Passenger Counting System

Passenger counting is one of the basic methods of evaluating the effectiveness of timetables, routes and rolling stock utilization in public transportation. By collecting data on the number of passengers travelling on specific lines in relation to the time of day, you can effectively plan the use of available vehicles. Timetable modifications can minimize the costs of rolling stock utilization while keeping consistently high level of service, which results in passengers satisfaction. To make this possible, it is necessary to collect highly accurate and detailed data on the number of travelling passengers.

Infotron's Passenger Counting System offers **accuracy exceeding 98%*** and provides all the essential data needed for ridership analysis, planning of new routes and making necessary modifications to timetables.

Providing current timetables to the system makes it also possible to analyse each vehicle in terms of punctuality in relation to the time of day.
* - proven by tests conducted in cooperation with Warsaw Tramways

FACT:

 IR based systems, in most cases, use additional statistical calculations to "improve" raw data (which some manufacturers of IR systems do not hide [1]) to reach the accuracy threshold of 95%, which has become the industry standard for passenger counting systems. In many cases, systems with a declared accuracy of 95% do not reach even 90% [2] [3].

Passenger counting module.

Passenger counting modules are desgined to be installed in virtually any type of vehicle, regardless if it's a new vehicle with low-level floor, or older type one with stairs at the entrance. Each counter is installed inside vehicle above entrance (at ~2 m height) – for each pair of doors, regardless of its width, only one counter is needed, while most infrared based systems need two or more sensors for doors wider than 100cm.

Example installations in modern low-floor bus (above) and in an older type of tramway with stairs (below).

[1] „Statistical processing of passenger numbers" iris GmbH
[2] „APC validation and sampling for NTD and internal reporting at TRIMET" J.G. Strathman, T.J. Kimpel
[3] „Regional Smart Bus Demonstration Project Evaluation Report" King County Department of Transportation

Passenger counting modules use advanced stereoscopic image analysis - currently the most advanced technology for people counting, exceeding in almost every respect active and passive infrared based systems.
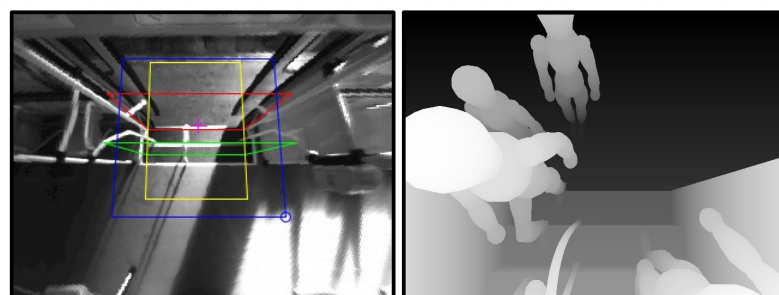

FACT:

Stereo-vision based systems are resistant to factors that deteriorate accuracy in IR systems, such as:

- High backround insolation and temperature changes;

- Background and passenger clothing color(especially black).

Analyzing differences in images observed by each of the two cameras, a disparity map is created - this enables the counting module to distinguish moving objects from the background with very high accuracy. Because the counting module sees the depth of the scene, it is possible to set the minimum height of detection, making it possible to ignore objects lower than a predetermined threshold, e.g. small children, a trolley, or a large suitcase.
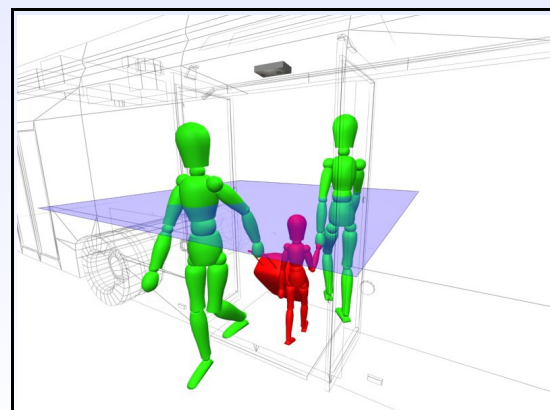
Configurable height threshold.


Virtual counting gates and depth map simulation.

FACT:

Verifying if the IR system is properly set requires either riding in a vehicle with people counting the passengers manually, or installing dedicated cameras with recorder.

The studies [4] have shown that the average length of time required to fully calibrate the system using infrared sensors, could take up to 17 months (!). Additionally almost one third of questionnaired users, stated that systems still weren't fully calibrated even after five years of operation.

