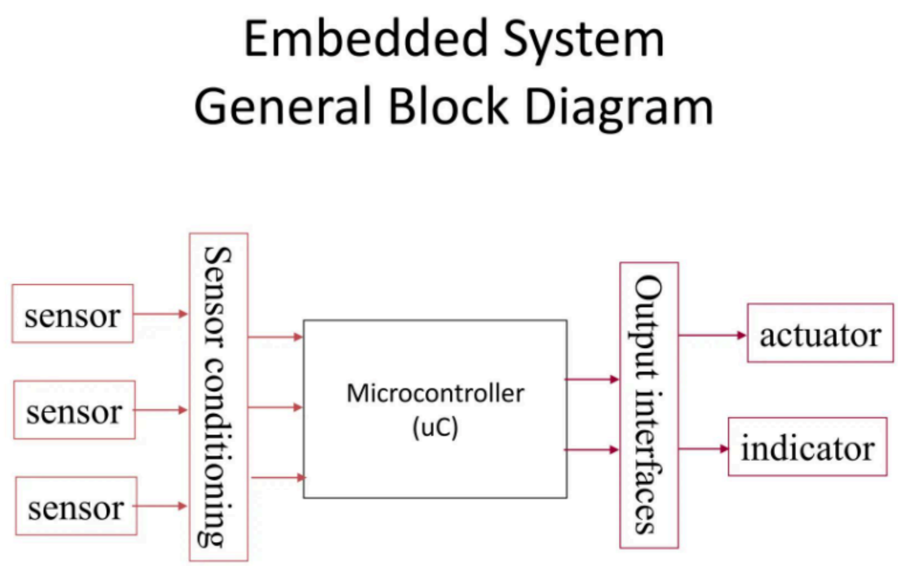


Figure 1. Embedded system block diagram showing sensor input, processing, and output

The way our prototype works is by combining hardware and software into one system. When a device is plugged into the strip, the system begins monitoring two key things at each outlet: electrical current and temperature (*as shown in Figure 2*). Current sensors track how much electricity is flowing, while heat sensors (made from conductive materials like copper and zinc) measure the temperature around the plug and wiring. These sensors constantly send real-time data to a small microcontroller inside the strip.

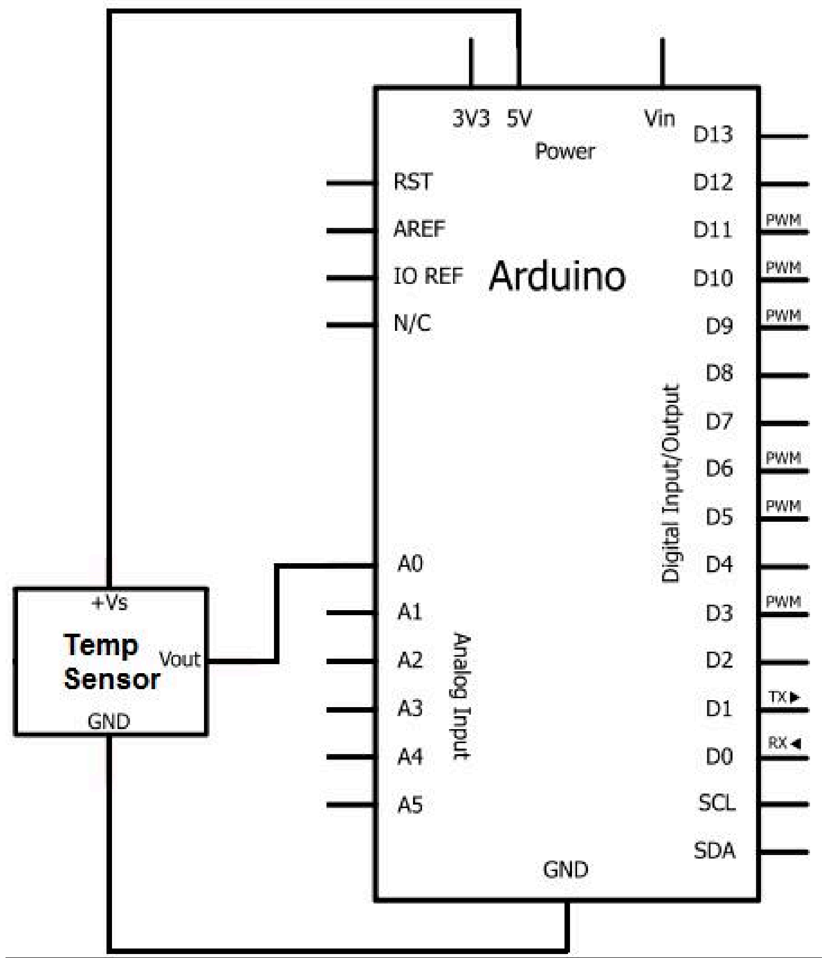


Figure 2. Temperature and current sensors connected to a microcontroller

Second, the microcontroller processes this data using programmed safety thresholds (*see Figure 3*). For example, if the current suddenly spikes or if the temperature slowly rises above a safe limit, the system recognizes this as a potential hazard. This is important because many electrical fires do not come from sudden surges, but from gradual overheating that traditional breakers fail to detect.

