

METHOD AND APPARATUS FOR ANALYZING INTER-PERSONAL DISTANCE AND BEHAVIOR OF PURCHASING

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a method and apparatus for analyzing an inter-personal distance and a behavior of purchasing.

2. Description of Related Art

In retail stores such as shopping centers and convenience stores, it is important for efficient management to analyze customer flow line data and behavior and reflect the analysis to in-store arrangements and product selection that promote purchases. Until now, methods for evaluating product management and sales analysis using POS systems and determining customer flow lines, attributes, and behavioral patterns in actual stores to evaluate a conversion rate (CVR) and a product shelf visiting rate have been conceived. In addition, the degree of congestion in the store can also be considered as an influence on behavior of purchasing. So far, though there has been an example of calculating the number of people in a certain area from the people count, there is no example of evaluating the subjective sense of distance and approach time to another person in the store after entering the store. The evaluation of the influence

of subjective distance and approach time to another person on a behavior of purchasing becomes one element of knowledge that is essential for novel efficient store management.

JP2021-182220A discloses a system and a method for predicting movement destination of a moving object from flow line data and accordingly can realize a highly accurate flow line simulation.

JP2011-515758A discloses acquisition of shopper behavior data such as the time of product selection and the place of purchase when a shopper selects a product in a store, to provide an insight relating to product selection of a shopper.

JP2015-11649A discloses a system of detecting and analyzing a behavior of picking up an article placed in an article arrangement area.

In the related art, recording the distance between people and analyzing how the distance influences on a behavior of purchasing is not disclosed. JP2021-182220A cannot analyze a behavior of purchasing and an inter-personal distance by predicting a moving object from the distance between a plurality of people and the duration time thereof. JP2011-515758A records behavior data at the time of product selection of a shopper, that is, time that has been taken when a product is selected but cannot analyze a distance from another person and relevance of such data.

JP2015-11649A discloses detecting and analyzing an article acquisition behavior but cannot calculate a distance from another customer and research how the distance influences on a product acquisition behavior.

SUMMARY OF THE INVENTION

The present invention is to solve the problem described above in the related art and to provide a method and apparatus for analyzing an inter-personal distance and a behavior of purchasing that enables to evaluate and analyze how a distance or approach time to another person influences on a behavior of purchasing or a conversion rate at retail stores such as shopping malls and convenience stores.

In order to solve the problems in the related art, according to the present invention, apparatus for analyzing an inter-personal distance and a behavior of purchasing includes a people flow sensor that detects a movement of a person in a store; a flow line data recording unit that detects flow lines in the store of the plurality of people detected by the people flow sensor and records the flow lines as flow line data; an inter-personal distance analysis recording unit that analyzes a distance between the plurality of people by using the flow line data recorded in the flow line data recording unit and records behavior

patterns of the plurality of people obtained from the flow line data in an associating manner; a purchase index analysis recording unit that determines and records purchase circumstances of products in the store of the plurality of people recorded in the flow line data recording unit; a data storage unit that stores data recorded in the inter-personal distance analysis recording unit and data recorded in the purchase index analysis recording unit; and a result display unit that displays the data stored in the data storage unit.

In order to solve the problems in the related art, according to the present invention, in a method for analyzing an inter-personal distance and a behavior of purchasing by using analysis apparatus including a people flow sensor, a flow line data recording unit, an inter-personal distance analysis recording unit, a purchase index analysis recording unit, a data storage unit, and a result display unit, the method includes recording flow lines in a store of a plurality of people detected by the people flow sensor as flow line data in the flow line data recording unit; analyzing a distance between the plurality of people from the flow line data by the inter-personal distance analysis recording unit, recording the distance in association with behavior patterns of the plurality of people obtained from the flow line data, and determining and recording purchase circumstances of products in the

store of the plurality of people recorded in the flow line data recording unit by the purchase index analysis recording unit; storing data recorded in the inter-personal distance analysis recording unit and data recorded in the purchase index analysis recording unit in the data storage unit; and displaying the data stored in the data storage unit on the result display unit.

According to the present invention, it is possible to quantitatively evaluate the subjective sense of distance and approach time to another person in a store after a customer enters a retail store such as a shopping mall or a convenience store, and a relevance between such information and a conversion rate or a behavior of purchasing is analyzed, so that the analysis is useful for store management.

