

Defect Detect

Low-Cost AI Quality Control Solution

Ryan Mosalem | Shaunak Kale | Anthony Pella | Limin Ding | Joshua Kim

ABSTRACT

As AI transforms existing production lines, current systems on the market are expensive, inefficient, and highly specialized. Defect Detect uses the next generation MAX78000 AI microcontroller to prove the viability of ultra low-cost, ultra low-power, edge AI solutions.

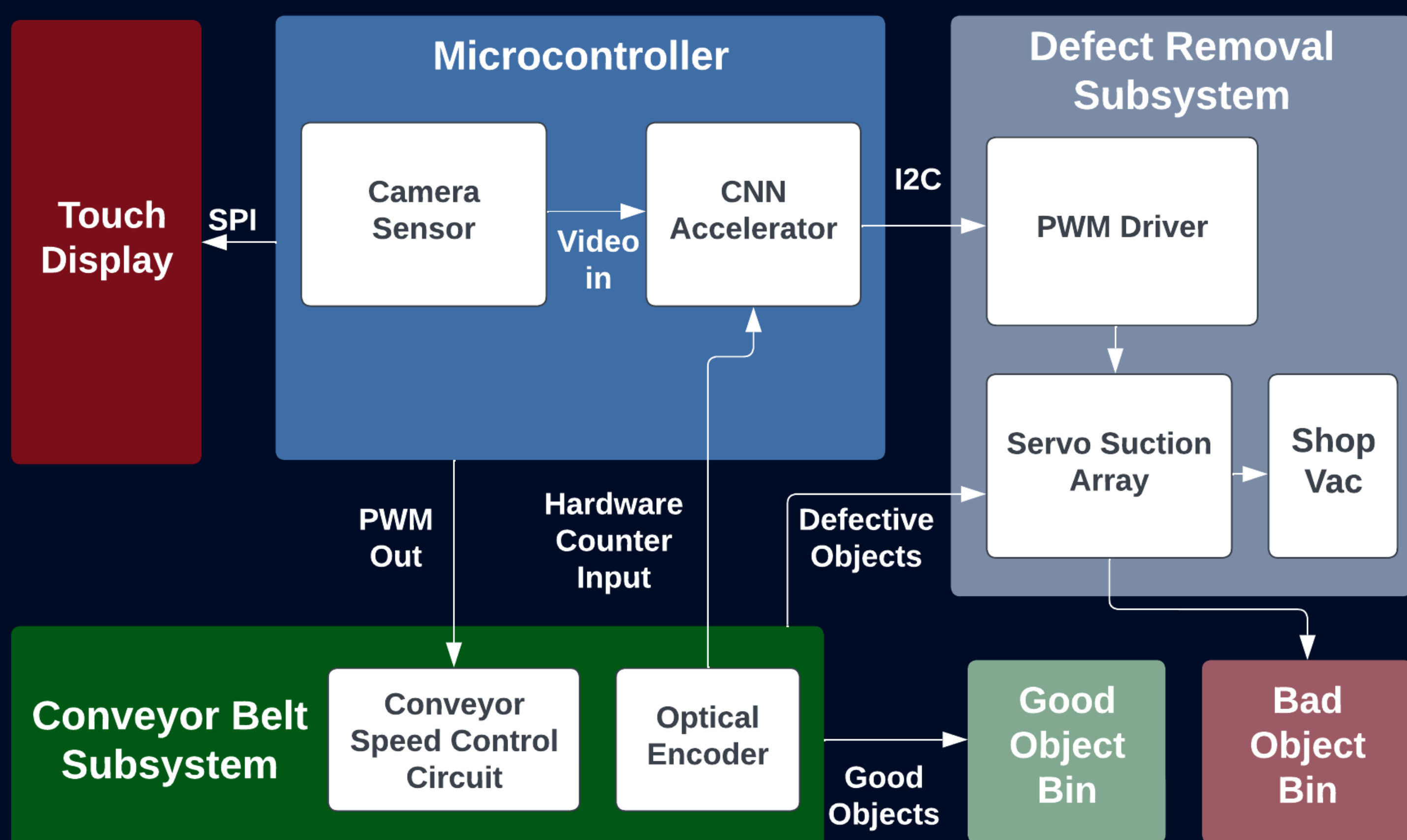
OVERVIEW

Unfiltered pinto beans are loaded onto a conveyor belt and analyzed for defects. Defective objects are removed with a custom array of servo-controlled ball valves connected to a central vacuum system. Our custom PCBA integrates the MAX78000 with an I2C controlled PWM Driver, optical encoder, and an LCD to display frames and detections live.

