# Car Detecting System Implement with OpenCV on Embedded System

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## Abstract


- The purpose of this research is to create a online monitoring system for a parking lot, which can detect the spot is empty or not.
- Our project runs OpenCV on Linux, which can be built into our embedded system. The System will detect the shape of the car and use the algorithm to judge if there is a car in the parking spot. Each embedded system can keep an eye on one input video feed for several rows of parking spots.
- The goal of this project is to utilize OpenCV library[1] and modifying it to make our own image recognition system. We will also put it on a embedded system to show the possibility of enhancing the existing parking lot security system with digital analysis solution embedded in a board.


## Background

Some parking management systems are already built into the parking garage. Most of them use pressure sensors or radar to detect if there is a car above the ground. This can only be done by putting the sensor hardware close to the spot, which is expensive and need pre-planning. Our embedded system is easy to install and relatively cheaper to get, because its size is small and you do not need to rebuild the parking lot or get additional hardware since optical camera are equipped in most lots.

Figure 1: Current parking lot cameras

## Design Approach

This research was conducted in several phases:

1. **Fully Utilize OpenCV library and YAML data serialization standard to build our own algorithm to detect vehicles (Software):**
   - Record coordinates on video source
   - Set recognition area.
   - Let the board run our algorithm
2. **Correctly implement the board (Hardware):**
   - Run the image on the PYNQ board
   - Implement the USB webcam and HDMI output
   - Import OpenCV package

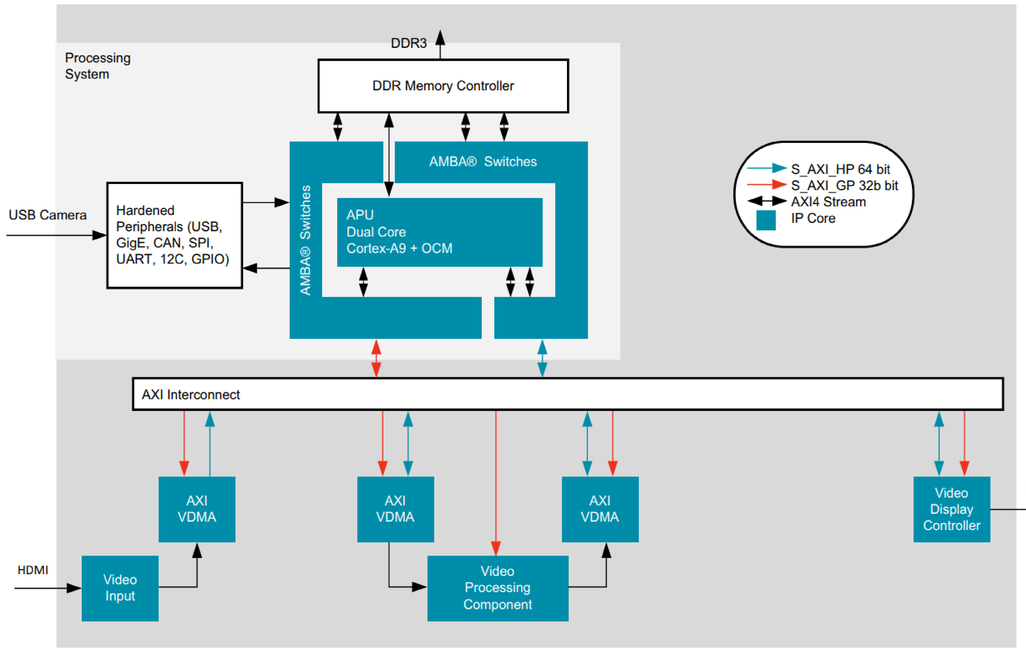


Figure 2: Frame-buffer Architecture for Video Processing[2]

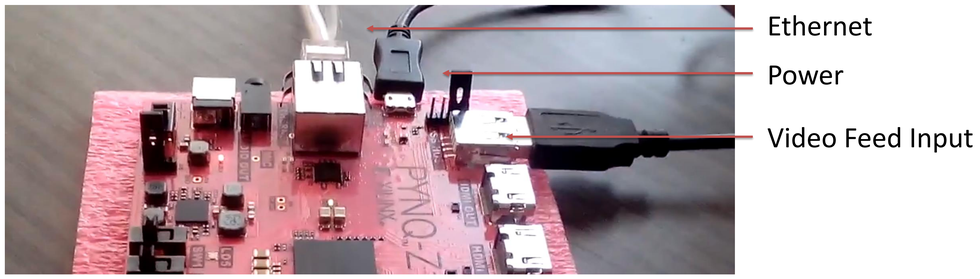


Figure 3: The realization of fig.2 on board

## Results

Our team has been able to construct an detecting system collecting the parking data(Fig. 4).


Figure 4: Real time analyzed feed of the parking lot behind CoRE

## Challenges and Future Direction

During the project, the team had faced several challenges that needed to be taken care of and provides the following recommendations for the future direction of the implement:

Hardware:

- Limited Resource for practice with real world security camera.
- Video Streaming Resolution might be too high to process on the embedded system.
- Implementing DMA (Direct memory access) is hard, but have the ability to speed up the streaming rate.

Software:

- Clear View in Source Video is required for better recognition rate, but the view can be blocked by trees or solar panels which is common above a parking lot.
- The angel of camera makes cars in the video overlap with each other.

As a algorithm and the implementation on the board has been created, the next step should be to use these analyzed data to establish the notification system to publish the result online.

## References


[1]: OpenCV Library https://opencv.org/

[2]: Frame-buffer Architecture for Video Processing(Figure 2) https://www.xilinx.com/support/documentation/application_notes/xapp1167.pdf


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