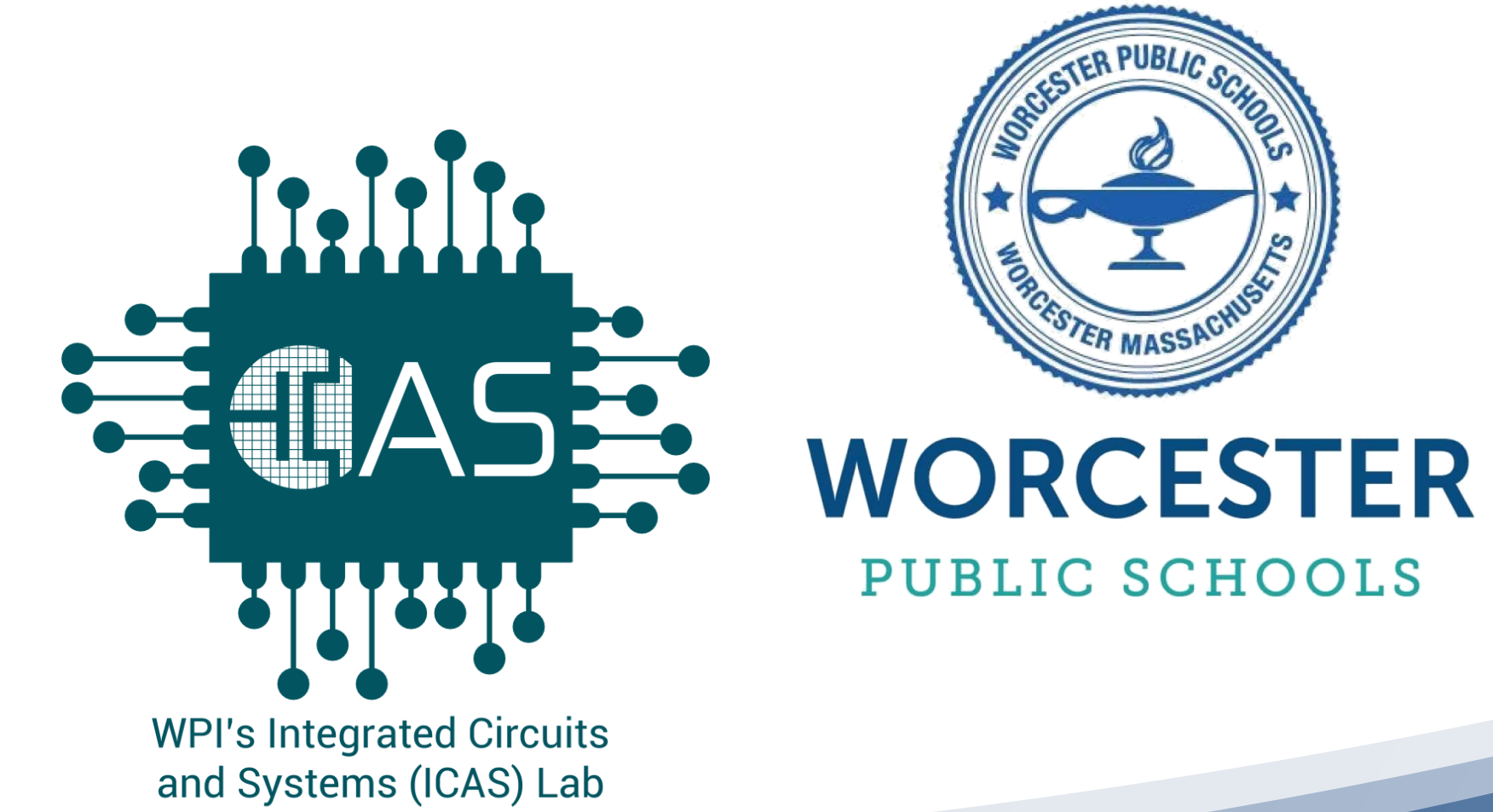


# Power Examination and Optimization of a Transcutaneous Oxygen Monitor



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## Why Blood Oxygen Levels Matter

In 2017, almost 545 million people, which is approximately 7.4% of the global population, were affected by chronic respiratory conditions [1].



To maintain patients' health, healthcare practitioners must closely monitor critical respiratory health metrics, such as Arterial Partial Pressure of Oxygen (PaO<sub>2</sub>).



