THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY | DEPARTMENT OF ELECTRONIC & COMPUTER ENGINEERING

Kitchen Safety Guide

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Project Overview

Background

Unattended Cooking is always the major factor that causes fire incidents. According to a report from National Fire Protection Association, US fire departments responded to an estimated average of 172,900 home structure fires per year caused by cooking activities from 2014 to 2018. In those data, “unattended cooking” is a deadly cause of kitchen fire accidents. In over one-third (31%) of home cooking, fire is responsible for unattended equipment and over half (53%) of the associated deaths. Therefore, kitchen safety deserves extra attention.

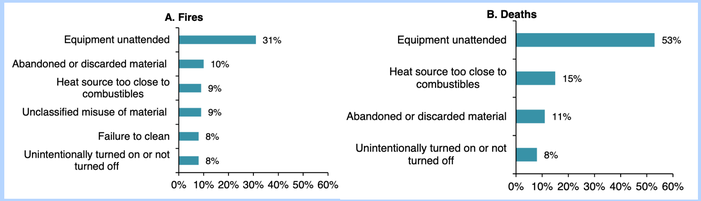

Figure 1. Leading factors in home cooking fires and cooking fire deaths: 2014–2018

Project Overview

The aim of this project is to develop an AI-embedded surveillance system specifically for kitchen safety monitoring. It will detect potentially dangerous situations (unattended cooking from now) and provide immediate responses to users. To achieve this aim, this project is comprised of two parts. For the AI part, we will train a YOLO module to detect fire from the stove and the hand of the cook. Depending on the result of our module, the system will detect potential danger/ fire hazards.

Methodology

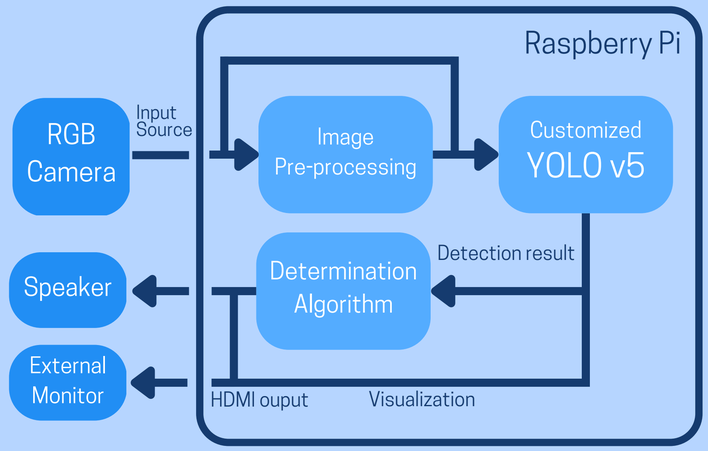

Figure 2. Block Diagram of the Kitchen Safety Guided

By detecting the fire from the stove and human hands, we can identify whether the situation is unattended. So, we trained a YOLOv5 model for individually detecting fire, pot, humans, and hands. Hand activity can also be detected as the presence of humans.

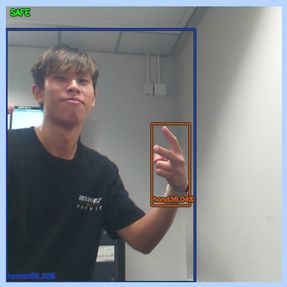

Figure 3. Kitchen Saferty Guide Visualization Output

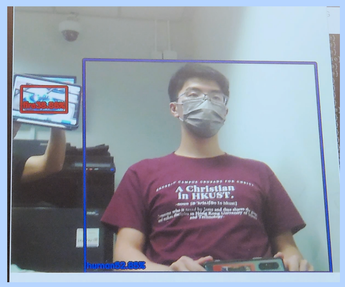

Figure 4. Kitchen Saferty Guide Visualization Output

What we have achieved

- Training a YOLOv5-based, fire detection model
- Visual analysis of real-time image (1 FPS)
- Visual and audio output according to the situations
- Specialized algorithm for fire hazard detection and prediction

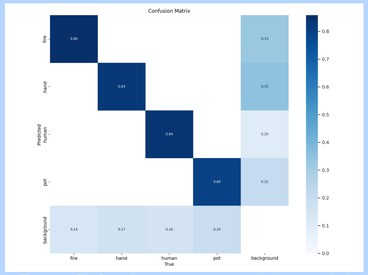

Figure 5. Confusion matrix of the model

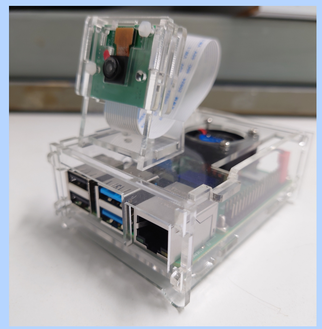

Figure 6. Completed hardware

Conclusion

We have achieved fire hazard detection with Computer Vision, Visual analysis, and Machine Learning. We met our objective of providing an AI-embedded surveillance system specifically for kitchen safety monitoring that can react to unattended cooking or open flame.

Room for improvement

- Increase the number of data sources (e.g. other cooking videos) to reduce the likelihood of overfitting
- Increase the detection speed by hardware acceleration or using CUP optimized model format (e.g. .onnx)