Homework

Report 1

- **Common Color Representation Systems**:
    - **RGB System** (Red, Green, Blue): A system based on light color mixing, commonly used in displays and digital media. It represents various colors from black (RGB = 0, 0, 0) to white (RGB = 255, 255, 255).
    - **CMYK System** (Cyan, Magenta, Yellow, Black): Primarily used in the printing industry, mixing colors through a subtractive color model.
    - **HSV System** (Hue, Saturation, Value): Often used in image processing and computer vision to describe hue, saturation, and brightness.
    - **CIELAB System**: Developed by the International Commission on Illumination (CIE), this system is used for uniform color perception representation, widely applied in color measurement and matching.
- **Characteristics of These Systems**:
    - **RGB System**: Intuitive, represents all colors by mixing three primary colors.
    - **CMYK System**: Suitable for printing as it precisely expresses the results of ink mixing.
    - **HSV System**: Better aligned with human visual perception compared to RGB, making color adjustments easier.
    - **CIELAB System**: Provides a color representation closer to human visual perception, often used for precise color matching and analysis.

Report 2

CMOS (**Complementary Metal-Oxide-Semiconductor**) is a semiconductor technology widely used in image sensors, integrated circuits, and microprocessors in electronic devices. Due to its low power consumption and high integration, CMOS technology has become an essential part of modern electronic devices for capturing and processing images.

1. Basic Introduction to CMOS:

1. **Working Principle**:
   Each pixel in a CMOS image sensor consists of a photodiode and a connected transistor. The photodiode converts light signals into electrical signals, and the transistor amplifies and transmits this electrical signal to subsequent circuits for processing. Unlike CCD, each pixel in CMOS independently performs charge conversion and amplification, making the transmission process more efficient.

2. **Advantages**:
   - **Low Power Consumption**: One of CMOS's biggest advantages is its low power consumption, making it suitable for battery-powered devices like smartphones and digital cameras.
   - **Lower Cost**: CMOS technology uses standard semiconductor manufacturing processes, making production costs lower than CCD and easier for mass production.
   - **High Integration**: Due to its semiconductor nature, CMOS can integrate the image sensor with other circuits on the same chip, improving the compactness of devices.

3. **Disadvantages**:
   - **Relatively Lower Image Quality**: Early CMOS sensors had inferior noise control and low-light performance compared to CCD, but modern CMOS sensors have significantly improved in these areas.
   - **Smaller Dynamic Range**: Compared to CCD, CMOS sensors have a relatively smaller dynamic range, which may perform poorly in high-contrast scenes.

4. **Applications**:
   - **Consumer Electronics**: CMOS sensors are widely used in smartphones, laptops, tablets, and home digital cameras. Due to their low cost and power efficiency, these devices require energy-efficient image sensors.
   - **Security Surveillance**: Security cameras often use CMOS sensors, especially in scenarios requiring continuous image capture, transmission, and processing.
   - **Automotive Industry**: CMOS sensors are used in backup cameras, dash cameras, and image processing systems in autonomous driving technologies.

2. CCD and CMOS Comparison and Analysis

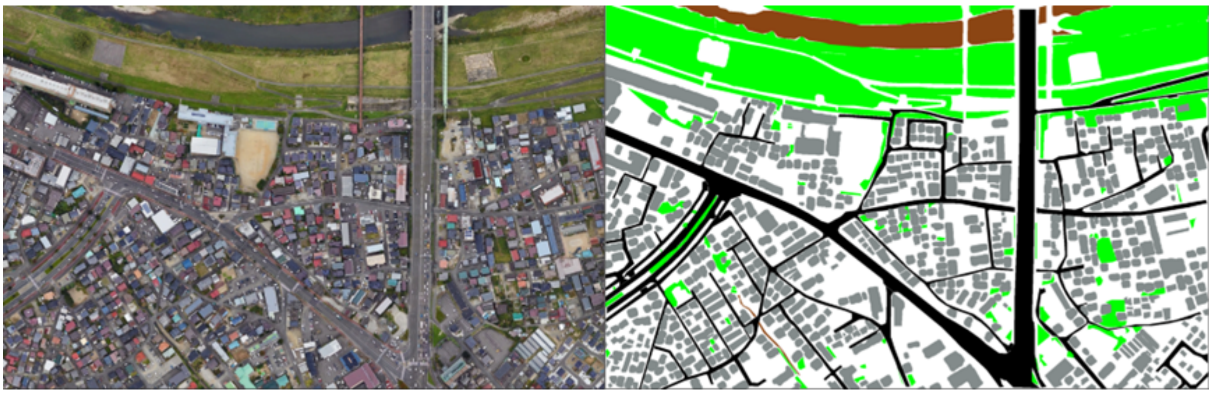
In the report, you can compare CCD and CMOS in the form of a table or paragraph, especially regarding the following aspects:

- **Image Quality**: Low noise, high accuracy of CCD vs. the improvements and popularity of CMOS.
- **Power Consumption**: Higher power consumption of CCD vs. the low power consumption of CMOS.
- **Manufacturing Cost**: Higher manufacturing cost of CCD, while CMOS is more affordable due to standardized production.
- **Applications**: CCD is mainly used in professional equipment, while CMOS is widely applied in everyday consumer electronics.

I have researched projects related to semantic recognition (identifying buildings, trees, roads, etc. in satellite images). During the research process, the pixel size of satellite images determines the level of detail in the data, while the accuracy of the labels needs to match the image resolution. Model selection not only needs to consider the image resolution but also balance the trade-off between computational resources and accuracy requirements.

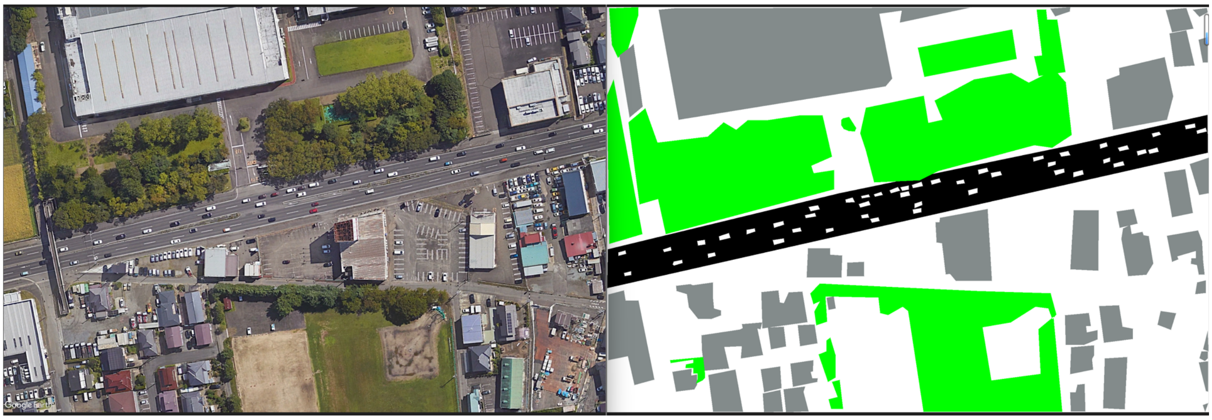
I encountered some issues during my research.

This is my data source and labels. Decompose four sets of such images into 10,000 for training.



This is the recognition effect of the model I used after training.

Now I want to be able to recognize vehicles on the road more accurately, so I have added clearer images to the training set.



And the recognition effect using the trained model is:

Are there any methods to improve the results?