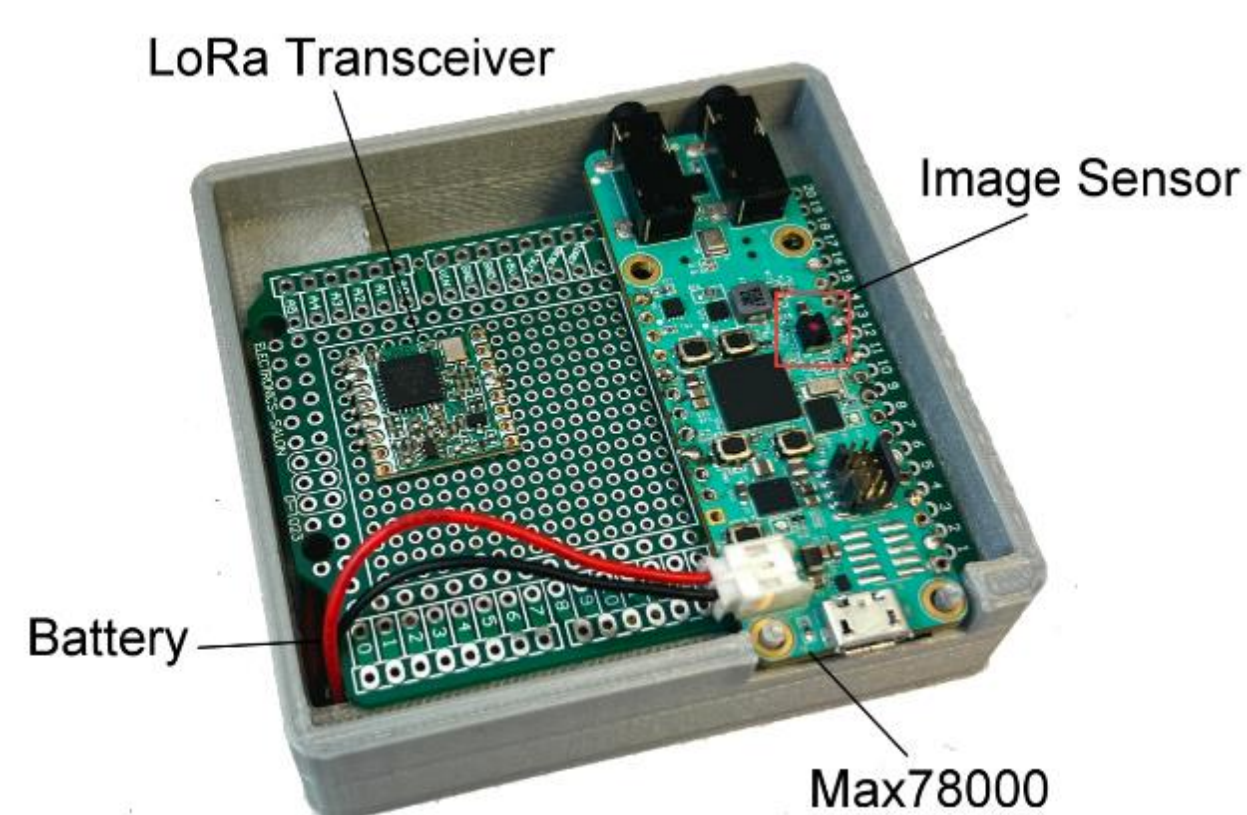


## Background

Finding parking spots is an issue that plagues every driver. SpotOn addresses this problem by proposing an intelligent parking sensor system powered by ML image recognition. Using an onboard CNN accelerator with a microcontroller, parking spot detection can be accomplished with low cost and low power consumption. Spot statuses are sent to a central database through LoRaWAN communication and rendered on a web application for users to easily access.

