State Of Charge (SOC) Estimation Using Machine Learning

Group 18 Capstone Presentation

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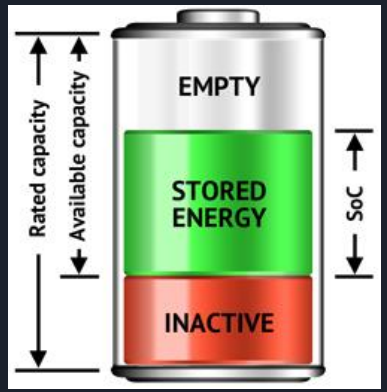
Agenda

- What is State of Charge (SOC) Estimation
- Current industry applications
- Use of Machine Learning
- Components
- Product Testing Approach
- Results
- Lessons Learned
- Potential Improvements

What is State of Charge (SOC) Estimation

- State of Charge is the measurement of how much energy is left in a battery
- SOC is an important parameter to monitor the health of a battery
- Fuel Gauge or gas Gauge analogy

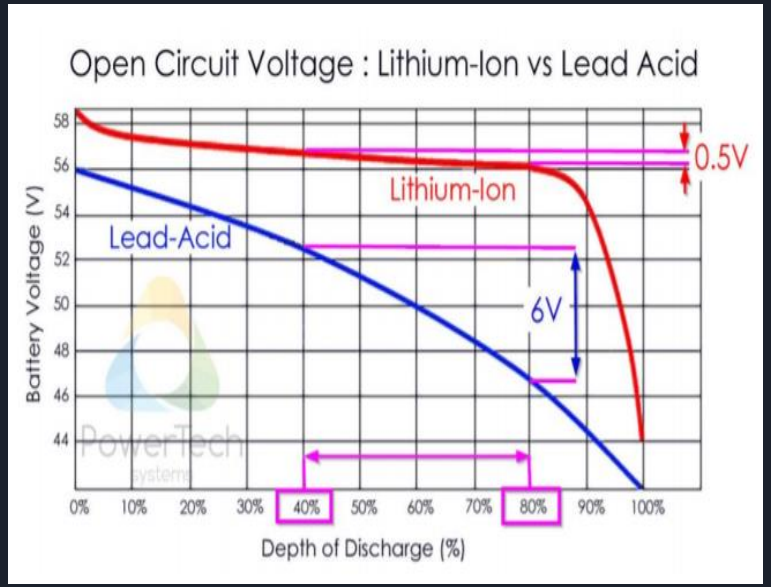


Current industry applications

- Two current methods widely used for SOC estimation
  - Open Circuit Voltage (OCV)
  - Coulomb Counting
- Each of these methods have their own drawbacks

Open Circuit Voltage (OCV) Method

- Calculating SOC using Open Circuit Voltage
- The OCV method is fairly accurate when it is applied to lead acid batteries
- However, it cannot be applied to lithium batteries due to its non-linearity



Coulomb Counting Method

- Coulomb counting is also a commonly used method for estimating SOC
- Current measurement based estimation method for SOC
- The current measurement is carried out by a precise measurement device

Disadvantages Of Coulomb Counting Method

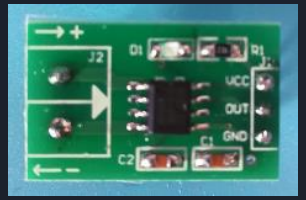
- Hard to measure
- Accumulation of bias
- Inaccuracy Under high or low temperature
- In order to measure, the battery needs to be fully charged

Use of Machine Learning

By using a machine learning, we can ignore the disadvantages that coulomb counting has

- We are using standard measurements instead of constant measuring
- By using machine learning we can train data without knowing the information of internal structure of Battery
- By using machine learning, we can accurately predict the State of Charge keeping in mind the degradation of a lithium ion battery