## UN Sustainable Development Goal

### Transcutaneous Blood-Oxygen Monitoring

Clinical & Home Settings

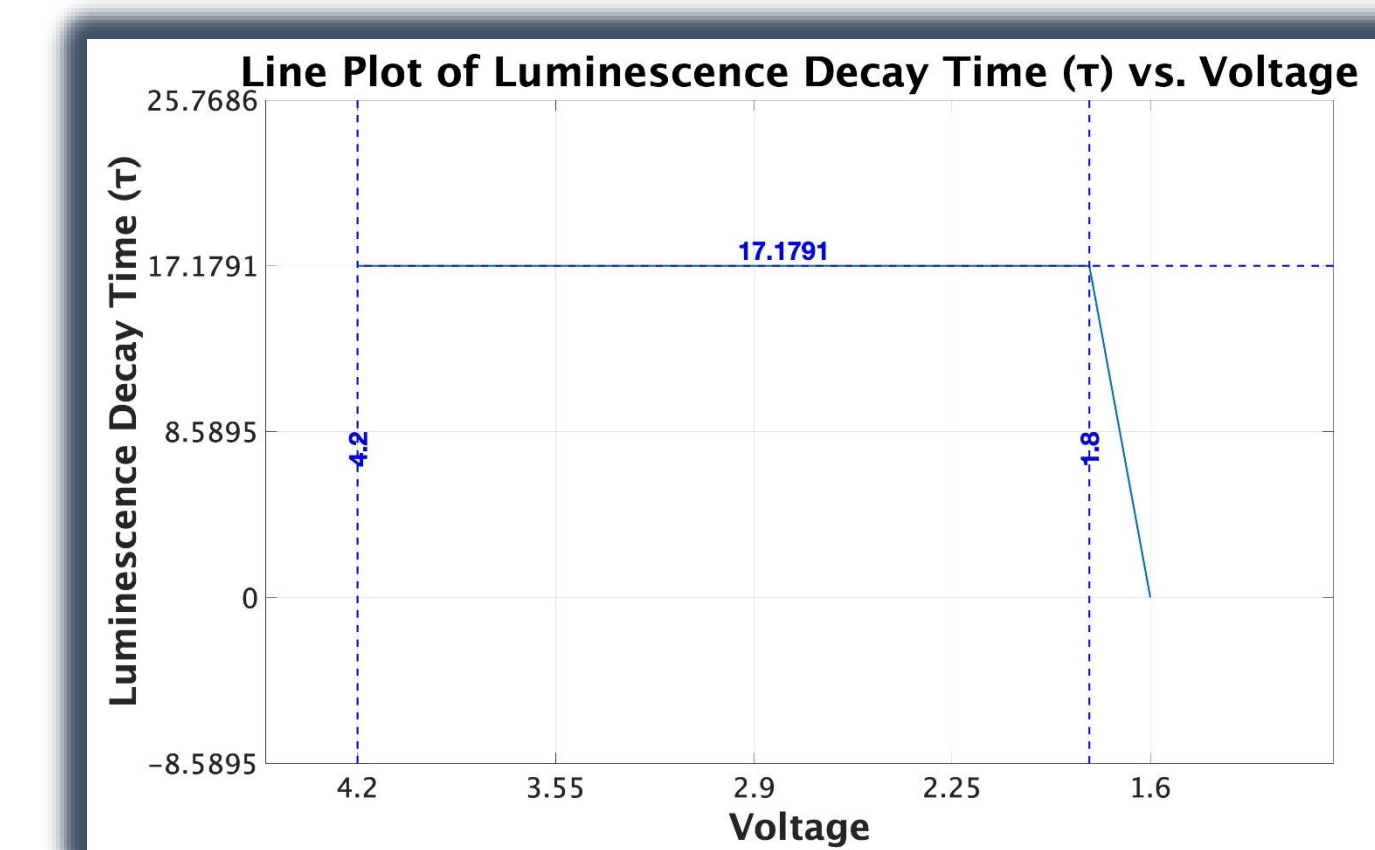
Noninvasive & Comfortable for Patients

