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Purdue University

BS Electrical Engineering (Dec. ’17)

MS Electrical Engineering (Starting Jan. ’18)

# *PORTFOLIO*

## *(In Progress) Senior Design Project: FireNode*

### *Description*

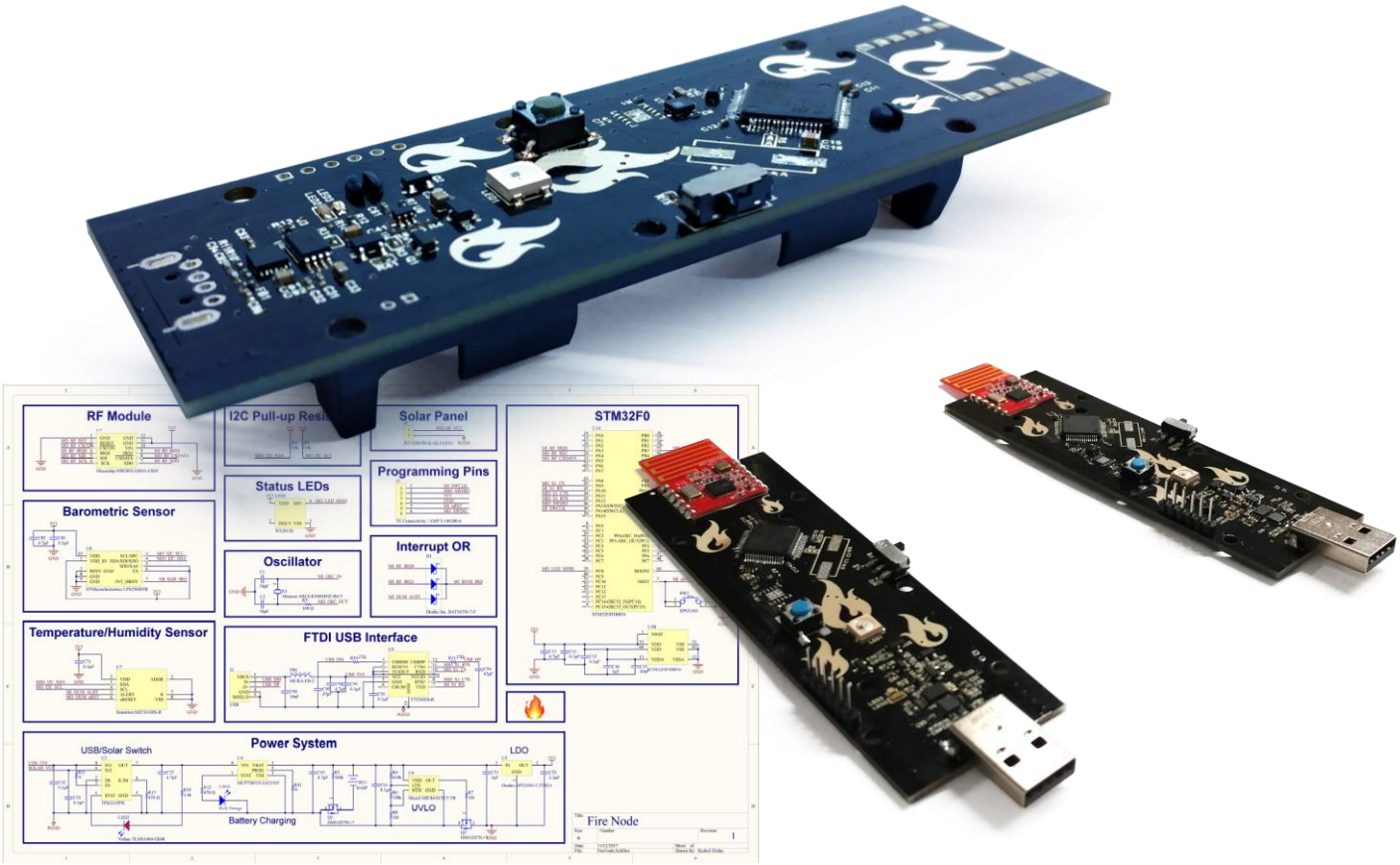
FireNode is a system of devices used to detect forest fires and fire-dangers as they form using a mesh-network of small, cheap devices. The network works on an ad-hoc basis, implementing software-defined routing but also supporting flood-fill algorithms in case of disconnected or destroyed devices. The devices are designed to be cheap and replaceable, with an indefinite operation lifetime thanks to low power consumption and a built-in solar panel. Each node incorporates temperature, humidity, and pressure sensors, and includes a USB "tap" which lets any Android device connect and read sensor logs. A base-station can connect to the network and perform central processing to identify likely fire dangers.