Main Physical Components

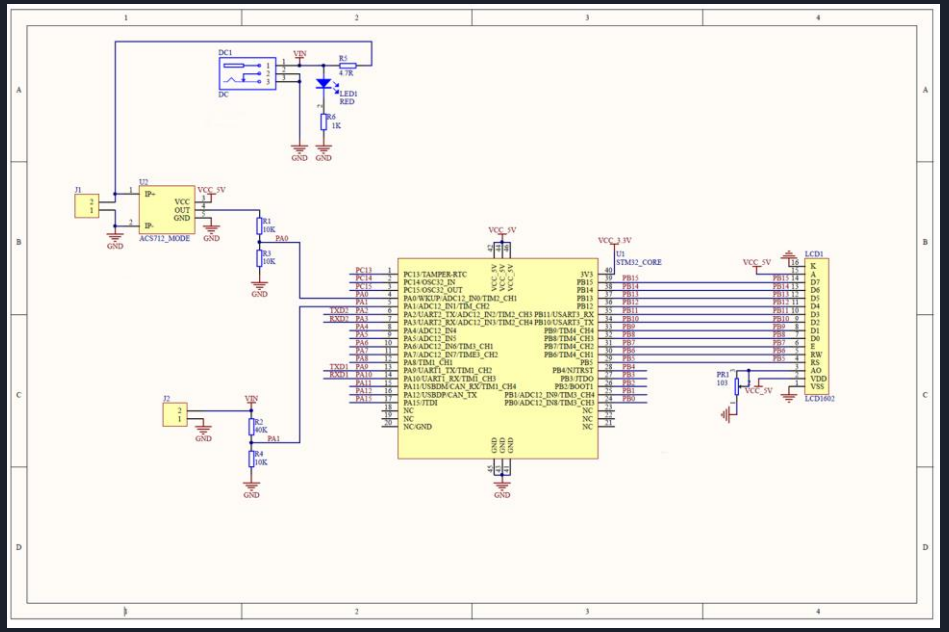


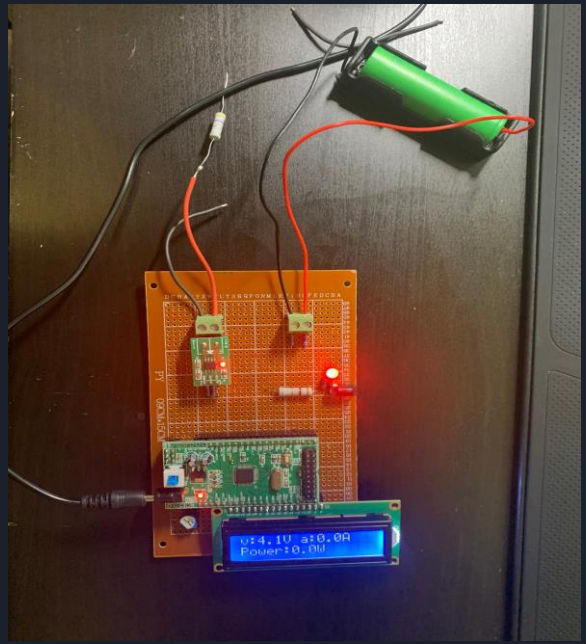
ACS 712

STM 32

LCD 1602

Results - Physical Demo



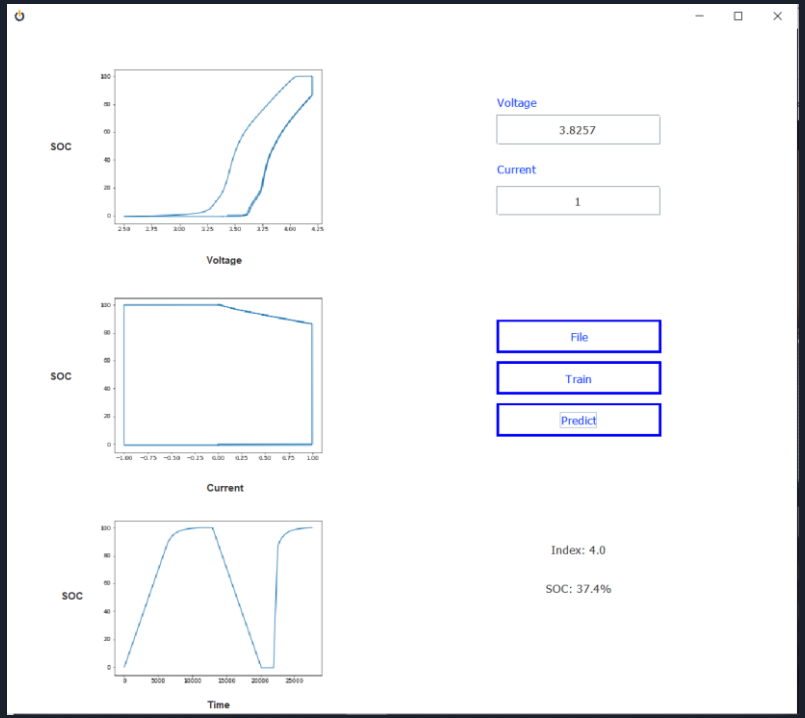


Results - Software

SOC VS Current

SOC VS Voltage

SOC VS Time



INPUT Voltage
Input Current

File Upload and
Train Module

Results

Analysis Process

- Module successfully incorporates all the parameters of the battery needed
- Module is able to estimate SOC (state of charge)
- Trained model provides appropriate results
- Model runs efficiently without any errors

Testing Process

- Unit Testing
- Integration Testing
- System Testing

Video

Lessons Learned

- Time management
- Importance of research / Knowledge of the topic
- Always have a backup plan

Potential Improvements

- Physical model should send result to GUI via bluetooth
- Improve aesthetics
- Add additional inputs, such as temperature

Thank You