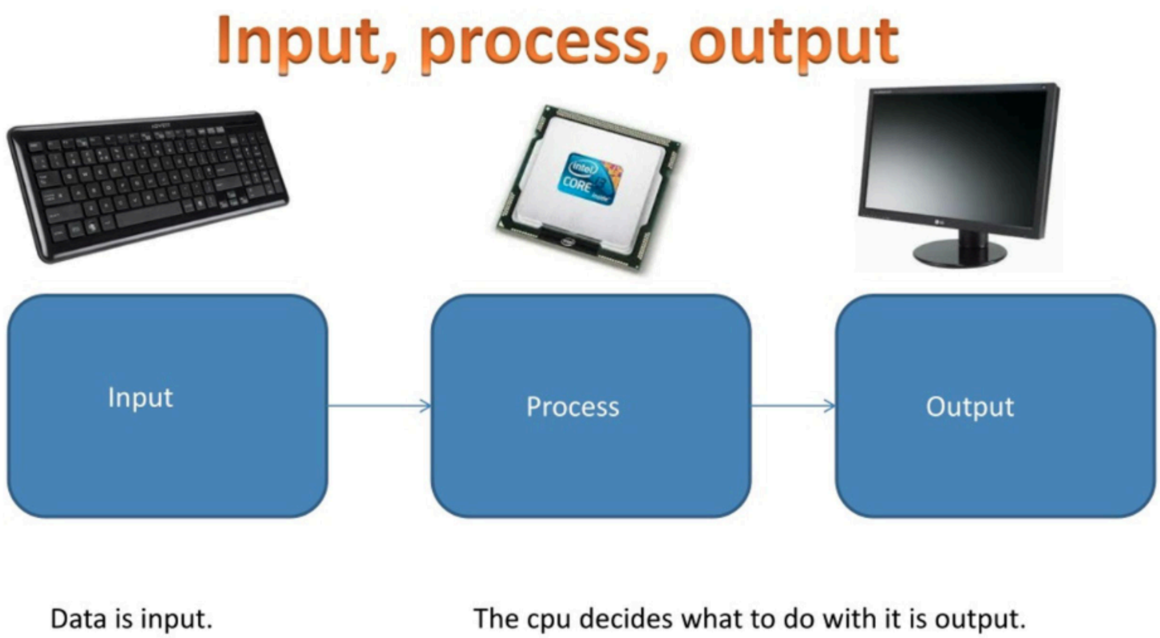


Figure 3. Microcontroller processing sensor data and making decisions

Third, once the system detects abnormal behavior, it decides what action to take. There are two main responses

- If the risk is moderate, the system sends a warning alert to the user through a connected app or indicator light on the strip.
- If the risk is severe, such as continuous overheating or dangerous current levels, the system will automatically shut off power to that specific outlet or the entire strip. (as shown in Figure 4)