### *Key Work*

- Efficient power supply with supply-switch from USB, Solar, or Li-Po Battery.
- Software-defined network architecture inspired by a simplified, low power implementation of IEEE 802.15.4
- Server-side sensor fusion and prediction of danger modeled as a classification problem

### *Technologies Used*

- 900 MHz ISM transceivers
- STM32 (C/C++ & Assembly programs)
- Altium CircuitMaker (PCB Layout and Circuit Design)
- SMT soldering
- Android app (Java)
- Microsoft SQL Server, Microsoft Azure, server-side Python, client-side HTML/CSS/JS



## *Electric Imp internship: impAccelerator Sensor Node*

*Description*

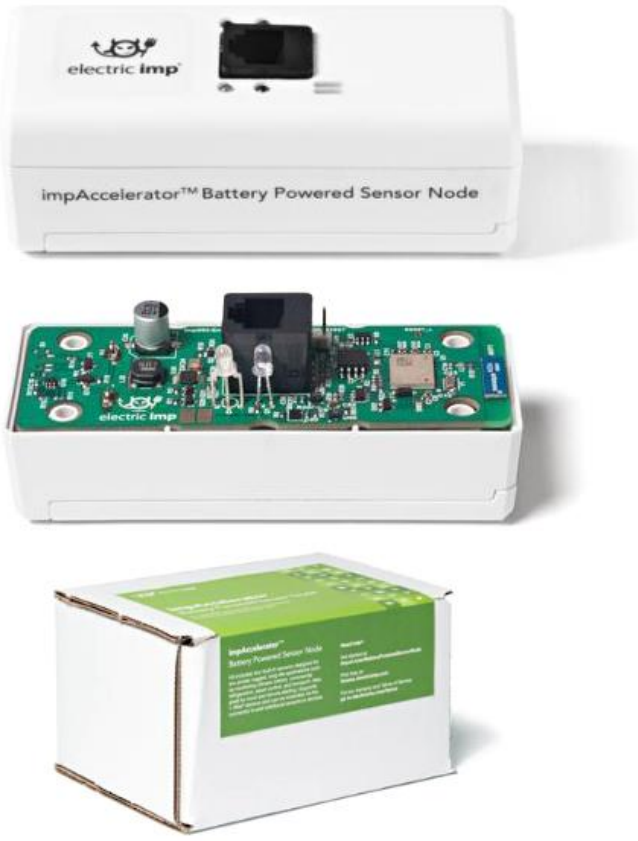
The Electric Imp Environmental Sensor Node is a small, battery-powered node designed for environmental sensing in industrial environments. The device includes temperature, air pressure, humidity, and motion sensors, and is extensible via 1-Wire, UART, or $I^2C$ protocols, as well as analog pads. I designed the first iterations of this device at my internship over the summer of 2016, and it is now sold (with very minor changes to my original work) on the Electric Imp site and used as a reference design for customer inquiries. The board is a 4-layer board with 0402 scale components. I oversaw the original schematic and layout and got to manufacture and boot-up the initial prototypes. I also picked the enclosure and made modifications to add branding elements.

