TECHSUMMARY March 2021

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Evaluation of Counting Device for Pedestrians and Bicyclists

INTRODUCTION

Understanding the travel behavior of pedestrians and bicyclists 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.

Sensor A is used to count pedestrians and bicyclists and even more objects. It is a hardware-software system that is composed of two components: the sensor (hardware) and the software (the data platform). It uses a camera to take multiple snapshots per second of a region under study and then uses image-processing algorithms to count the number of pedestrians and bicyclists.

Sensor B is also an IP camera (sensor) that is capable of automatically counting objects in addition to capturing video footage. Sensor B is typically designed for the indoor counting process. However, in this project, it was evaluated for the outdoor counting under different weather conditions at a very high-traffic volume location in New Orleans. We benefit from its ability to capture video footage for utilizing them in the manual validation process.

The purpose of this study was to evaluate the performance of sensors A and B to count pedestrians and bicyclists and compare their counts with the manual counts under different conditions (weather, time of the day, shadows, complex background, and different density of pedestrians and bicyclists). This was achieved by mounting the sensors in different six locations in New Orleans and Baton Rouge cities. The evaluation process was performed during different weather circumstances including storms and during the day-time and the night-time.

Figure 1
The mounting process of sensor A on a light pole

OBJECTIVE

The primary aims of the project were: (1) verifying the accuracy level of sensor A and sensor B to automatically count pedestrians and bicyclists from real-time video footage; and (2) determining if sensors A and B could deliver robust systems for both near-term and long-term multimodal data collection program opportunities so that they will make DOTD more efficient in its pedestrians and bicyclists data collection endeavors.

To achieve these aims, the research team was looking to successfully achieve the following specific objects:

1. Mounting the sensors at six different locations in New Orleans and Baton Rouge: These locations were carefully selected to provide a different density of pedestrians and bicyclists. The sensors were mounted continuously for three months at New Orleans locations and another three months at Baton Rouge locations.
2. Collecting video footage that covers the same coverage areas of the sensors: The collected video data will be under varying conditions to evaluate the accuracy of the sensors under different circumstances. The video footage was recorded during the daytime and the nighttime at the selected locations. Different weather conditions (i.e., storms, heavy rains, and cloudy weather) were considered through the evaluation period. Some of the selected locations provided shadows and complex background conditions to evaluate the ability of the sensors to count in such conditions.
3. Comparing the accuracy of the obtained counts from the sensors with the manual counts from the recorded video footage.

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SCOPE

For this study, the research team used the testing locations approved by the PRC. The evaluation was undertaken on sensors A and B that were leased through this study. The research team engaged representatives of sensor A in the acquisition and installation of the devices. The research team relied on LTRC to provide video cameras for this study, including sensor B. The PI calibrated and evaluated the automatic counting feature of sensor B. It was agreed to lease sensor A for six months. During this period, data was collected for three months at sites in New Orleans and the remaining three months at sites in Baton Rouge.

METHODOLOGY

Three sensors A were mounted and evaluated in six different locations in New Orleans and Baton Rouge areas. Several continuous video data readings were recorded utilizing additional video recording cameras that were mounted to cover the same coverage areas of the sensors. Sensor B was used to record real-time video data at LTRC1 (Decatur St. and St. Peter St. at the New Orleans) location. Other locations used additional video cameras that are mounted on the same poles of the sensors and covered the same coverage areas of the sensors. The recorded video data were used for the manual counting process to evaluate sensor A and sensor B. The density of pedestrians and bicyclists are varying in the selected locations.

The installation process of sensor A was done at New Orleans locations by direct wiring to the light and the signal poles to get the required DC voltage. At the Baton Rouge locations, all sensors A were powered through the utilization of solar cells. The solar panel provided 160W of power; its dimensions were 67 in. x 26 in. (1710 mm x 666 mm); and it weighed 109 lb. (49 kg). Sensors A at New Orleans consists of only the sensors, while those in Baton Rouge consist of the solar-cell panel, the battery box, and the sensor.

Based on the provider of sensor A's recommendations, the maximum accuracy of the device can be obtained after two weeks from the installation time. Two weeks are required to calibrate the device. The research team mounted video cameras at the same locations covered by sensors A. A minimum of 8 hours of video data (with 32 hours being the preferred standard for evaluating accuracy) was used for evaluating sensors A's accuracy per the selected period. The selected video data represented a variety of days, times, weather conditions, volume levels, etc.

Sensor B has a static IP address that can be used to set-up the device. It is important to select the correct setup parameters to successfully calibrate the camera. The calibration process of sensor B includes the object window decision. The object window size depends on the angle and the height of sensor B's lens. The second calibration step is to determine the location of the passing lines. Sensor B can provide up to 8 lines. Any object that passes the line(s) will be automatically counted by sensor B.

CONCLUSIONS

The evaluation process was performed by comparing the collected counts of sensor A and sensor B to the manual counts that were obtained from video recording cameras that covered the same coverage area of the evaluated sensors. Sensor B was evaluated at one heavy traffic volume location in New Orleans. The obtained results and analysis indicated that both sensor A and sensor B failed to provide robust counting systems for pedestrians and bicyclists under different conditions (weather, time of the day, traffic volume, and density of pedestrians and bicyclists). The reason for the low accuracy of both sensor A and sensor B to match the manual count is not clear since the entire counting algorithm for both sensors is proprietary.

The evaluation of sensor A showed that the overall total observations median and mean absolute percentage of error (APE) of the pedestrians during the day-time are 119.72% and 119.15% and during the night-time are 69.10% and 111.90%, respectively. While the overall total observations median and mean APE of the bicyclists during the daytime are 69.62% and 80.03% and during the nighttime are 89.47% and 80.15%, respectively. The evaluation of sensor B showed that the overall total observations median and mean APE of the pedestrians and bicyclists are 89.9% and 86.1%, respectively.

The research team highly recommends developing a simple counting system and use the same recorded video footage to evaluate the newly developed hardware/software system and compare its performance with the performance of both sensors A and B. It is concluded from processing the collected data of both sensor A and sensor B that they both couldn't develop a robust automated system that can replace manual counting statewide.

RECOMMENDATIONS

The results obtained from this study show that the APE of the pedestrians and bicyclists counts obtained by sensors A and B is high at the selected testing locations in New Orleans and Baton Rouge. Both sensors failed to give robust counting systems for both pedestrians and bicyclists at the selected testing locations and under different conditions (weather, time of the day, traffic volume, and density of pedestrians and bicyclists). The installation fees and the maintenance fees of sensor A are extremely high. The research team has no access to the object tracking algorithm of sensor A, so it is hard to expect why there is a huge gap between sensor A's counts and the manual counts. The research team highly recommends continuing evaluating other counting systems that could give robust systems with high and acceptable counting capability of both pedestrians and bicyclists. Additionally, researcher recommend developing a simple counting system and using the same recorded video footage to evaluate the newly developed hardware/software system and compare its performance with the performance of the current counting systems.