Portland State University
ECE 411 - Industry Design Processes **Fall 2023**
Product Design Specification **Date: October 16th, 2023**
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1. Executive Summary with Concept of Operations

The Parking Counter is an intelligent device that monitors available parking spaces in real-time. It features a high-definition LED display for clear visibility. This solution is applicable to various parking facilities, providing vital occupancy information to drivers and management.

- ***How it Works:*** The IR motion sensor detects vehicles, sending data to the microcontroller. The microcontroller updates the LED display instantly, providing a real-time count of available spaces.
- ***Who Uses it:*** Beneficial for multi-floor lots, commercial garages, and public parking areas. Provides drivers with live parking information and enables management to optimize resources.

2. Brief "Market" Analysis

Intended Customers: The customers of this product will be people who own parking lots. This will help the customer attract more customers ,because it provides convenience for their consumers. it will be considered a reliable place to park cars in, because it helps people not waste time trying to look for a parking lot that is completely full.

Competition and Unique Selling Proposition: The competition in this space primarily comes from an Austrian company providing ultrasonic parking sensors, which can be costly at $300-$500 per parking space. The proposed product stands out due to its significantly lower production and installation costs, making it a much more affordable option for parking lot owners.

Price Estimate and Rationale: Our demo will have 5 parking spaces ,1 microcontroller and LCD screen. All of these should not cost more than $40. We will assume an installation fee of $40 as well. We, as engineers, are happy to sell our product for $200.

3. Requirements

- ❖ Must accurately detect the presence or absence of vehicles in parking spaces.
- ❖ Must provide real-time updates of available slots.
- ❖ Motion sensors must reliably detect vehicles within specified range.
- ❖ Information displayed must be intuitive and user friendly.
- ❖ Should be customizable based on user preferences.
- ❖ Must not pose any safety risks to users or vehicles in the parking area.
- ❖ Must adhere to relevant local regulations and standards.
- ❖ Should be designed to be economically viable, with low production and maintenance cost.

- ❖ May be modular and customizable based on user preferences.

4. System Architecture

The product's architecture prioritizes user efficiency. It consists of key components working together for a seamless experience. The core is the ESP32 microcontroller in the processor block, managing data. Motion Sensors at each parking space connect to the processor for real-time vehicle data. A solar panel powers the system, recharging batteries. User outputs include an LCD screen for real-time updates and a webapp for remote monitoring and access to parking availability.