Higher Quality Treatments for Patients with Respiratory Illness

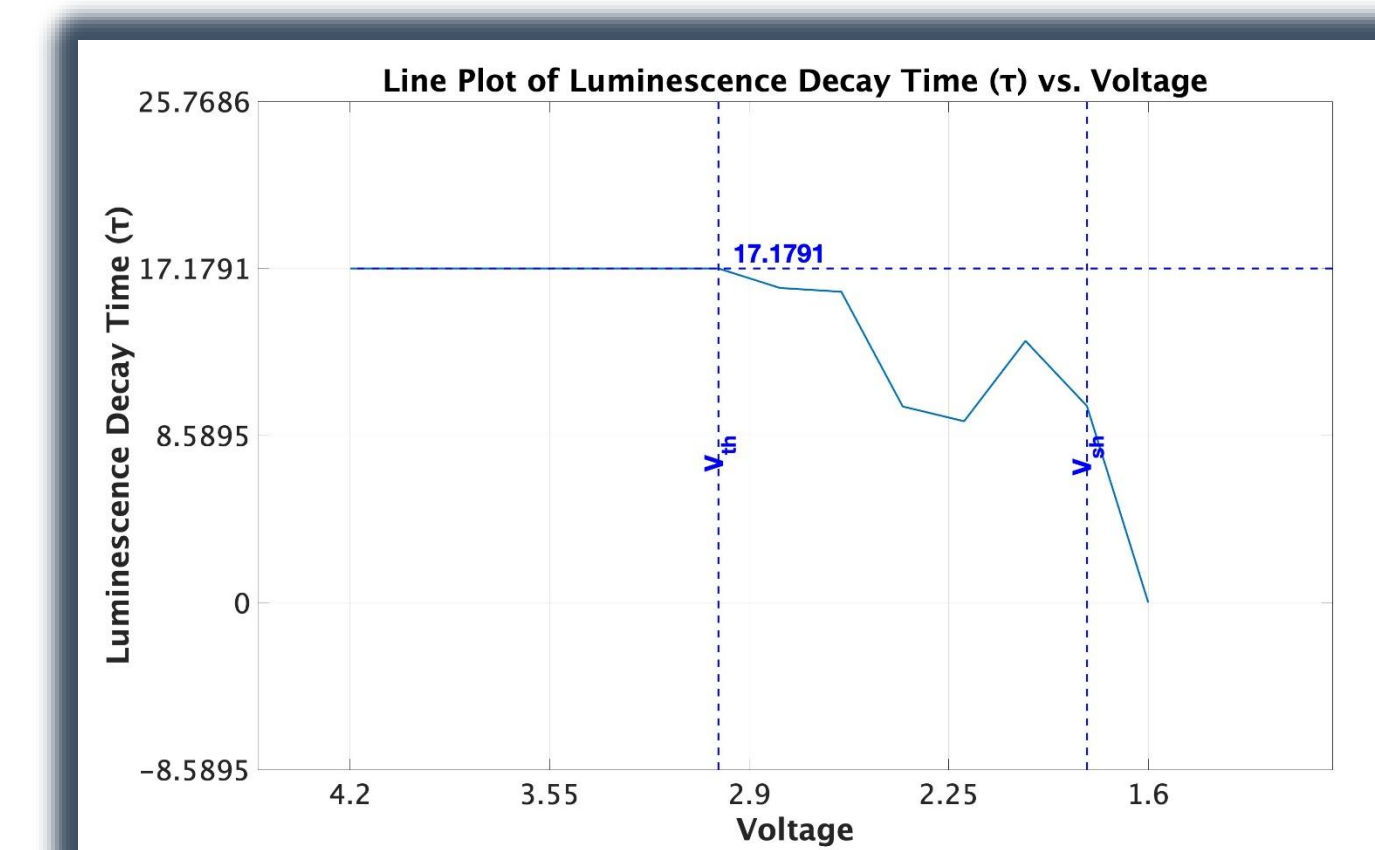
Reduces Equipment and Personnel Needed, Expanding Healthcare Capacity



