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ENHANCED ROAD SECURITY USING EDGE DETECTION AND INFRARED IMAGERY

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ABSTRACT

Edges are prominent features in images and their detection plays main role in computer vision and image processing. Identifying and Detecting the edges are a low level task in a variety of applications such as shape recognition, image compression, enhancement and restoration. The technique laid out aims to develop enhanced techniques for road safety. Road safety is a major issue and many lives are lost due to inadequate safety measures, including poor lighting conditions, road conditions,etc. The methods laid out aim to provide enhanced safety that can be further used in enhancing road safety with the potential to avoid accidents. These are performed using various criteria involving concepts of edge detection, infrared imaging and real time imaging. In addition to this, it also analyses other safety techniques and algorithms that have been previously developed in this line of research. One of the methods laid out caters to the problems colour blind people have, specifically in distinguishing between the green light in traffic signals and street lights.

Keywords: *Infrared, Edge Detection, Log, Power Law Transform, Real Time Imaging*

1. INTRODUCTION

The fundamental image pre-processing tool un many image processing applications is image enhancement. The important applications such as biomedical, remote sensing, autonomous navigation, etc. Requires digital images with good contrast and visual detail. Enhancement methods finds use to modify an image to show visual information contained in image in a better manner [1]. According to Weber's contrast law, the minimum change required for human visual system to perceive contrast, however this applicable only for a properly illuminated area. The human visual system uses objective evaluation measure for selection of parameters, such as edges which improves results, while reducing time required for enhancement process [1],[2].

Image fusion is an ever growing field. Various new techniques for image processing have been discovered in recent times. There are many problems regarding the current state of road safety. One problem is that colour blind people have some difficulty in distinguishing between traffic signals and streetlights [1]. This paper proposes an edge algorithm, specifically using canny filter, to try to solve the above mentioned problem.

Another problem encountered in roads occurs in many cases due to bad lighting and weather. For instance, on a rainy night, it is very difficult for drivers to observe the vicinity properly. This leads to many accidents. This paper proposes the use of infrared cameras, which are helpful in cases of poor lighting [3] [4] [5].Applying edge detection, in this case the canny filter, to this captured image further helps the driver as at a glance objects will appear clearer.

Real Time Imagery can be very useful in the roads. A continuous sampling of the road can help the driver drive in a more accurate fashion by clearly observing obstacles surrounding the vehicle. Sample images were obtained and were enhanced using power law transform. Edge detection was used next, in this case the log edge detection, and finally the

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original was fused with the edge detected image which yielded better results.

2. DIFFERENT IMAGING METHODS

2.1 Infrared imaging

Infrared (IR) light is electromagnetic radiation with a wavelength longer than that of visible light, measured from By the nominal edge of visible red light at 0.74μm, and extending conventionally to 300μm [6]. The wavelengths correspond to a Infrared have range of approximately 1 to 400 THz of frequency and includes most of the thermal radiation emitted by objects near room temperature. Infrared imaging is widely used for military and civilian purposes. In military applications it finds useful in target acquisition, surveillance, night vision, homing and tracking. Non-military uses include thermal efficiency analysis, environmental monitoring, industrial facility inspections, remote temperature sensing, short-ranged wireless communication, spectroscopy, and weather forecasting [2],[3]. Humans radiate chiefly at wavelengths around 12 μm at normal body temperature. The atomic level infrared energy elicits vibration modes in a molecule through a change in the dipole moment, making it a useful frequency range for study of these energy states for molecules of the proper symmetry. Infrared spectroscopy examines absorption and transmission of photons in the infrared energy range, based on their frequency and intensity [2], [3].

The following is an infrared image of a cat. This is converted to grayscale, and is further edge detected using canny edge detection techniques as shown in figures 1, 2 & 3. This will help in the cases of bad lighting and weather, for instance driving in the night in the midst of heavy rains. The image is converted to gray scale for simplicity in the computing and processing stages. Gray scale images process the property of ease of manipulation which this technique exploits.

Figure 1: Infrared image

Figure 2: Grayscale image

Figure 3: Edge detected image

2.2 Real time imaging

Real time imaging can be of tremendous use and can be used. A major and important cause for traffic accidents is largely due to a low level of vigilance. [3] describes a real-time prototype computer vision system where the driver vigilance is monitored. A remotely located CCD camera and a specially designed hardware system are included.

[4] describes a stereo vision-based hardware as well as software architecture to be used on moving vehicles for road safety purposes. It

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allows, in the detection of, generic obstacles as well as lane position in a structured environment and proposes techniques for the same.