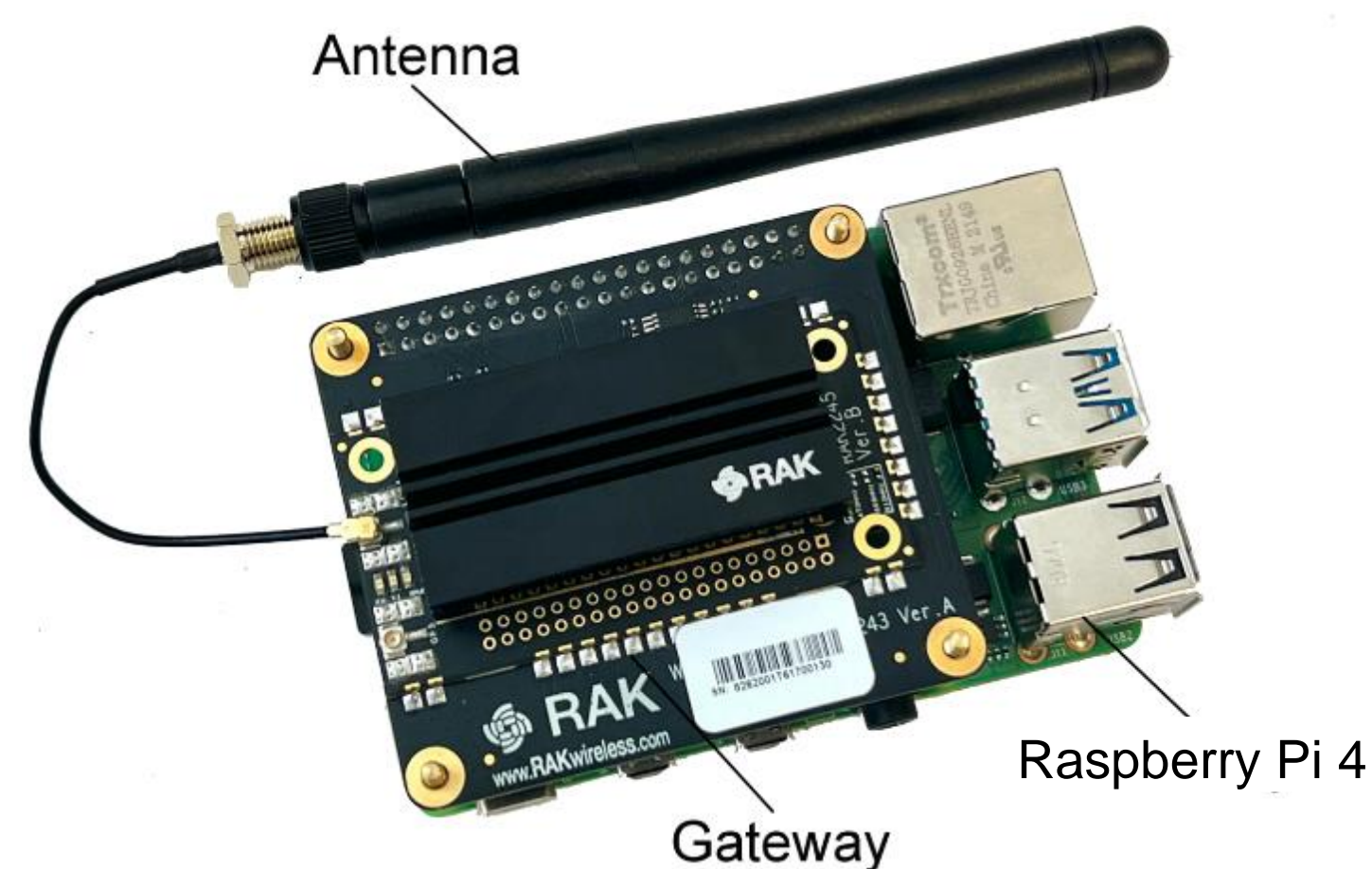
## Overview

### Detection Unit



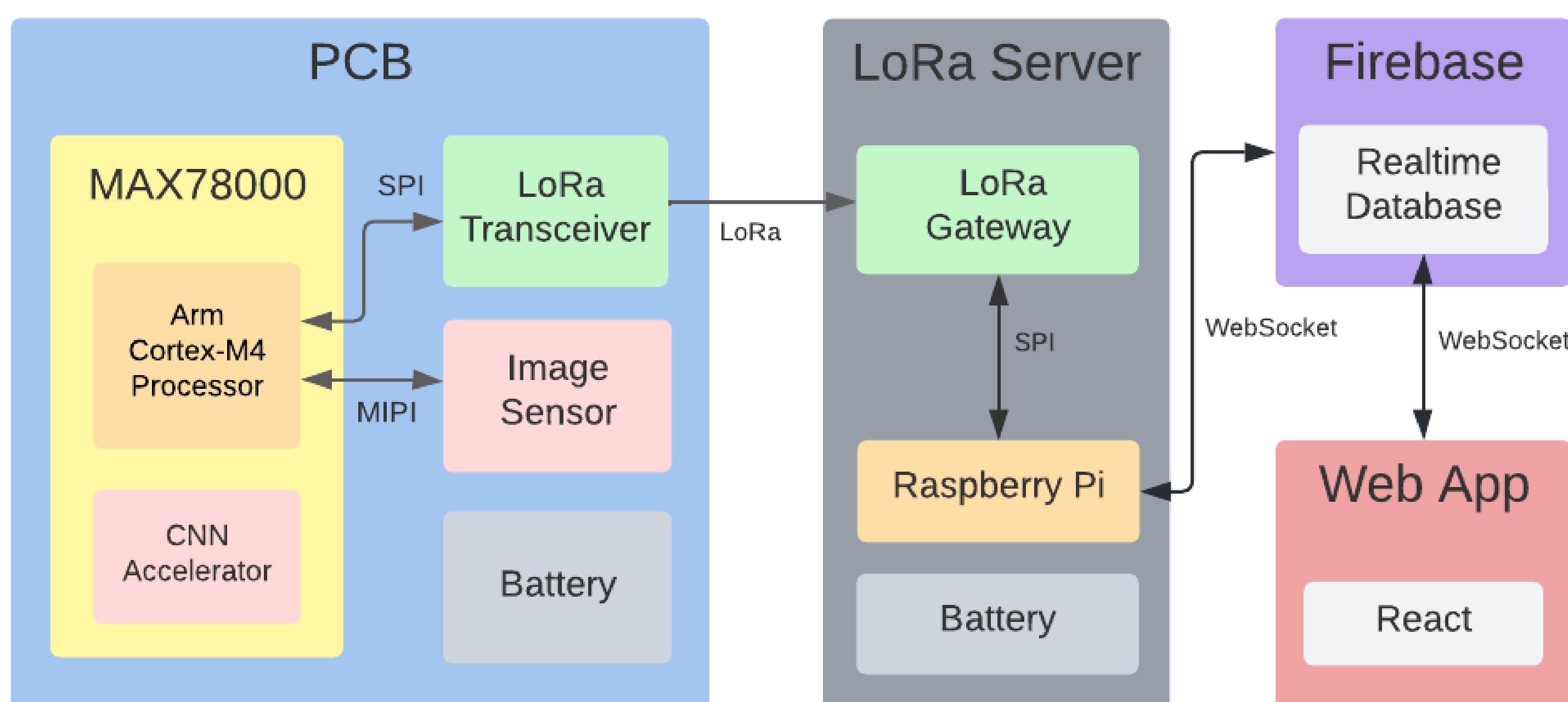
- Periodically capture images of parking spots
- Segment and feed captured images to a CNN model
- Send parking statuses to a central server through LoRaWAN