4.1. LO decomposition

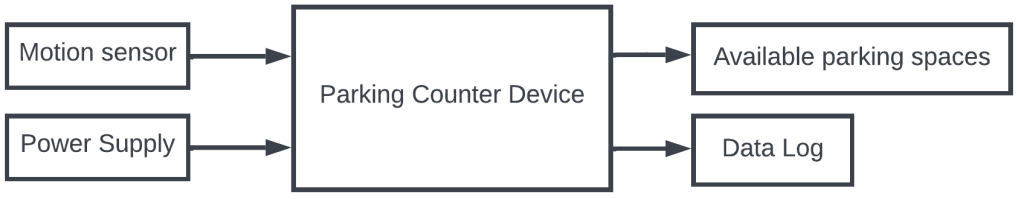

Figure 1: level 1 decomposition diagram

4.2. *L1 Composition*

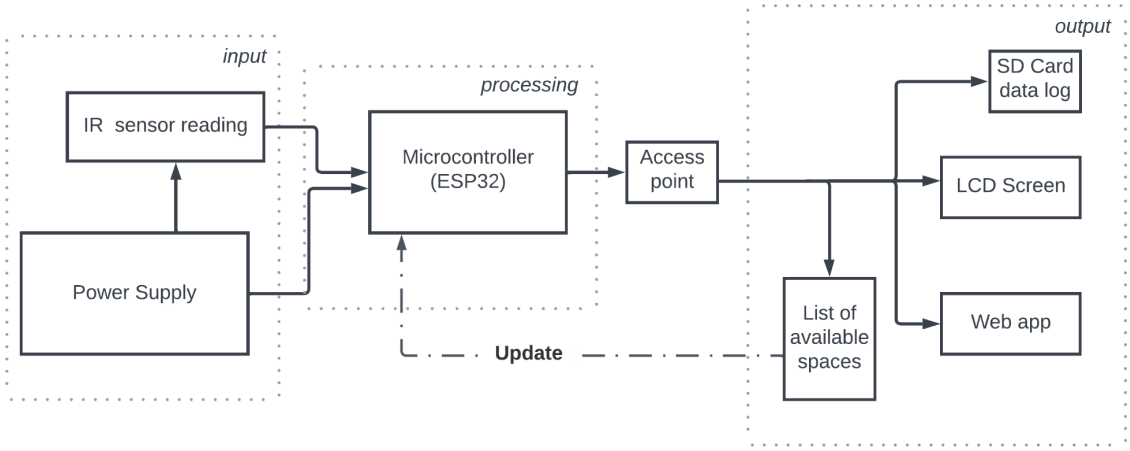

Figure 2: level 1 decomposition diagram

5. Design Specification

As shown in *Figure 3*, the parking counter device features IR sensors for precise vehicle detection and an ESP32 microcontroller as a central data processing unit. Furthermore, an LCD screen shows real-time parking availability, and a web app provides another preferal display window to adapt advanced future applications such as opencv mapping for complex parking structures. Arduino IDE processing language will be implemented to store necessary coding commands to the microcontroller chip.

- **Sensor:** Infrared (IR) sensors for precise vehicle detection
- **Processor:** ESP32 microcontroller as the central data processing unit
- **Actuators:** LCD screen with I2C for real-time parking availability display, and data logging to an SD card
- **Power Source:** Solar panel with a charger module
- **Mechanical Design:** Compact and weather-resistant enclosure for outdoor installation
- **Firmware:** Custom firmware developed using Arduino IDE processing language
- **Development Environment:** Arduino IDE for coding and testing
- **Additional Feature:** Integration with a web app for advanced applications like OpenCV mapping for complex parking structures

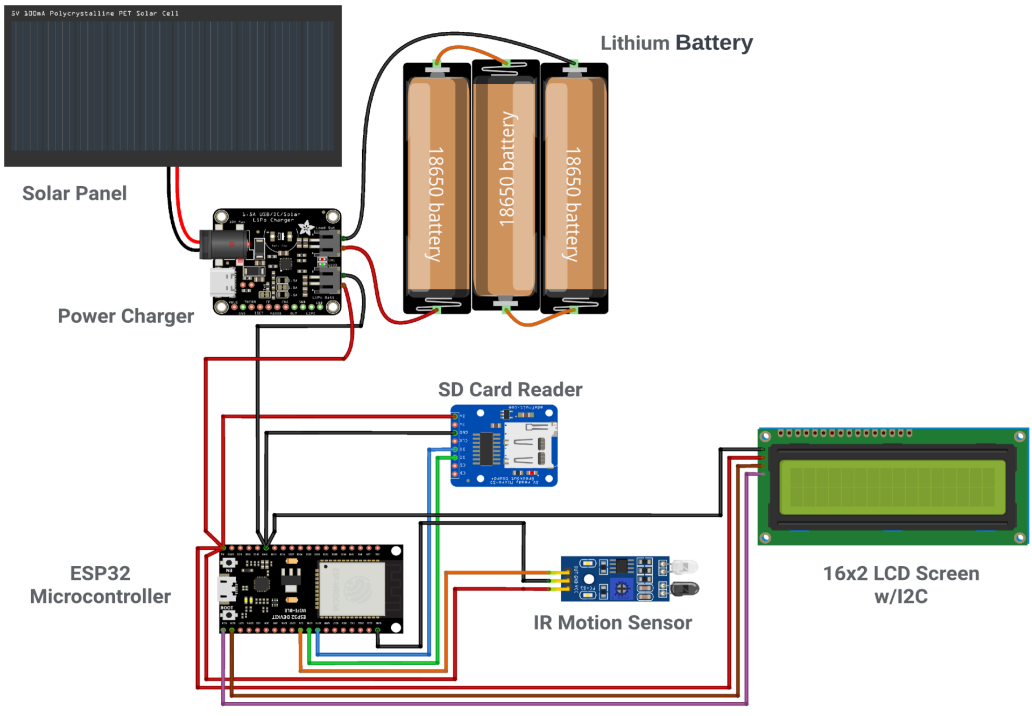

Figure 3: Technical design basic schematic

References

[1] "The cost to install ultrasonic parking space availability sensors can range from $300 to $500 per space, depending on local labor costs. | ITS Deployment Evaluation," *www.itskrs.its.dot.gov*. https://www.itskrs.its.dot.gov/node/209110#:~:text=Costs%20%2F- (accessed Oct. 17, 2023).