The system has been successfully tested in Warsaw Tramways - full calibration of the system from its launch up to the point where it reaches maximum accuracy took only one day. During tests, the images from built-in cameras were used to verify the results of manual counting.

Additionally, video recordings from built-in cameras can be used for the purpose of periodic accuracy checks and fine tuning of the settings after repairs and service maintenance of the vehicles.
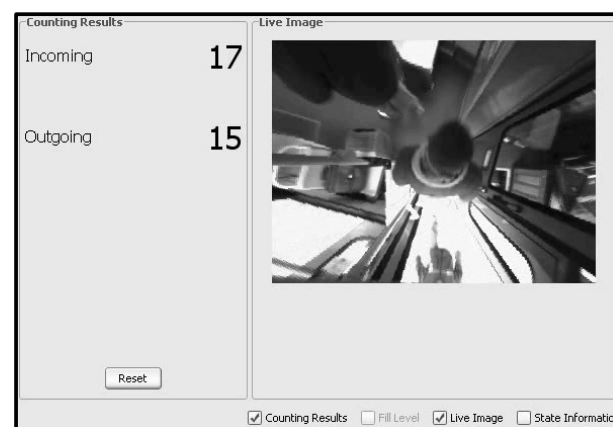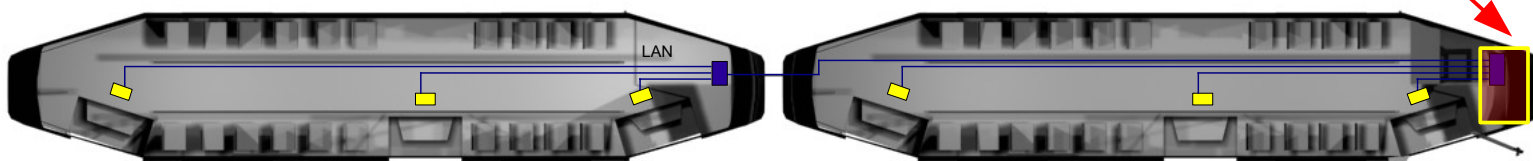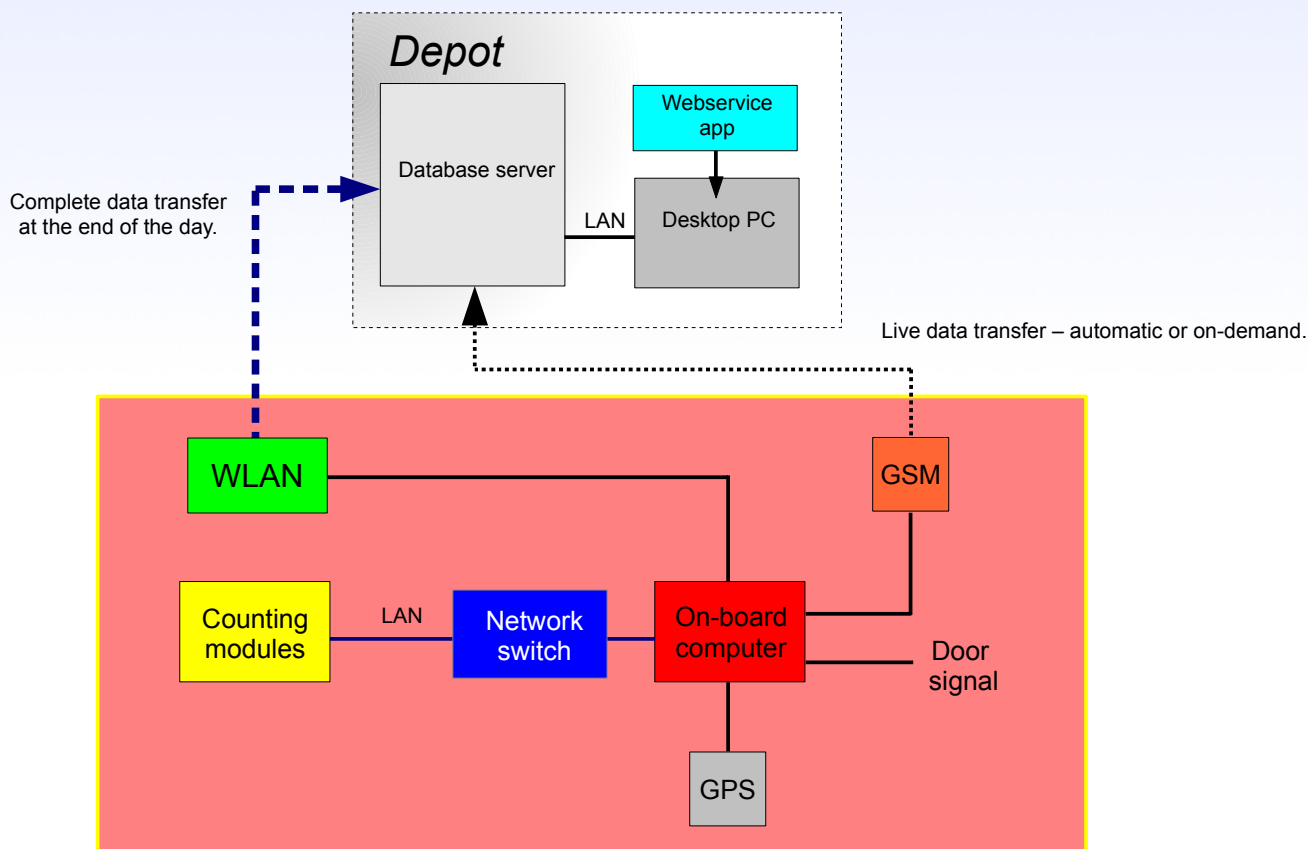