*Key Work*

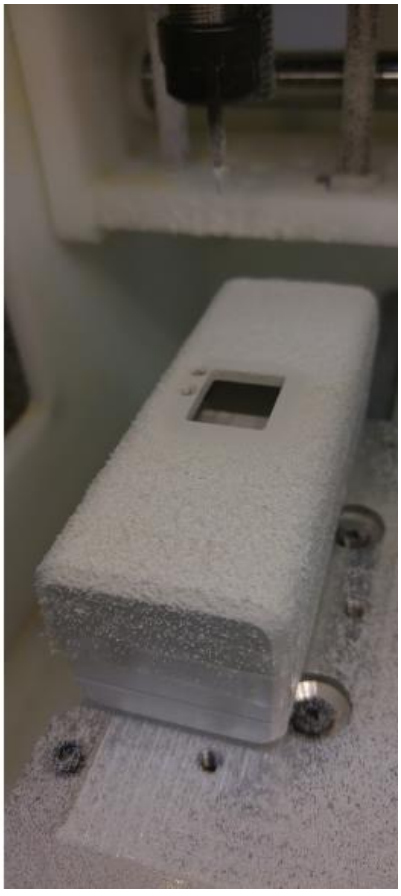
- New product introduction combining features from old designs with novel capabilities of more powerful chip
- Buck regulator implementation and power circuit efficiency gains
- RF-behavior characterization of transmit power and wakeup-receive-transmit cycle power consumption
- Wi-Fi antenna selection choice accounting for efficiency, cost, size, and availability
- Enclosure selection and CAD modifications

*Technologies Used*

- Electric Imp imp003 (Cortex M3 IC by Murata incorporating Broadcom networking)
- Altium Designer
- Test bench instrumentation
- SolidWorks







## *Electric Imp internship: impExplorer Developer Kit*

*Description*

The impExplorer is a quick prototyping board which quickly shows the capabilities of the Electric Imp platform. It was designed to meet the need of quickly on-boarding new developers to the platform. The intern team ran developer surveys and compiled a report showing the customer need, desired features, intended effects, and a go-to-market strategy. We compared various competitors unboxing experiences and suggested a strategy combining the strengths of each with a focus on Electric Imp's customer culture and brand image. The product is now being sold as Electric Imp's introduction kit. It is also being used for pitches to potential corporate customers.

*Key Work*

- Customer surveys and existing developer program evaluation
- Unboxing experience design
- Go-to-market strategy creation

*Technologies Used*

- Electric Imp imp001
- Altium Designer
- Excel (for report compilation)
- Photoshop (Unboxing visual design prototyping)

## *Purdue IEEE Underwater Remotely Operated Vehicle: Power Distribution Board*

*Description*

The underwater robotics team at Purdue IEEE builds a new ROV every year. In the 2016-2017 academic year, I worked with a team of 4 electrical engineering students to design, manufacture, and test the power system for the robot. The power box draws 1.44kW, converts, and distributes the power to the rest of the robot. I designed a new fully parallel architecture, enabling any combination of motor driver ESC's to fire at the same time without worry of overdrawing any sub-circuit. The board can provide up to 50A safely to the rest of the system. My team worked with a mechanical design team to ensure proper heatsinking and water isolation.

*Key Work*

- Parallel power architecture design able to supply up to 1.44kW at 50A and 28V
- Electronic Speed Controller integration and control
- Analog circuitry for initial ramp-up at power-up

*Technologies Used*

- Murata DC-DC converter units
- EAGLE (Circuit/PCB Design)
- Test bench


## *Miscellaneous Projects*

*Human Journey to Mars: Research, VR application, NASA Presentation*

My Human Journey to Mars class researched new architectures for sustainable human habitation. Additionally, I worked on the VR experience to present the work done by the class in a novel setting. I presented the VR experience at the Humans-to-Mars 2017 Conference and at NASA Goddard Space Flight Center.

For some fun extra flair, I designed a mission patch inspired by historical NASA missions for every student in the class.

Mission Patch


Buzz Aldrin playing the VR demo

*TEDx Pittsburgh: Stage prop lights*

In collaboration with a local artist, I helped create a stage prop for TEDx at the University of Pittsburgh. The prop included light strips designed to look (and act) like Pittsburgh city streets and traffic.