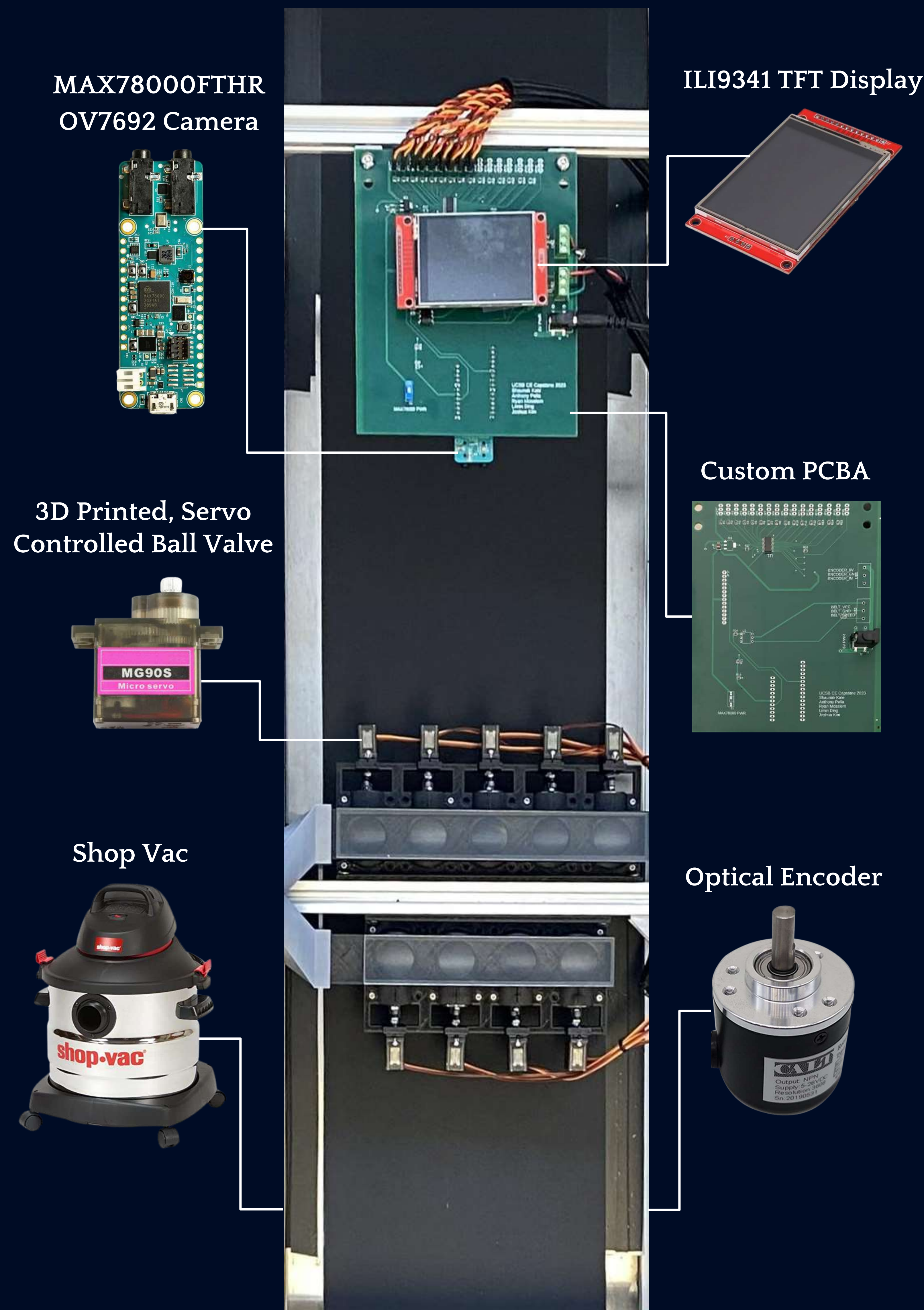
The onboard CNN accelerator on the MAX78000 allows for rapid inference on camera frames, outputting class labels, and bounding boxes at a high framerate.

Our Single Shot Detector model is trained on automatically annotated synthetic datasets of defective objects so as to ignore non-defects. The system is optimized for high recall (minimal false negatives), which is preferred in most industrial settings.