Problems, configurations, and effects other than those described above will be clarified by the following description in Description of Embodiments below.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram illustrating a configuration example of apparatus for analyzing an inter-personal distance and a behavior of purchasing according to Embodiment 1 of the present invention;

FIG. 2 is a diagram illustrating an example of

acquisition data of an acquired flow line of a people flow sensor according to Embodiment 1 of the present invention in a table format;

FIG. 3A is a front view of a vending machine area illustrating an example of an installation method for a people flow sensor of the vending machine area according to Embodiment 1 of the present invention;

FIG. 3B is a plan view of a vending machine area illustrating a flow line example that can be acquired by the people flow sensor in the vending machine area according to Embodiment 1 of the present invention;

FIG. 4 is a diagram illustrating a method for determining an approach distance and approach time in an inter-personal distance analysis unit according to Embodiment 1 of the present invention;

FIG. 5A is a diagram illustrating coordinate data recorded in an in-store staying recording unit in the inter-personal distance analysis unit according to Embodiment 1 of the present invention;

FIG. 5B is a diagram illustrating approach time data recorded in the in-store staying recording unit in the inter-personal distance analysis unit according to Embodiment 1 of the present invention;

FIG. 5C is a diagram illustrating distance calculate time data recorded in the in-store staying recording unit

in the inter-personal distance analysis unit according to Embodiment 1 of the present invention;

FIG. 6 is a flowchart illustrating a flow of processing in the inter-personal distance analysis unit according to Embodiment 1 of the present invention;

FIG. 7 is a table showing an analysis result example of the inter-personal distance and the behavior of purchasing according to Embodiment 1 of the present invention;

FIG. 8 is a histogram showing a relationship between a conversion rate and approach time to another person which is displayed on a result display unit according to Embodiment 1 of the present invention;

FIG. 9A is an in-store plan view illustrating a circumstance in which a position relationship of two people in a store is not recognized according to Embodiment 2 of the present invention;

FIG. 9B is an in-store plan view illustrating a circumstance in which a position relationship of two people in a store is recognized according to Embodiment 2 of the present invention;

FIG. 10A is a block diagram illustrating a configuration example of apparatus for analyzing an inter-personal distance and a behavior of purchasing according to Embodiment 2 of the present invention;

FIG. 10B is a block diagram illustrating a configuration example of the apparatus for analyzing an inter-personal distance and a behavior of purchasing according to Embodiment 2 of the present invention and is a diagram illustrating a configuration in which an inter-personal recognition analysis unit 303 is placed after an inter-personal distance analysis unit 301 with respect to the configuration of FIG. 10A;

FIG. 10C is a block diagram illustrating a configuration example of the apparatus for analyzing an inter-personal distance and a behavior of purchasing according to Embodiment 2 of the present invention and is a diagram illustrating an example in which flow line data recorded in a flow line data recording unit 201 and in-store arrangement/floor information input from an in-store arrangement/floor information input unit 202 are processed in parallel by the inter-personal distance analysis unit 301 and the inter-personal recognition analysis unit 303 with respect to the configuration of FIG. 10A;

FIG. 11 is an in-store plan view illustrating a queue that can be formed inside and outside of a store according to Embodiment 3 of the present invention;

FIG. 12 is a block diagram illustrating a configuration example of apparatus for analyzing an inter-personal distance and a behavior of purchasing according to

Embodiment 3 of the present invention;

FIG. 13 is a block diagram illustrating a configuration example of apparatus for analyzing an inter-personal distance and a behavior of purchasing according to Embodiment 4 of the present invention;

FIG. 14 is a diagram illustrating data of approach time between people that is measured in a store in a table format according to Embodiment 4 of the present invention;

FIG. 15 is a diagram illustrating an example of analysis results of attribute of in-store staying customers and inter-personal distance in a table format according to Embodiment 4 of the present invention;

FIG. 16 is a diagram illustrating an example of analysis results of customer serving time in a table format according to Embodiment 4 of the present invention; and

FIG. 17 is an in-store plan view illustrating a distribution of a degree of congestion in a store according to Embodiment 5 of the present invention.

