# FireEscape

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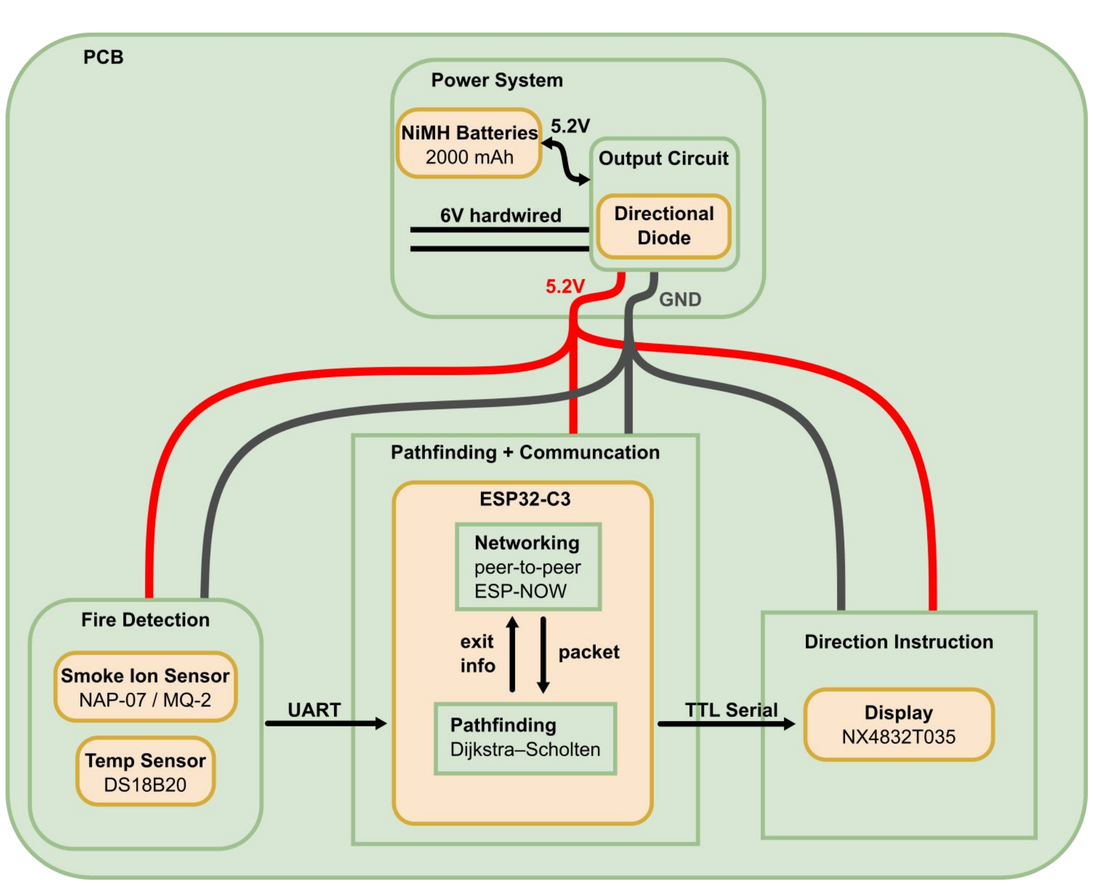
## Product Pitch

Our product aims to **guide occupants** to the **safest path out** of a burning building through a **distributed system** of **fire detecting nodes**. Currently, the existing solutions include evacuation maps in key areas based on strictly the closest exit. However, this does not take into consideration the **potential threats that those paths** could have. Our solution eliminates the risk of directing occupants towards fire hazards when trying to escape the building and prioritizes the safety of users.

The nodes are able to **dynamically plan the safest and most optimal path out** depending on **distance, temperature and smoke data**, reacting in **real-time** to **threats of fire** throughout a building. Our system is able to display directions in **< 600ms** taking into account packet reception, command computation, serial data transfer, and display time. Within our test scenarios, nodes have a **100% detection rate** and the **planned paths are optimal and correct** based on a given floor plan for a building.

