LOUISIANA TRANSPORTATION RESEARCH CENTER

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ITS Support for Pedestrians and Bicyclists Count: Developing a Statewide Multimodal Count Program

Figure 1
HOG detection of pedestrian and cyclist

INTRODUCTION

Understanding the travel behavior of pedestrians and cyclists on Louisiana's roadways is critical to evaluating safety outcomes relative to rates of exposure; identifying appropriate, context-sensitive complete streets infrastructure interventions; and understanding overall statewide and location-specific transportation trends. Better understanding of such trends ultimately affects long-term planning and investment. Pedestrian and cyclist counts, as well as vehicle counts, are important sources of information for planners and policymakers when dictating transportation planning and infrastructure spending. Current and reliable statistics are essential for evaluating the usage of roadways and for optimizing spending and investment. A wide range of hardware is available to address the challenges associated with pedestrian and cyclist counting such as laser beams, infrared counters, and piezoelectric pads. Manual counts performed by humans in the field are common but are labor-intensive and inefficient for large-scale counting programs sought by cities and states today. Also, these counts generally rely on human capacity and accuracy rates are prone to human error. In areas with a high density of pedestrians and cyclists, the method of manual counting is essentially impractical. As a result, there has been more effort into the development of algorithms that minimize human intervention when counting.

OBJECTIVE

The objective of this study was to develop a system for automated pedestrians and cyclists counting on roadways using archived video data. This goal was achieved by following a part-based method, which utilizes the Histogram of Oriented Gradient (HOG) technique as well as a latent support vector machine (SVM). This technique is the preferred algorithm for automation due to its high-speed processing capability and its open source availability. It is anticipated that the results of this study will assist LTRC-16-4SA in evaluating available count technology equipment options and identifying preferred alternatives suitable for statewide deployment.

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SCOPE

The research team relied on video footage collected at locations on the campus of Louisiana State University (LSU) as well as one additional site in Baton Rouge, Louisiana. These were sites with expected high volumes of pedestrians and cyclists. The study is exploratory in nature, researching on the feasibility of developing an algorithm capable of automated counts. The research documents other current research and technology used today in this field of counting.

METHODOLOGY

The research team developed the HOG algorithm using a part-based method documented by previous research for detecting objects in frames extracted from video footage. Five locations in Baton Rouge, LA, with varying characteristics and densities of pedestrians and cyclists were chosen as the source of this project's video data. The sites were filmed daily to ensure that the footage was obtained for morning, afternoon, and evening hours. To be able to utilize HOG on the videos, three steps need to be deployed: detection, tracking, and classification. However, because of the limited time of the study, the research team focused solely on the detection element of the HOG algorithm. Manual observation counts were used to provide the ground truth data for validation of the performance of the HOG algorithm. For each frame developed from the video footage, two research team members manually counted and recorded the number of pedestrians and cyclists to reduce possible errors due to human factors. The manual observations were compared with results of the HOG algorithm and accuracy determined as follows:

Accuracy Rate= |(# HOG Algorithm)/(# Manually Counted)|* 100%

where, *# HOG Algorithm* refers to the number of pedestrians or cyclists that were detected, using the HOG algorithm, in all the frames for each site; and *# Manually Counted* refers to the corresponding ground truth data. The closer the calculated *Accuracy Rate* is to 100%, the better the detection accuracy rate of the HOG algorithm. Figure 1 shows frames with HOG detection of a pedestrian and cyclist, respectively.

CONCLUSIONS

Overall, the accuracy rates ranged between 29 – 91% for detection of pedestrians and between 0 – 60% for cyclists. This result was fairly poor but can be attributed to a number of reasons, such as occlusion, lighting condition, and viewpoint angle of the camera. Generally, in investigating the effect of density on the accuracy rate, the higher the number of pedestrians on a frame, the poorer the accuracy rate. No trend was observed on the cyclists data probably due to very limited density recorded on each frame as a result of the very low cyclist population of the sites investigated.

It was concluded that the developed HOG algorithm was not able to accurately detect in a consistent manner and additional work was needed to address issues of background image interference, occlusion where the accuracy levels were very low with increased number of targets on a frame, and varying intensity of lighting conditions.

RECOMMENDATIONS

The study recommends the further development of the detection part of the algorithm and an added tracking part to enhance the accuracy rates. The target of any future work should be the development of a high-speed algorithm in order to be able to use it online to count pedestrians and cyclists. The final prototype that should be the aim to have in the future is a remote-online program that can make an online count process 100% automated. This will save much effort and time when compared to traditional manual count processes.