1. Introduction

Background

On January until March 2020, there are 503 fire accident cases that happen in Jakarta, the Capital city of Indonesia [4]. Most of the fire accidents are happen in crowded neighborhood areas. Fire is one of the most dangerous things but also one of the most important things in human life. Such accidents can be prevented with early detection of the fire. One of the detection systems that can be used is a sensor. But a sensor somehow is a little bit expensive and the placement is not efficient.

In the current time, there are a lot of surveillance cameras or CCTVs are installed almost on every buildings or houses. A fire detection system can be installed on surveillance cameras for better efficiency instead of installing a new device for the fire detection sensors. With the increasing usage of CCTV surveillance video systems for security purposes in monitoring industrial environment, public and general environment, and other environments, many people considering this fire detection system as the early fire detector [2]. The color, shape, flicker frequency, and motion characteristics of the flame image are analyzed in the early flame detection [11].

Problem Statement

There are many method has been used by the researcher to detect fire [16][7][13][10][11]. A fire detection system proposed by H. Yamagishi and J. Yamaguchi based on HSV color space and neural network, which uses hue and saturation to identify the fire field, is one of the earliest methods. However, due to the high computational complexity of the operation, the duration of the process is not real-time [16]. There is also a research in [7], using LBP-TOP and Grey-level Co-occurrence Matrix which resulting the method used is not sensitive to the object movement and cannot fully detect the object visually. A research using hidden Markov models in [13] showing a result that it is efficiently detects flames. But, it may produce false alarms because the method used is only based on color information and ordinary movement detection. It can be reduced using separate Markov models. Another method using background subtraction is proposed in [10]. This method needs to declare the background image first. However, using this background subtraction method has disadvantages. It cannot deal with the sudden, drastic light changes. These are the reason in this study the ViBe algorithm is proposed. ViBe algorithm is better on detecting moving target objects such as flame combustion. But, the result from ViBe algorithm processing still has noise. In order to solve that problem, the ViBe algorithm is combined with three frame differences to reduce noise, improve accuracy, increase image morphology processing, and reduce voids in the recognition results [11].

Objective

In this study, the process flow will start with changing RGB to HSI color models. This will improve the saturation identification and the average saturation of the image is used instead of the originally fixed threshold, which can adapt to different light and dark environments to identify flames. Then, the ViBe algorithm will be combined with three frame differencing method in order to reduce the noise, and other problems stated above. Then, LBPTOP will be applied as feature extraction. Then, classify it using SVM Classification.

In this study, there are five sections to be explained. Related works according to the methods discussed in Section 2. Then, it will be followed by system design in Section 3. Section 4 provides test results and evaluations of the method. Finally, the author concludes this study in Section 5.