

CLAIMS

[CLAIM 1] A congestion-state-monitoring system for estimating a congestion level for each region for substantially capturing an entire building or facility comprising:

an in-view congestion level estimation device that processes images from a plurality of cameras to estimate a congestion level in a range of each image;

a number-of-people counter that counts or estimates a number of people coming and going based on the image capturing an entrance and exit to the region,

a spatial congestion level estimation device that estimates a congestion level of a region out of the range of each image based on a result of the in-view congestion level estimation device; and

a graphical user interface that displays the congestion level of the region as a heat map, wherein:

the in-view congestion level estimation device outputs the number of people in the image that is estimated based on a sum of interest points or feature values extracted from each of the images as an in-view congestion level;

the spatial congestion level estimation device performs combining, complement, or analysis of the congestion level of the region based on an output of the number-of-people counter and a local congestion level based on the in-view congestion level estimation device to estimate a spatial distribution of the congestion level in the region; and

the graphical user interface displays the heat map which has color which depends on the output special distribution of the congestion level, at a point which is not included in the range of each image in the region.

[CLAIM 2] The congestion-state-monitoring system according to claim 1, wherein the spatial congestion level estimation device estimates a stay time or a distribution of the stay time for at least one floor by using a plurality of samples of combinations of average people densities and local people densities, which are obtained at a substantially same time; and estimates the congestion level at least one of a region where the congestion level is not directly determined by the number-of-people counter and a point which is out of capture range of the plurality of cameras, based on a model of a crowd behavior pattern constructed by a statistic model selection method.

[CLAIM 3] The congestion-state-monitoring system according to claim 1, further comprising a face detector that detects a face from the image capturing an entrance and exit to the region and outputs a number of faces, wherein

the in-view congestion level estimation device extracts an edge or a corner as the

interest point and performs segment regression using a plurality of sets of the sums and the numbers of the faces, each of the sums and each of the numbers of faces being obtained from a same image, thus estimating the number of people from any of the sums.

[CLAIM 4] The congestion-state-monitoring system according to claim 1, further comprising a face verification device which verifies the face;

wherein, based on a plurality of combinations of a flow-in time and a flow-out time of a same person having verified the face, a parameter of the staying time or a distribution of the staying time is calculated for each predetermined category regarding a characteristic of people;

wherein the spatial congestion level estimation device uses the calculated parameter of the staying time or the distribution of the staying time for a hyperparameter in a model of the crowd behavior pattern; and

wherein the graphical user interface is a digital signage terminal displays, as the heat map seen by general customers, a distribution of a current congestion level for the entire buildings or facilities, by using congestion levels in all the plurality of regions.

[CLAIM 5] The congestion-stage-monitoring system according to claim 4, further comprising a controller for controlling respective priorities of the plurality of cameras in the in-view congestion level estimation device, the number-of-people counter and the spatial congestion level estimation device,

wherein the controller temporally let the face verification device acts a mode of prioritizing faces to update a regression expression which is used for estimation by the in-view congestion level estimation device;

wherein the in-view congestion level estimation device counts people flows based on a flow of an edge or a corner; and

wherein the number-of-people counter selects a reliable one of a number of people of the number-of-people counter and the people flows of the in-view congestion level estimation device and uses the selected one.

[CLAIM 6] A congestion-state-monitoring method for estimating a congestion level for each of a plurality of regions which are neighborly set, according to structure of buildings or facilities, comprising:

a first step of processing images from a plurality of cameras and estimating an in-view congestion level in a range of each image;

a second step of counting or estimating a number of people coming and going based on the image capturing an entrance and exit to the region;

a third step of estimating a congestion level of the region out of the range of each image

based on estimation results of the first step and the second step; and

a fourth step of displaying a current congestion level of the entire buildings or facilities as a heat map on a graphical user interface, by using a congestion level of all the plurality of regions,

wherein the first step comprises outputting a number of people captured in the image as an in-view congestion level, which is estimated based on a total of numbers of interest points extracted from the each image;

wherein the third step comprises calculating at least one congestion level for each of the plurality of regions and outputting a spatial distribution of the congestion level, by combining, complement, or analysis of an average congestion level of the floor or the region based on a difference between a number of people flowing in and a number of people flowing out in the second step a local congestion level based on the first step; and

wherein the fourth step comprises displaying the heat map which has color which depends on the output special distribution of the congestion level, at a point which is not included in the range of each image in the region.