### Central Server

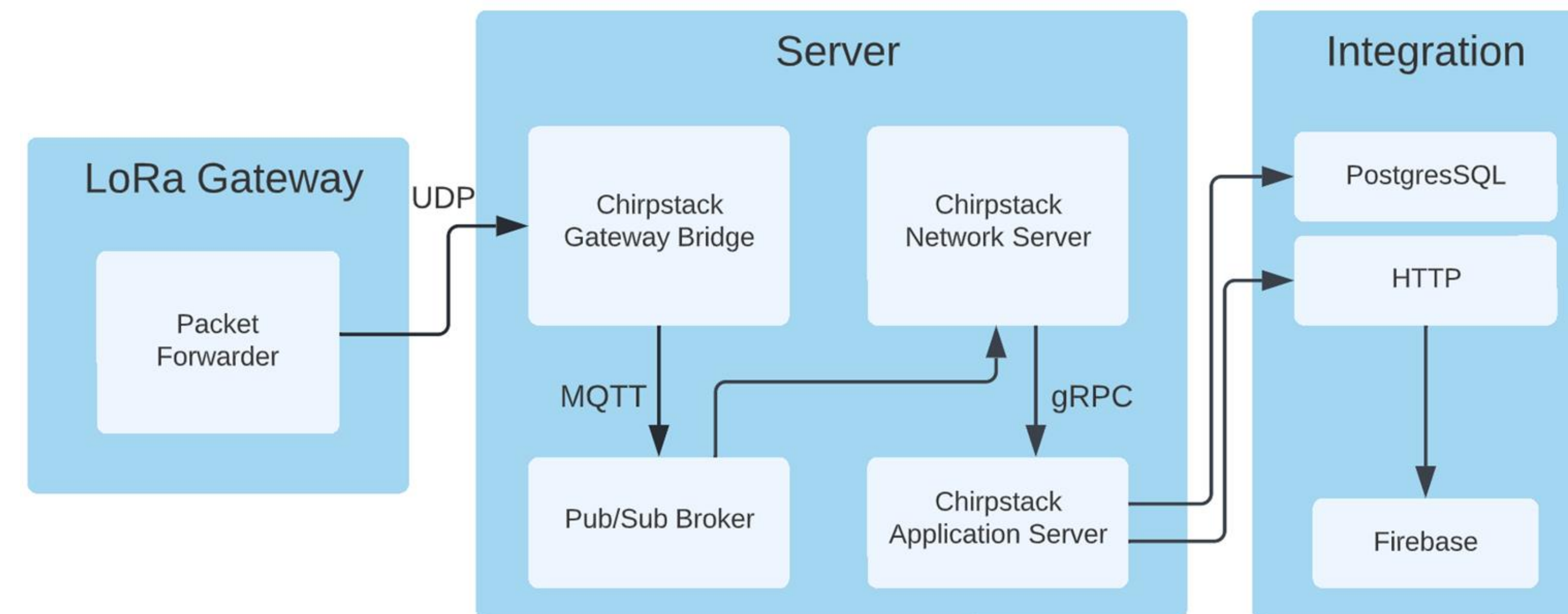


- Host the LoRaWAN network server
- Receive parking statuses from each unit and send to Firebase

## System Flow

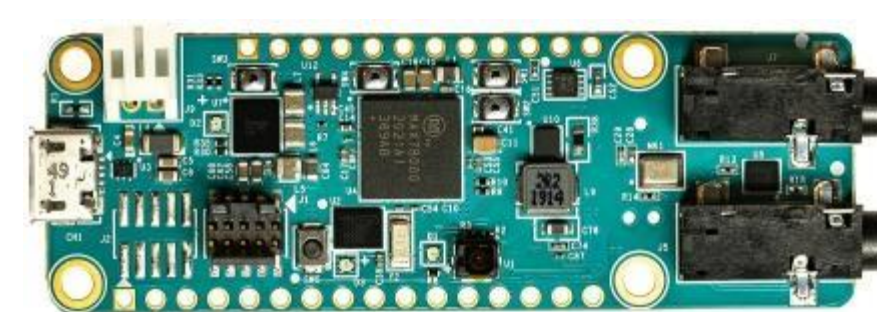


## LoRaWAN Network Server Stack



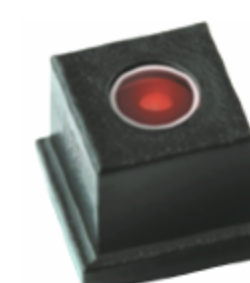
- Provides web-interface for device management and API for integration
- Network server is hosted on Raspberry Pi
  - receive and process LoRaWAN packets