Major benefit - video-based counting accuracy verification.

[4] „Transit Cooperative Research Program TCRP Synthesis 77 – Passenger Counting Systems" Transportation Research Board of The National Academies

Besides counting modules, the system consists of on-board computer with GSM, GPS and Wi-Fi modules for wireless data transmission on the depot. Counting modules communicate with the on-board computer via LAN. Using network switch enables virtually unlimited number of counters to be connected to single computer.

The GSM modem can be used to send live information about current vehicle load and - if needed - other data, e.g. the vehicle delay status.

Complete data transfer at the end of the day.

Depot

Database server | LAN | Webservice app → Desktop PC

Live data transfer – automatic or on-demand.

WLAN | GSM

Counting modules | LAN | Network switch | On-board computer | Door signal

GPS

Exemplary installation diagram in older type of tramway.

LAN

The system can be supplied with basic reporting software or advanced database management system in order to create reports and statistics - manually or automatically according to configurable criteria, such as time interval, line, or group of stops.

Basic functionality, which is:

- counting passengers;
- automatic WLAN data transmission;
- GSM data transmission, e.g. current vehicle load;
- passenger counting database management;
- integration with timetable format in order to assign stop name to GPS position;
- generating reports from various group of vehicles and time periods;
- data export to spreadsheet or PDF;
- calculating additional parameters like passenger-kilometers, passenger exchange time, or
- deviations from time-table
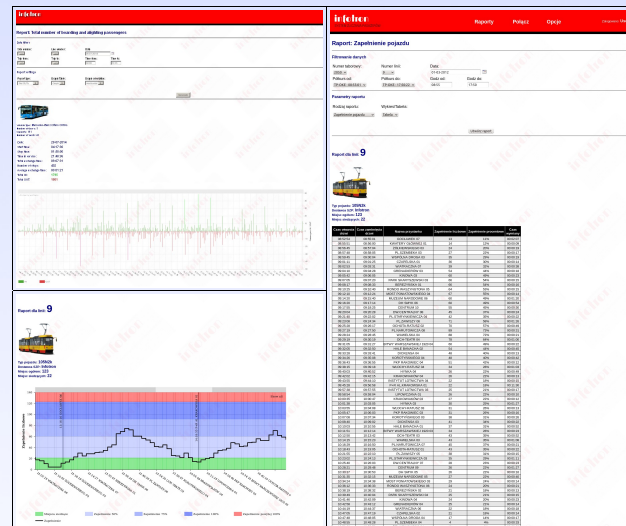
Exemplary screenshots from basic web-service reporting software.

can be expanded according to specific customer's needs, like connecting ticketing boxes or additional sensors to on-board computer to record additional parameters (e.g. using wheelchair ramp or using windshield wipers indicating rainy weather to assess its impact on the number of passengers travelling etc.).

If client already has his own software for statistical purposes it is possible to integrate our system with it.

We approach each client individually and we always offer the best solution to fulfill specific requirements.