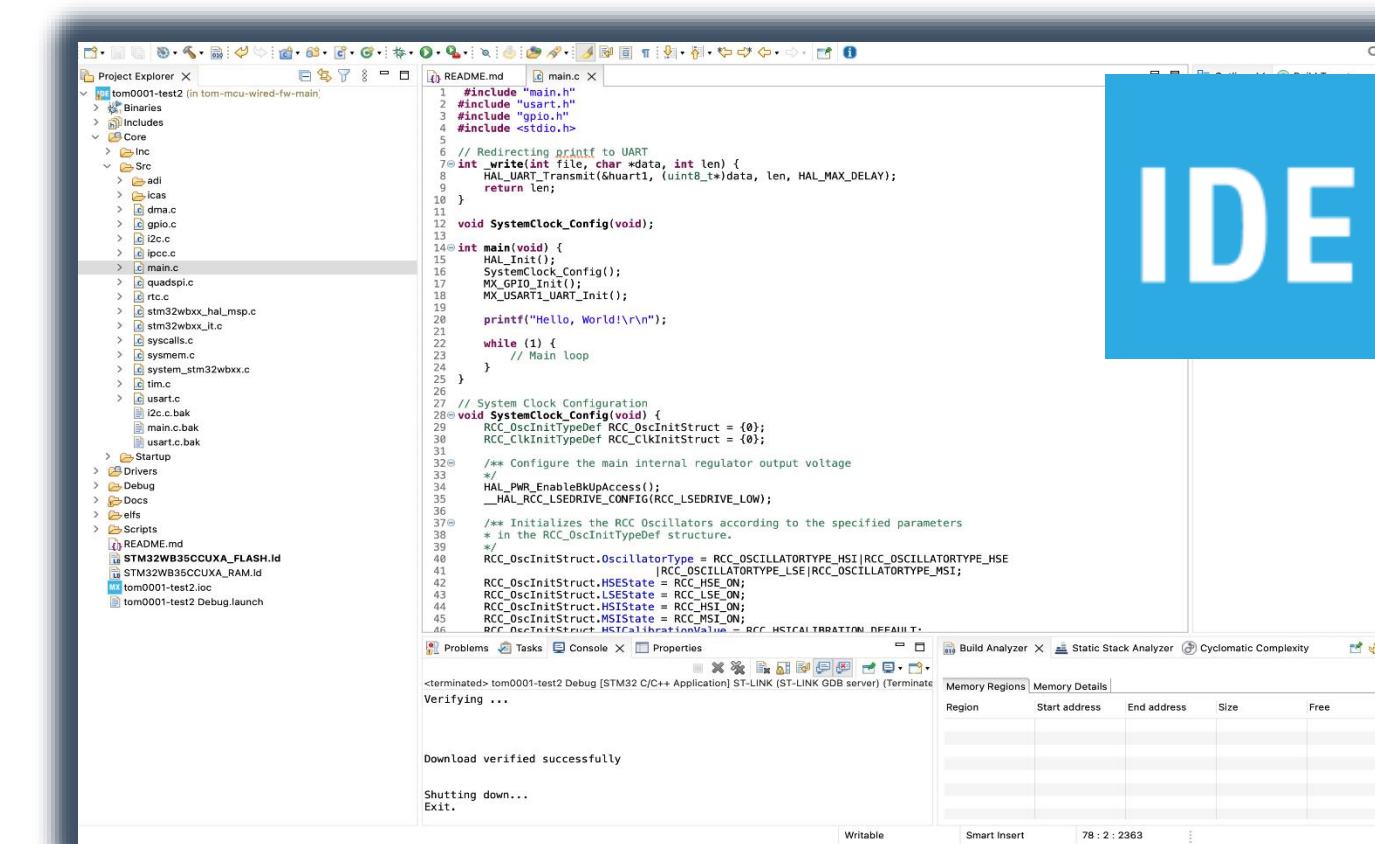
## Power Examination & Optimization



**Task #1**  
Determine the **operating voltage** range with DC Supply



During  $V_{bat}$  monitoring  $\tau$  values are expected to **deviate** from the correct value.



