CHAPTER 1

INTRODUCTION

This chapter includes the following subtopics, namely: (1) Rationale; (2) Theoretical Framework; (3) Conceptual Framework/Paradigm; (4) Statement of the problem; (5) Objective and Hypothesis; (6) Assumption; (7) Scope and Delimitation; and (8) Significance of the study.

1.1 Rationale

Intelligent transportation systems (ITSs), a collection of advanced application services on the various modes of traffics and transports, are being used in many countries especially in smart cities to reduce traffic problems. Current ITS has to collect several data to perform a good analysis. Those technologies are related to the fields of computation, electronic and sensor, Internet of Things(IoT), etc.

Although ITSs purposely provide an effective process and convenience to all users in our daily traffic, the traffic injuries and deaths have a terrible impact on individuals, communities, and countries. One of the problems is the condition of the road at night. It can easily provoke a traffic accident to vulnerable road users especially motorcycle riders. In ASEAN countries, motorcycles are the common mode of transportation. It contributes the road crashes more than other modes do. According to a recent report on road safety [1], 36% deaths of the road user category in Indonesia are contributed by the motorized 2 or 3 wheel riders as shown in fig.1.1. It is the highest rate in the observation.

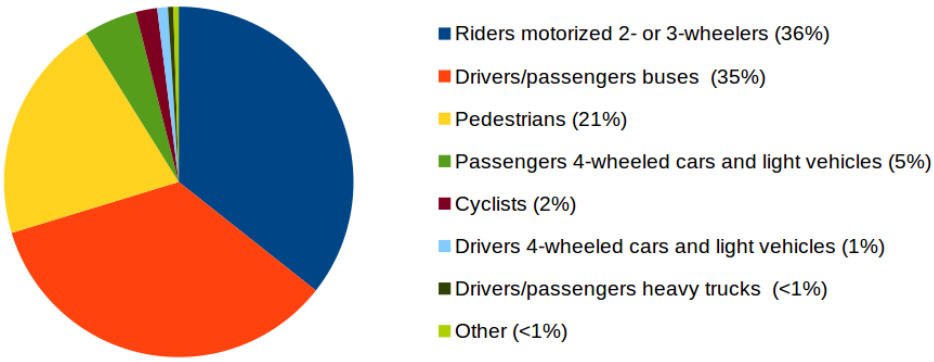

Figure 1.1: The deaths by road user category [1]. The data provided by the Indonesia National Police in 2010.

Most recent studies on the intelligent traffic proposing various methods are challenging for the collection of daytime images. Based on human perception, the daytime is easier to recognize the vehicles than the nighttime due to the unclear environment. Unfortunately,

those studies ignore the motorcycles in the detection procedure even in the daytime. There is another method proposed to detect the motorcycle, but it costly computes the algorithms during the experiment such as [2]. Huynh et al. design the CNNs(Convolutional Neural Networks) based architecture to detect the motorbikes from dense traffic. However, they fail to meet the requirements for integrating with other real-time systems. This is due to taking a long time for CNNs process even though having the assistance of the GPU(Graphical Processing Unit) device.

The object of motorcycle and the nighttime environment are interesting in the area of computer vision. This is because it is difficult to identify the object of the motorcycle at nighttime and it contains various obstacles. The road users using their natural eyes concentrate on the taillight to quickly recognize the vehicles. The manufactures standardize the differences of taillights between the motorcycle and the car. The motorcycle has one taillight while the car has 2 taillights. The motorcycles' taillights might be easily confused in case of multiple motorbikes or cars. It is also very similar to the traffic light, road lamp, road sign, banner, etc.

1.2 Theoretical Framework

The digital technology is found almost everywhere in our daily lives. It can be employed in many fields i.e. telecommunication, geography, photography, etc. Consequently, digital cameras are being used to serve the solutions for society through the technology of image processing. There are a lot of studies in this area. Some researchers are proposing methods for various topics such as segmentation, recognition, detection, etc. The objects in image processing are categorized into several types to identify. For instance, there are many possible classes of the objects in our daily traffic including pedestrian, car, truck, bus, motorcycle, bike cycle, etc. To recognize or classify them, the machine learning provides numerous methods to work with the image processing techniques that can perceive the data as well as a feature like intensity, color, edge, shape, brightness and so on.

The RGB (Red Green Blue) color model is found commonly in the digital image. There are also several other color systems like HSV (Hue Saturation Value), HSL (Hue Saturation Lightness), HCL (Hue Chroma Luminance), CMYK (Cyan Magenta Yellow Black), etc.