## Key Components



### MAX78000

- Arm Cortex M4 @ 100MHz
- CNN Accelerator
- Supports low power modes



### Image Sensor

- 1/13-inch optical Size
- Automatic Exposure/Gain Control
- MIPI Interface



### LoRa Transceiver

- Low power radio communication
- SPI Interface



### Raspberry Pi 4

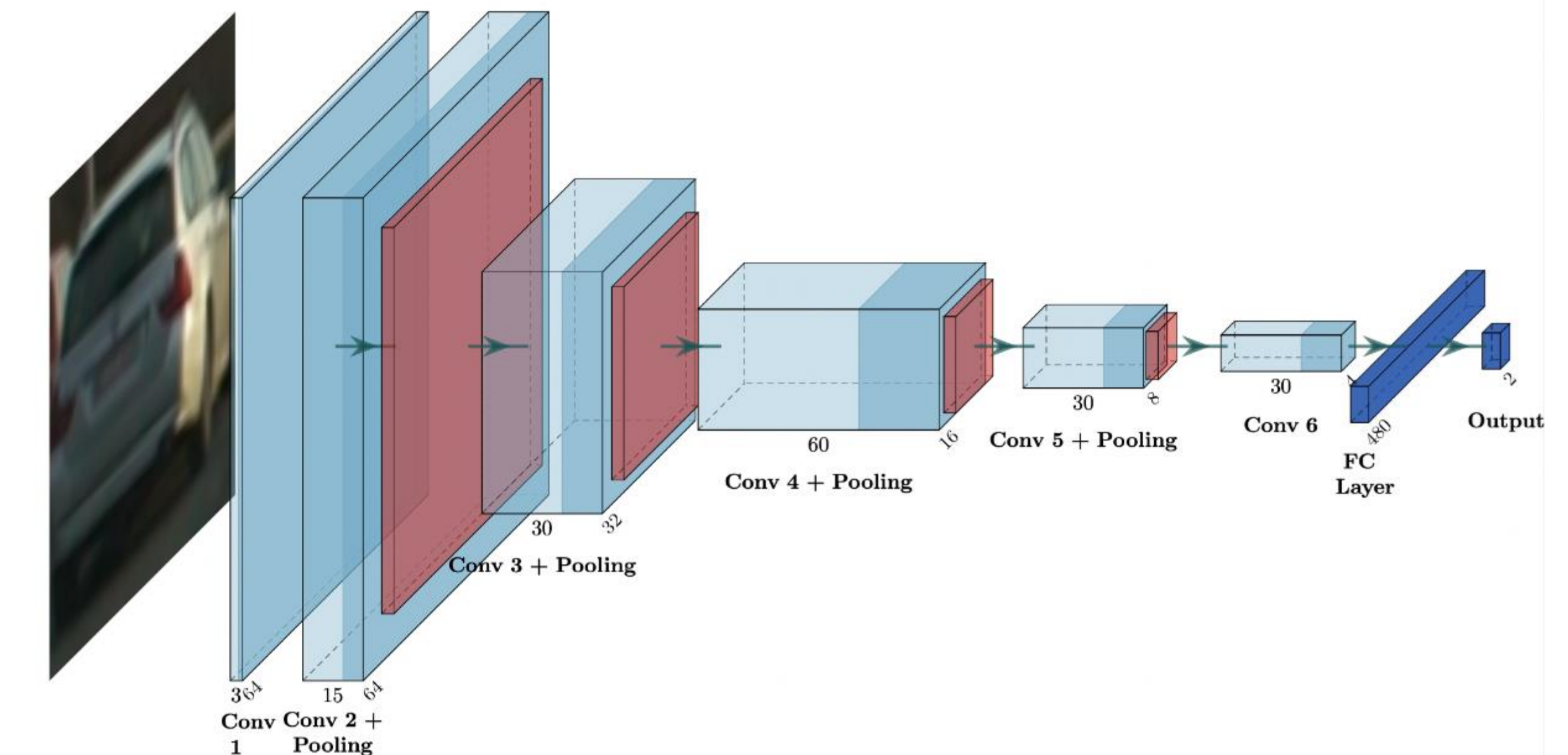
- ARM v8 @ 1.5GHz
- 8GB SDRAM