DESCRIPTION OF EMBODIMENTS

The present invention relates to an apparatus for quantitatively analyzing a relationship between an inter-personal distance and a behavior of purchasing in a store and a method thereof. The apparatus includes an inter-personal distance analysis unit that calculates inter-

personal distance and approach time together with flow line data, and a purchase index analysis unit that quantitatively measures and evaluates a behavior of purchasing of a customer and enables to record a distance between people in an actual store and analyze how the distance influences on a behavior of purchasing.

That is, the present invention relates to apparatus for analyzing an inter-personal distance and a behavior of purchasing that analyzes a behavior by measuring a distance between people and has a configuration including an inter-personal distance measuring function of detecting a position of a person in an actual space in a measurement range and thoroughly measuring a distance between people in a case where there are a plurality of people, a time recording function of recording time when position information is acquired, a determination function of determining behavior patterns of people, from position coordinates, positions of hands, and positions of heads of each person, and a function of capable of recording inter-personal distances and behavior patterns in an associated manner.

In addition to the function of measuring an inter-personal distance of the analysis apparatus, the present invention further includes a mutual recognition determination function of considering of a layout of in-store arrangement, determining position coordinates of two

people to be measured and whether there is an obstacle therebetween, and determining whether the two people mutually recognize counterparts, a function of recording an inter-personal distance when it is determined to be recognized based on the mutual recognition determination function, a function of including a setting that can be changed per store with respect to the determination reference and determining that the two people are not mutually recognized in a certain predetermined distance or more, even in a status in which there is no blocking obstacle between people, a function of determining a direction of a body from a direction of hand, foot, head, or face, a travelling direction, a walking speed, or the like and estimating recognition of another person, and an inter-personal recognition distance measuring function of measuring an approach distance or approach time in case of recognition of another person when there are a plurality of people in a store.

In addition to the inter-personal distance measuring function, the present invention includes a queue determination function of determining whether a queue is formed by using any element of an inter-personal distance, a position where it is assumed that a queue is formed, moving speeds of individuals, a flow line with people in front and behind, a moving speed comparison, and the like,

by using a function of determining that a queue is formed inside and outside the store, a function of recording a length of the formed queue, waiting time, processing speed, and the like in the queue determination function, a function of recording a fact that a queue is formed inside or outside of the store and a fact that the queue is positioned where the queue is visible to passersby outside, and a function of recording an approach distance and approach time with another person who approaches in a queue waiting circumstance.

Further, in the inter-personal distance measuring function described above, the present invention includes a function of determining whether two people know each other, by using information of an inter-personal distance, information on time of staying nearby, timings of entering and leaving the store, comparison of moving speed, and queue determination/recording information, a function of recording a fact with which person an acquaintance relationship exists, time when a person with the acquaintance relationship stays within a certain predetermined distance, and a case where a person who is not in an acquaintance relationship comes within a predetermined distance in terms of the number of times, the number of people, and staying time, a function of determining whether a person is an employee, from any one

of staying time, a flow line record, characteristics of clothing, belongings, and portable items, information from a communication device possessed by the employee, and the like, and a function of recording inter-personal distances respectively, depending on whether the distances are a distance from an employee, a distance from a person who has an acquaintance relationship, and a distance from other people, and approach time to each of the people.

Hereinafter, embodiments of the present invention are described with reference to the drawings. The embodiments are examples for describing the present invention, and omissions and simplifications are appropriately made for clarity of explanation. The present invention can also be implemented in various other forms. Unless otherwise specified, each component may be singular or plural.

The position, size, shape, range, and the like of each component shown in the drawings may not represent the actual position, size, shape, range, and the like in order to facilitate the understanding of the invention. Therefore, the present invention is not necessarily limited to the position, size, shape, range, and the like illustrated in the drawings.

[Embodiment 1]

A first embodiment is described with reference to FIGS. 1 to 8.

FIG. 1 illustrates a block diagram of an analysis apparatus 10 including an inter-personal distance measuring function according to Embodiment 1. A simplified illustration of the components of the analysis apparatus 10 according to the present embodiment is illustrated in FIG. 1.