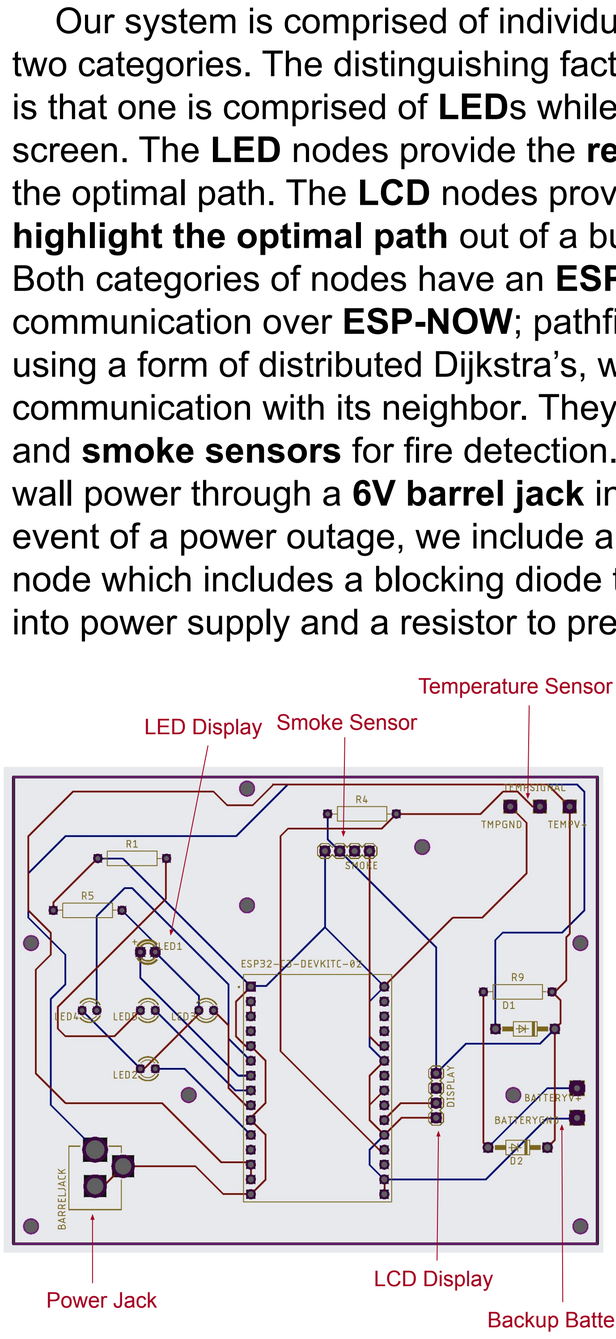
## System Architecture

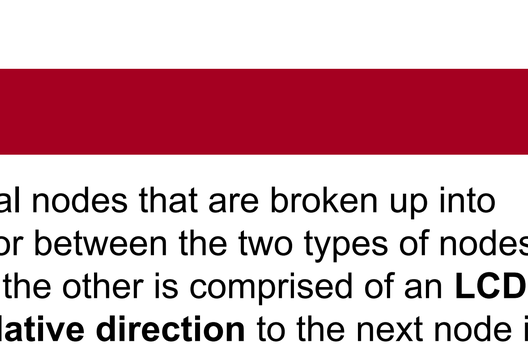
Interfacing between all our components is our **PCB**. Power enters through our power system, which is configured to **charge the batteries** and power the rest of the board, but **switch over to battery powe**r in the event of an **outage**. Our ESP then requests the **latest information from the sensors** to **construct a packet** to send to all other nodes; this packet also includes information about the **current shortest path** to an exit that can be reached from that node, which is received from the **peer-to-peer ESP-NOW network** between nodes. Based on this information, and the status of whether a fire is detected or not, a **shortest path is generated** that **avoids any detected fires**. Based on this path, users are **guided to the exit** through our **LEDs** and **LCD displays**.




## System Description

Our system is comprised of individual nodes that are broken up into two categories. The distinguishing factor between the two types of nodes is that one is comprised of **LED**s while the other is comprised of an **LCD** screen. The **LED** nodes provide the **relative direction** to the next node in the optimal path. The **LCD** nodes provide in-depth information and **highlight the optimal path** out of a building **based on the floor plan**. Both categories of nodes have an **ESP32** microcontroller which allow for communication over **ESP-NOW**; pathfinding out of the building is done using a form of distributed Dijkstra's, where each node is only in communication with its neighbor. They also each include **temperature** and **smoke sensors** for fire detection. Currently, our nodes make use of wall power through a **6V barrel jack** input into our PCB. However, in the event of a power outage, we include a **backup battery** circuit for each node which includes a blocking diode to prevent the battery from leaking into power supply and a resistor to prevent overcharging.

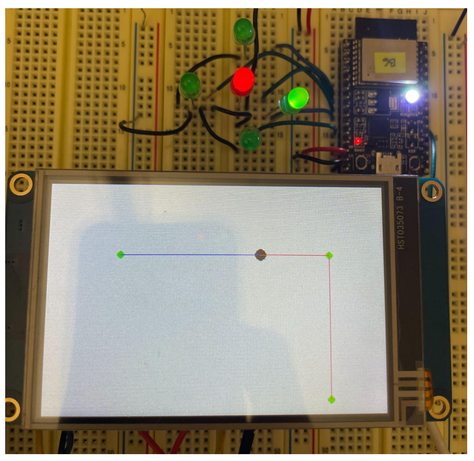


## System Evaluation

After we had our pathfinding, LEDs, LCD displays, and temperature sensors working, we wanted to ensure that we are able to integrate these subsystems on an example graph. This integration was successful, and the directions and escape routes were presented correctly.

**Examples of directions displayed on LEDs and LCD screen**



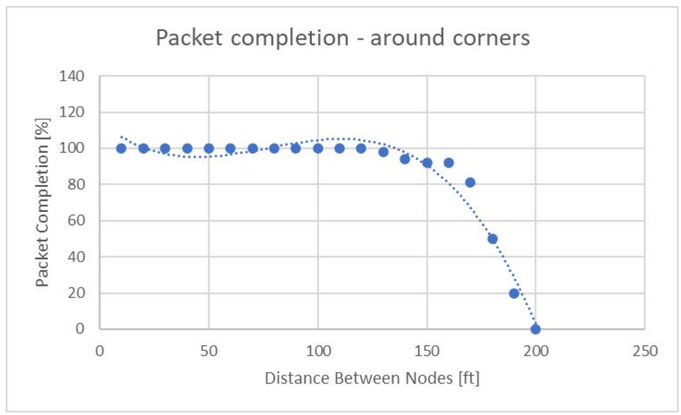
## Conclusions & Additional Information

Link to our website:

https://course.ece.cmu.edu/~ece500/projects/s23-teamb8/

We believe that our design provides a solution to a problem unsolved by current fire alarm systems. By informing occupants of real-time exit strategies, we are giving users the a better chance to avoid fires while they exit a burning building. We hope to be able to scale our project upwards to fit the fire code and evacuation standards of large scale buildings and implement our system to prioritize the safety of the public.

As we hope our system will be able to scale up to larger buildings, we performed testing to get an approximation of how far the nodes can be spaced apart in an indoor setting, while still being able to communicate.

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