HARDWARE DIAGRAM



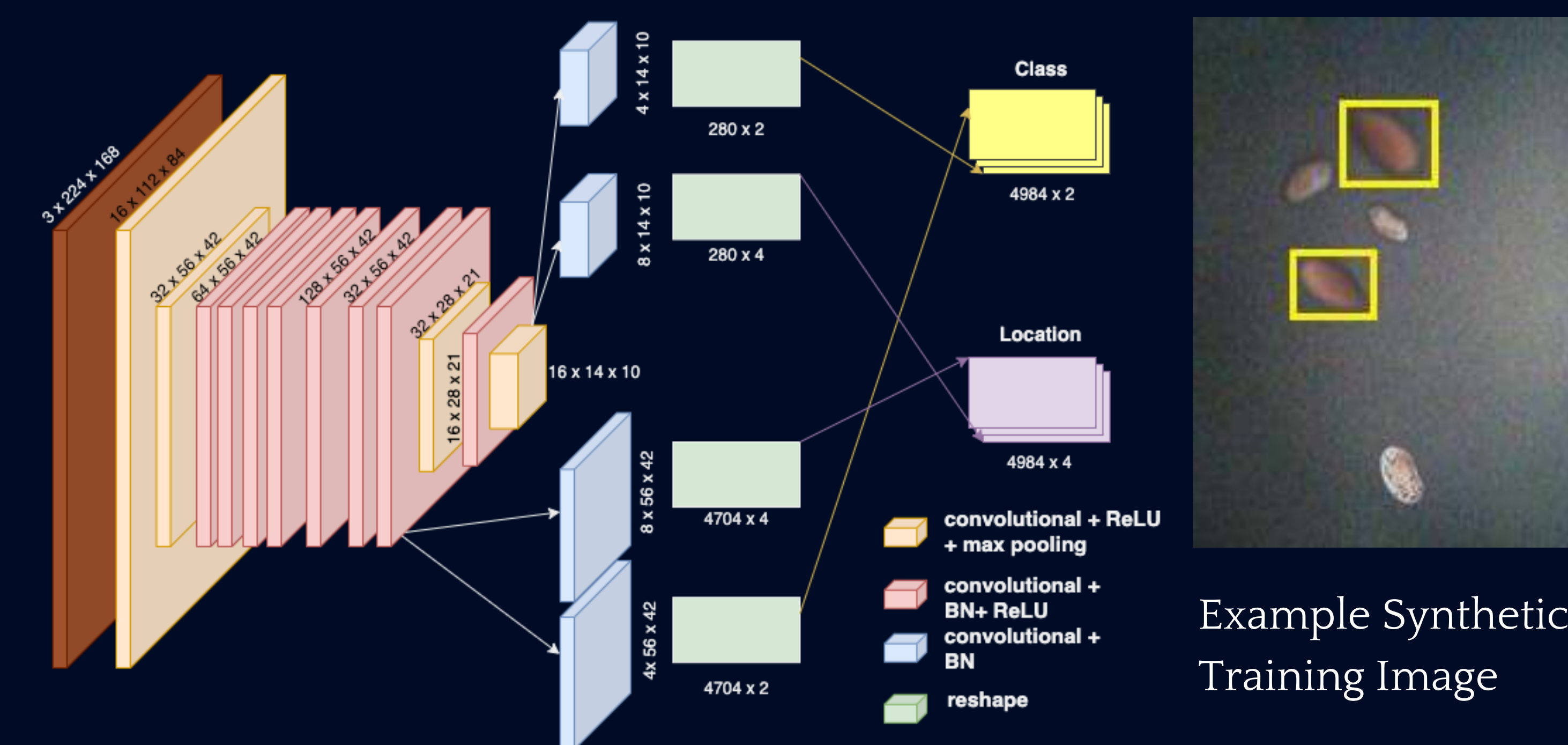
KEY COMPONENTS



DEEP LEARNING

16 Layer SSD (Single Shot Detector) Convolutional Neural Network model designed and trained with PyTorch.

Automated synthetic data generation and training pipeline for continuous model improvement.



EMBEDDED SOFTWARE

Upon detection, defects are mapped from the image frame to a discrete valve index. An offset is calculated between the object and removal mechanism and is queued at the corresponding index.

The optical encoder tracks the position of the conveyor belt with a hardware counter, allowing for extremely precise removal of defective objects.

