I. INTRODUCTION

Fire can quickly cause significant property damage as well as injuries to living things [1]. Fires can also start at variety of place, from forest to warehouses. This has led to the development of fire detection technologies for preventing and mitigating the impacts of these fires. Therefore, the purpose of this research is to build fire detection as an early warning tool to reduce and prevent the impact of damage caused by fires.

In general, fire detection can be divided into two categories, namely traditional fire detection and computer vision fire detection. Traditional fire detection techniques used smoke or heat sensors and require proximity to objects to activate. These sensors also require human intervention to confirm a fire has broken out. Furthermore, the system needs to collect information about fire's size, location, and temperature. To overcome this limitation, researchers have investigated computer vision-based methods in combination with various types of additional sensors [2-5]. Technologies in this category allow people to see the fire without coming to the scene and provide detailed fire information such as location, size, and temperature level, resulting in greater monitoring coverage, less human intervention, and more responsiveness. Although using the computer vision method has many advantages, some problems still occur with this method. Therefore, the researchers attempted to address the problem in terms of computer vision technology [6].

The computer vision–based fire detection method starts from the color of the fire using the Hue Saturation Intensity (HIS) and Red Green Blue (RGB) color models [7] to extract areas that have the possibility of fire to determine the fire area [8]. However, color-based fire detection is vulnerable to environmental factors such as lighting and shadows [6]. Exploring the characteristics and dynamics of different types of fire is very difficult and requires extensive knowledge of fire. However, this can be substituted by deep learning approaches with sufficient data to avoid overfitting. CNN is commonly used in fire detection as a deep learning model. However, the lack of dataset causes CNN not to perform well. After introducing the Imagenet dataset and other datasets. The CNN model is proven to have very good and accurate performance compared to other computer vision models [9].

Object detection technology is rapidly developing to get high accuracy and speed. There are several object detections commonly used, including You Only Look Once (YOLO), EfficientDet, Single Shot MultiBox Detector (SSD), and Faster Region-Based Convolutional Neural Network (Faster-RCNN) [10]. YOLO version three was proven to have the highest accuracy and the fastest fire detection process compared to other models in the case of fire detection [11]. However, when compared to YOLO version four, the difference in performance using YOLO version four has a very significant increase, namely an increase in Average Precision (AP) by 10% and Frame Per Second (FPS) by 12% better than using YOLO version three [12]. Therefore, this research used a CNN deep learning model supported by YOLO version four to build a fire detection system.