Project Introduction

- Dynamic EV Charging System monitors building power usage to charge EVs using available power.
- Maximum power set by the building’s transformer capacity (500kVA or more).
- As building power usage rises, system automatically reduces output to stay within transformer limits.
- System requires continuous data monitoring and processing.

Objectives

- Research chargers, industry-standard protocols, and building data (Open Charge Point Protocol, Building Management System, etc.).
- Build/Assemble a functioning Level 2/AC charging station.
- Study and modify source code.
- Implement test case scenarios given by mentors into the charger.

Electric Capacity Management for Electric Fleets - Overall Sketch

Power Management Logic

- Testcase 1: If building power usage is unusually low or unstable, assume a building usage value that allows for a safe overhead while still charging the vehicles.
- Testcase 2: The EV charging session should start 1 hour earlier than when the charger indicates that the following day is DST, which always falls on the second Sunday of March.
- Testcase 3: Prioritizes high-power charging for low-battery cars and low-power charging for high-battery cars.

Testcase 2 identifies specific date DST Spring forward is to occur each year.

Hardware

- Assembled a Level 2 AC Charger Kit – Guaranteed safety and reliability.
- OpenEVSE Charger – For custom code integration via open-source software.
- Specifications – Charger operates on 240V and can output a max of 48A.
- USB SerialComm (red) – used for exchanging data between laptop and charger.
- USB Programmer (blue) – used for uploading compiled code to charger.
- Microcontroller – ATmega328p chip based on the AVR instruction set.

Future Work, References, and Acknowledgments

- Successfully assembled charger and powered it on.
- Testcase 1 detects power meter instability and assumes an appropriate power usage value.
- Testcase 2 identifies specific date DST Spring forward is to occur each year.
- Simulation created to demonstrate DST charge scenario logic of testcase 2.
- Testcase 3 prioritizes cars based on available power and the fleet’s current SoC.

Schmitz Hall Load Data (6/1/23 6PM - 6/4/23 6AM)

Software

- Simulate real-world scenarios in CMS (charging management software) using a year’s worth of power consumption data for different buildings, recorded at 15-minute intervals.
- Use Visual Studio Code IDE and Platform IO to update and deploy code that dynamically adjusts charging rates.
- Compile and run simulation tests using C++, displaying results in the VS Code terminal.

Future Work:
- Further improvements to test case solutions and implementing into source code.
- Further documentation of functionalities and features for the charger.

Results

- Given Building Scenarios:
  - Testcase 1: Building energy usage unusually low and stable. Could the meter be reporting inaccurately?
  - Testcase 2: With clocks advancing one hour at 2:00AM for Spring Daylight Savings, will there be sufficient time to charge the fleet to the required SoC by the deadline?
  - Testcase 3: If building energy usage unexpectedly increases, how will the system ensure the EV reaches its target SoC?

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