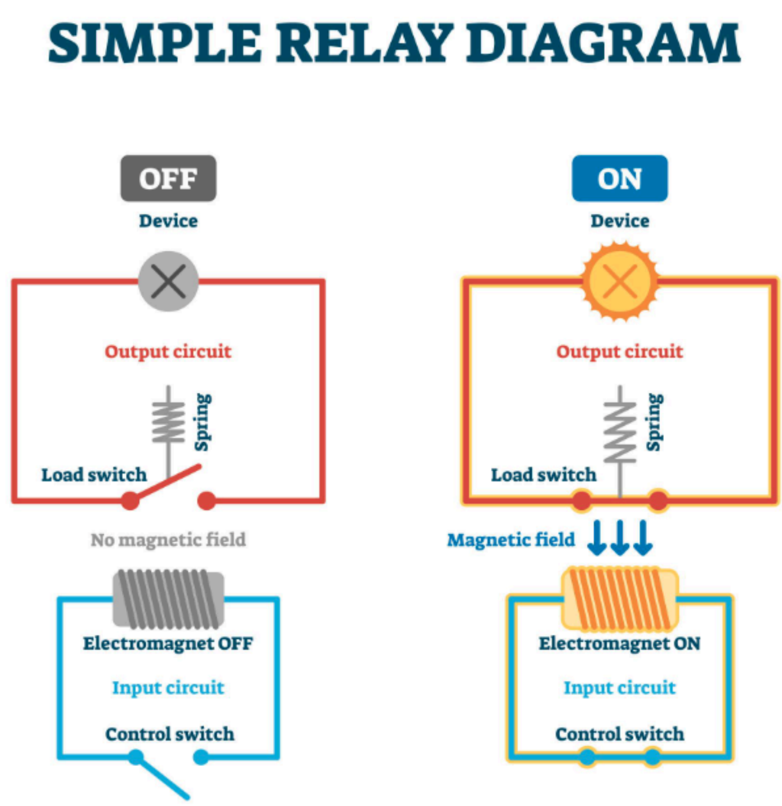


Figure 4. Relay switch cutting off electrical power during unsafe conditions

Overall, our design improves on current power strip technology by shifting from a reactive system to a preventative one. While other smart strips mainly focus on saving energy or remote control, our prototype is centered on safety and early detection. By stopping electrical issues at the source, this device has the potential to reduce fires in everyday environments like homes, offices, and construction sites, making it a practical and meaningful engineering solution.

Conclusion:

In conclusion, our Smart Power Electrical Fire Prevention Strip presents a practical and effective solution to a major safety issue in modern and older buildings. As discussed throughout the proposal, current electrical protection systems are mostly reactive and fail to detect slow, hidden risks like gradual overheating. Our design improves on these limitations by combining continuous monitoring, real-time data processing, and automatic response into one system

By integrating temperature and current sensors with a microcontroller and relay system, the device is able to detect abnormal conditions early and take action before a fire can occur. This preventative approach not only increases safety but also makes the technology more accessible for everyday use in homes, offices, and construction environments.

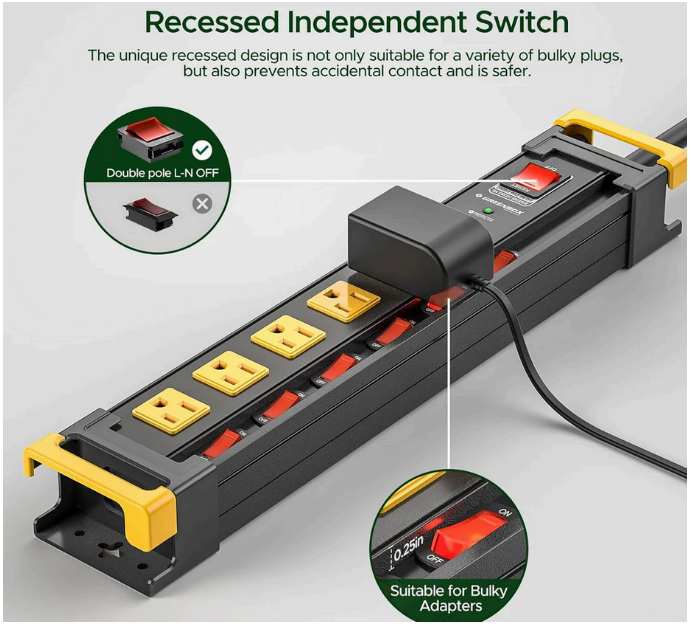
Overall, our project demonstrates how engineering innovation can be used to solve real-world problems by improving existing technology. With further development and implementation, this device has the potential to significantly reduce electrical fire risks and provide a safer environment for users, especially in areas with outdated wiring systems.

Graphics


Unique
Design
The convenient angular design supports
various bulky plugs at the same time.


What is a smart power strip
and how do they work?
Wirelessly connect
them to your phone
or smart hub.
Automate or
remotely power off
to save energy.
Can include USB
ports so you can
free up outlets.
Constellation.


MICROCHIP


Recessed Independent Switch
The unique recessed design is not only suitable for a variety of bulky plugs, but also prevents accidental contact and is safer.
Double pole L-N OFF
0.25in
Suitable for Bulky Adapters


SPACIOUS DESIGN FOR LARGE PLUGS


NTONPOWER
9 in1
Flat Plug Power Strip
3-Sided Design


Charging Station for Multiple Devices
Neat desktop & space saver
Others
VS
Our
1.78 Inch
Widely Spaced


USB Power Strip&Flat Extension Cord
USB A | 5V/2.4A Max
USB C | 5V/3A Max
USB A Ports
USB C Ports