2.2.1 Differentiating Between Traffic Light and Streetlight

There is a problem in differentiating between traffic lights and streetlights for a colour blind people. The following are pictures of a streetlight and traffic light, respectively, and edge detection is performed on the images. As can be observed from the results, there is a clear difference which will help in better navigation of roads. The below figures 4 & 6 show the images of Street light and traffic signal of real time images captured through camera and the figures 5 & 7 shows the edge detected image obtained through Canny edge detection technique.

Figure 4: Street light image

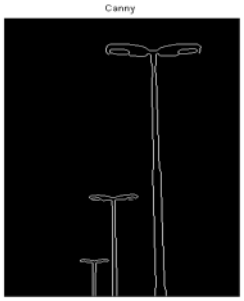

Figure 5: Edge Detected Street light image

Figure 6: Traffic signal image

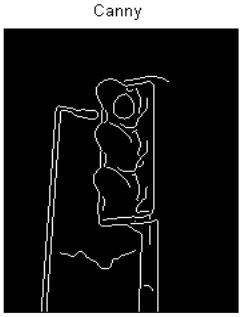

Figure 7: Edge detected Traffic signal image

3. PROPOSED ALGORITHM

The proposed algorithm can be explained in five steps

Step 1: Acquire the real time image and convert it into grayscale image.

Step 2: Enhance the quality of image using Power law transform.

Step 3: A 3x3 Laplacian mask is convolved with enhanced image.

Step 4: Apply Laplacian of Gaussian (LoG) edge detection operator to the enhanced image

Step 5: Apply image fusion between enhanced image and edge detected image to obtain final image.

4 EXPERIMENTAL RESULTS

The proposed algorithm has been applied to the sample real time images which are obtained in darkness. The quality of the images is very poor and having low brightness. The proposed algorithm clearly analyses the image and interpret data from it. This is especially important in road safety as the obstacles occur continuously and the driver is required to be continuously vigilant during night times and low light conditions.

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Case1

Figure 8: Sample image1

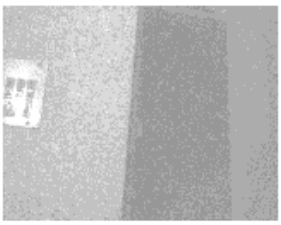

Figure 9: Enhanced image 1

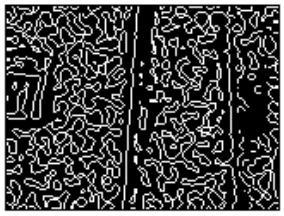

Figure 10: Edge Detected Image 1

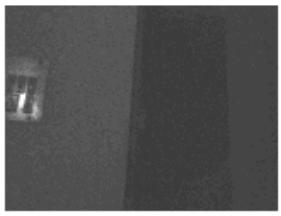

Figure 11: Fused Image 1

Case 2

Figure 12: Sample Image 2

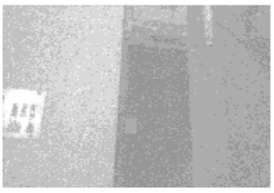

Figure 2: Enhanced Image 2

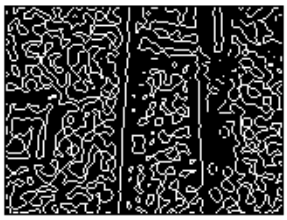

Figure 3: Edge Detected Image 2

Figure 4: Fused Image 2

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5 CONCLUSION

The proposed approach has a potential for various applications to detect edges and enhancing images used extensively for military and civilian purposes. From the analysis, the following findings were obtained. Edge detection of traffic lights and streetlights are useful for the colour blind people who cannot distinguish between them. Implementing such a strategy would be helpful. Infrared imaging is useful in cases of bad lighting and poor weather conditions such as rain, storms and the like. Implementation of the same would lead to less dependency on headlights and streetlights, and would be particularly useful in terrains with poor lighting facilities. Real Time imaging is useful and can be used in continuous monitoring of obstacles. This would help greatly in better driving. Real time scanning is useful. A 1D edge detector can be used to highlight potential edges, and then can be weighted by a Gaussian centered on the predicted edge location. A more sophisticated method is developed- an image detection method based on background differencing and edge detection techniques is developed which separates the objects from their backgrounds and works well under various lighting and weather conditions. Implementation of the above would lead to better road safety and reduction in the number of accidents.

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