### LoRaWAN Gateway

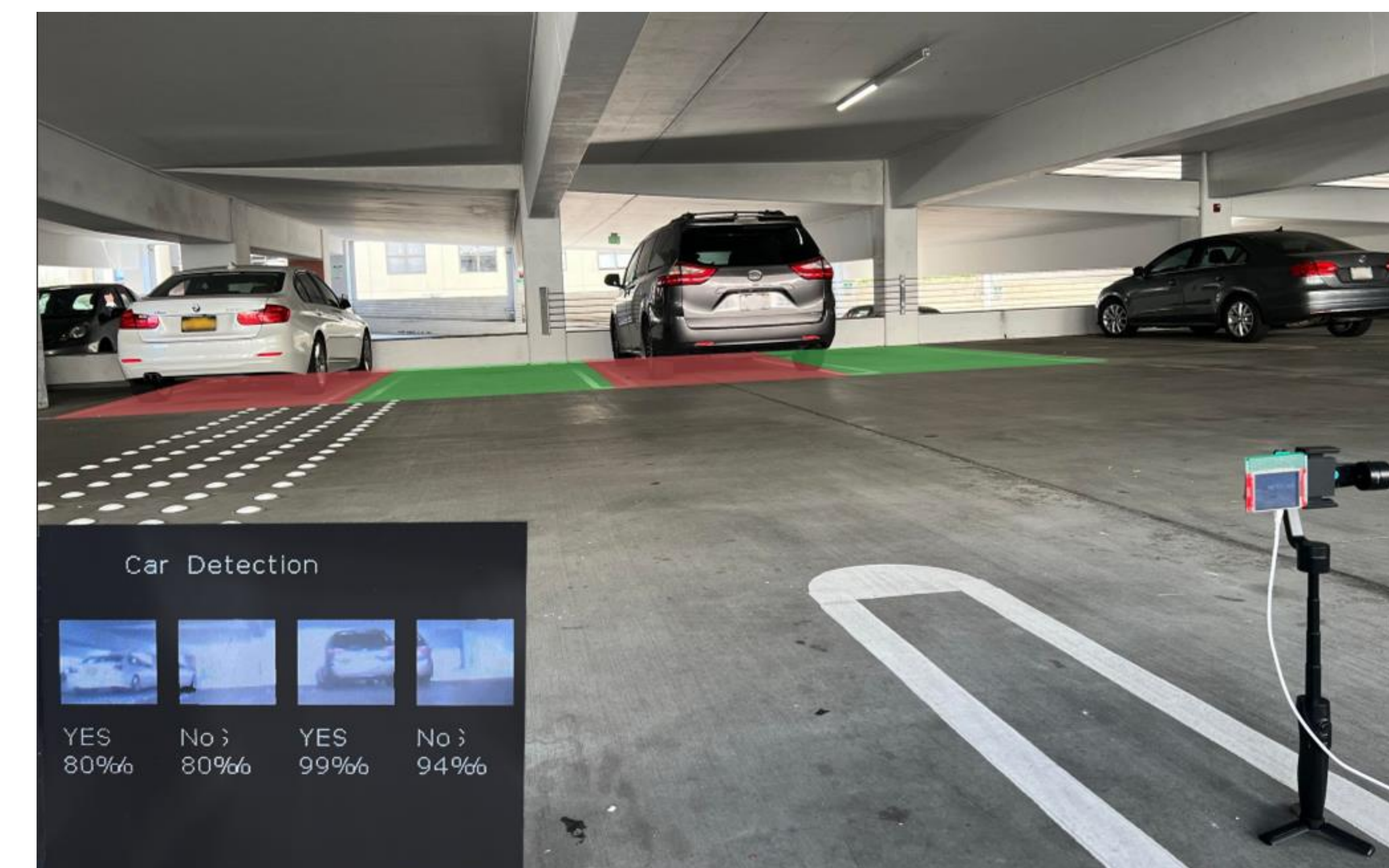
- Multi-Channel communication
- Full LoRaWAN stack support
- SPI interface

## CNN Architecture



- Classifies images based on whether they contain a car
- Trained with 13484 images for 55 epochs
- Achieved 97.9% accuracy on validation dataset and 88.1% accuracy during field testing

## Field Test



Web App QR Code



React Web App