The different changing of color in an image can be detected the edges by any method. The method of edge detection is one of the image processing techniques to find the shape or boundaries of objects. It can be used in computer vision, feature extraction, etc. Most of the edge detection methods are coming from the high pass filter by different kinds of kernel operators such as Robert, Sobel, Prewitt, and Laplace. The low pass is being used to smooth the image or reduce noise including Gaussian, Gabor, Averaging, Median, etc. Some edge detection methods require the optimal threshold to limit or filter out the misleading edges i.e. Canny edge detector. The threshold value may be given by a fixed number or

calculating from the automatic thresholding method. Otsu thresholding performs every pixel of image intensity on the histogram and then find the maximum variance from it to produce the optimal one. An edge is found at the peak of an image gradient. It can be used to classify for some forms of shapes including line, rectangle, circle, ellipse, etc.

1.3 Conceptual Framework/Paradigm

The benefit of taillights from all the vehicles is to allow human perception to identify that there are some existing vehicles in front. However the situation of nighttime is difficult to see the exact object, the road users can observe the characteristic of other lights and something else around the taillight. The object should be classified after completing the observation on the surrounding taillight. The observed area should be limited by the predictive taillight from its origin point.

1.4 Statement of the Problem

The ITSs require the accuracy and speed on detection. They are required to detect objects as high as possible neither day and night time. The recent methods of vehicle detections in nighttime [3, 4, 5, 6] are only interested in the car instead of motorcycle although it is the highest death category in Indonesia [1]. Nighttime images consist of low contrast, low brightness, and low signal to noise ratio. The accuracy of nighttime motorcycle detection is one of the necessary challenges in both ITSs and computer vision. Nowadays, It is one of the vital concentrations on road safety to reduce the vulnerable rate of the vehicle collision in our traffic.

1.5 Objective and Hypothesis

This work is to design the framework which can accurately detect all possible motorcycles for nighttime traffic images that are provided by a fore camera of a vehicle. The taillight is a main physical attribute that belonged to the motorcycle which is ridden within the road space and reflected any brightness to the atmosphere. In this case, if those characteristics can be extracted, the motorcycle will be able to be detected. To detect the taillight, RGB image is converted to the HSV color system, and then the color filter is developed to expose red light. To detect the reflection around the taillight area, Sobel operator and active contour are used.

Since the appearance standards of the motorcycle are consistently formed by the manufactures, the possibility of motorcycle detection is existing in computer vision. One of those physical standards is taillight. It is a hint to be recognized by either human perception or robotic sensor. It is commonly red. It might become lighter due to the quality of the lamp, environment, and local contrast when it is taken by the digital camera. However,

the taillight has still remained as the foreground which can be detected by some methods of color thresholding. For instance, R. O'Malley et al use HSV to detect the rear lamps of a vehicle at the digital nighttime images [6]. The other things of nighttime motorcycles are reflections. It is possibly caused by the taillight, the vehicle flashlight, etc. It is an additional attribute to support the taillight especially the shape of the motorcycle for identifying an object. It can be found by gradient-based approaches such as edge detection and active contour. The edge is noticed as one of the important features in the nighttime image [3].

1.6 Assumption

The standard laws and vehicles are applied thoroughly to serve transportation works. The vehicle standards are also the critical parts of road safety; faulty brakes are common causes of the traffic accidents [1]. The standard of the motorcycle is applied to its taillight, shape, size, and other lamps. The situation of traffic is sparse and one-way on the outskirts of the city. The headlight is always turned on for the vehicle which is installed on the camera in order to shoot the photos of rear motorcycles running along with the road space.

1.7 Scope and Delimitation

The proposed prototype and approach are the outputs of this research. For detection, all motorcycles are driving within the road space and less than 6, and their sizes are limited in the range of 20x20 to 200x200 pixels.

1.8 Significance of the Study

The ITSs and robotic industries can use the proposed design to improve or integrate with their existing features so that those systems will be more intelligent and flexible in both day- or nighttime environments. The concept which is proposed to work with low contrast and intensity, can be further studied and implemented in the structural literatures in our research as well.

The results of this study can be contributed to these following usages. The red and edges are exploited to become the vital features from the nighttime image. Generally, red and edge pixels are counted to be real numbers. Besides, we take advantage of potential light as known as taillight for a motorcycle. The light can is to determine the ROI and active contour. Twenty active points are proposed to initiate the active contour of motorcycle. All edge pixels within ROI are specially counted. The final contour area is calculated. All numbers are normalized by an image size. Eventually, all features (red pixel, edge pixel, edge ROI, active contour) are in the range of [0, 1] and used for motorcycle classification.