**Task #2**  
Develop code to monitor battery voltage

### Variables Needed

$V_{bat}$  = Optimal Operating Voltage = **4.2 V**

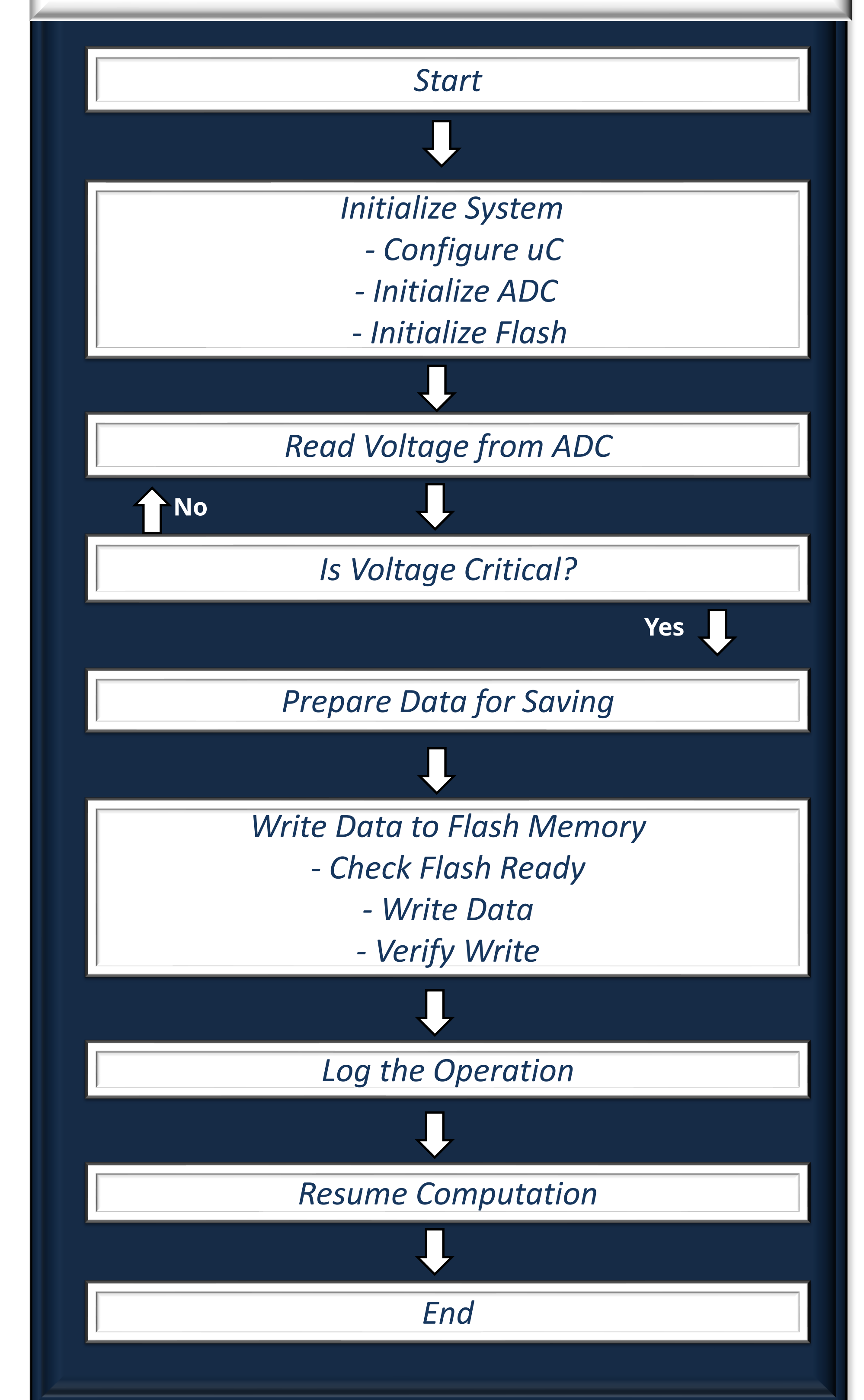
$V_{th}$  = Threshold Voltage = **3.0 V**

$V_{sh}$  = Shutdown Voltage = **1.8 V**

Conducting voltage testing gives us these variables

**Task #3**  
When insufficient power is available to the device, it shuts down and loses data. This becomes problematic when trying to optimize the device's power management. Our goal is to develop code that saves important data at critical voltages.

### Algorithm Flow Chart



## Innovative Oxygen Monitor

The Integrated Circuits Systems lab at WPI is developing a **wearable device which uses an unintrusive optical sensing technique** to measure the partial pressure of oxygen diffusing through the skin (PtcO<sub>2</sub>) which is directly related to PaO<sub>2</sub>.



*The goal of this project is to contribute to the development of a novel, wearable transcutaneous oxygen sensor by studying its voltage consumption and optimizing it's programming to ensure reliability and effectiveness.*

## Classroom Connection

As part of the Research Experience for Teachers Program, this research experience will impact students at Leominster High School. Researchers have created a lesson plan for High School Physics students relating to this project.

### Lessons Will Be...

- Dynamic
- Engaging
- Project-Based

### Topics Include...

- Wave Interactions
- Medical Devices

## Acknowledgements

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## References

[1] - GBD Chronic Respiratory Disease Collaborators. Prevalence and attributable health burden of chronic respiratory diseases, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet Respir Med.* 2020 Jun;8(6):585-596. doi: 10.1016/S2213-2600(20)30105-3. PMID: 32526187; PMCID: PMC7284317.

[2] - Vakhter, Vladimir, et al. "A prototype wearable device for noninvasive monitoring of transcutaneous oxygen." *IEEE Transactions on Biomedical Circuits and Systems* vol. 17, no. 2, pp 323-335, 2023