A people flow sensor 101 detects a position of a person in a measurement range of an actual space, transmits flow line data including coordinates of the person, information on the height of the head, and a position of a hand to a flow line data recording unit 201, and records the flow line data. The flow line data recording unit 201 records flow line data measured by the people flow sensor 101 and transmits the flow line data to an inter-personal distance analysis unit 301 and a purchase index analysis unit 302.

The inter-personal distance analysis unit 301 determines the number of people in the measurement range and sequentially calculates inter-personal distances when there is a plurality of people. The inter-personal distance analysis unit 301 calculates a distance from another person, whenever a coordinate position of a person is acquired, from the coordinate information of the person and acquired time information and converts the distance to inter-personal distance information. The inter-personal distance information indicates information showing to what distance

people approach each other, and information on time of staying in such a distance. In addition, information on the number of people detected in the measurement range or a circumstance how many people are there within a predetermined distance is also included in the inter-personal distance information.

The inter-personal distance information converted by the inter-personal distance analysis unit 301 is stored in an inter-personal distance information recording unit 401. An in-store staying recording unit 3011 is included inside of the inter-personal distance analysis unit 301 and records information on a position or time of a person staying in a store as described below.

The purchase index analysis unit 302 converts coordinate information of a person transmitted from the flow line data recording unit 201, positions of the head and a hand, acquired time information, and the like to purchase index information. The purchase index information includes information below.

First, the information is posture information, and the purchase index analysis unit 302 determines whether a person is in a status of standing upright in a store or in a status of crouching.

Second, the information is motion information, and a people flow sensor detects walking, stopping, or hand

stretching. In the sampling interval of the people flow sensor, the people flow sensor determines that the person walks, when position coordinates of the person change and determines that the person stops, when the position coordinates do not change, and the person is in a standing status for a long time. In addition, the people flow sensor can detect a hand stretching from the body of the person and can also record position coordinates of the stretching hand.

Third, the information is information on the number of people, and the information on the number of people such as the number of visitors, the number of purchasers known by purchase determination, the number of people who stops in front of a product shelf, the number of people who picks up a product, and the number of people of which a movement distance in the store is a certain predetermined distance or more is also included in the purchase index information.

The purchase index analysis unit 302 determines patterns of actions of picking up a product, putting a product into a basket, and the like, and actions of paying attention such as stopping in front of a shelf or slowing down, and records information obtained by analyzing purchasing actions of customers such as staying time and movement distance after the entrance into the measurement area, time taken for picking up an item, and time of taking

each action as purchase index information.

In addition, the purchase index analysis unit 302 also includes a function of determining whether a detected person makes a purchase, and the purchase information is also included in the purchase index information. As the method for determining a purchase, for example, in case of a vending machine, when a condition that a hand is close to an IC card reading unit for payment or an inserting unit for coins or bills for a predetermined period of time or more is satisfied, it is determined that a purchase is made. In case of an actual store where payment by a clerk or payment by a self-checkout machine is performed, a method for determining that a purchase is made when a person stops for a predetermined period of time or more in a specific area in front of a cash register may be exemplified. In case of a store without a cash register, it can be determined that a purchase is made when a product is picked up and taken out of the store.

The purchase index analysis unit 302 can calculate a movement distance or a walking speed of a person in the store from the flow line data sent from the flow line data recording unit 201, and the movement distance is also included in the motion information. In addition, with respect to the walking and stopping, duration time of each action can be also calculated, and the action duration time

also corresponds to purchase motion information.

The purchase index analysis unit 302 includes a function of counting the number of people who pass through a specific line, the number of people who stop, and the number of people who pick up an item, and determining whether a purchase in front of the cash register was made and counting the number of purchasers and can calculate a stop rate indicated by the number of people who stops at a certain area / the number of people who pass by, and a conversion rate indicated by the number of people who performs a purchasing action before a cash register / the number of people who enter a store, when a measurement range is a store.

The purchase index information as described above that is converted by the purchase index analysis unit 302 is stored in a purchase index information recording unit 402.

In addition, a case where the people flow sensor 101 includes a function of calculating any one of the purchase index information is considered, and in this case, the purchase index information calculated by the people flow sensor 101 is recorded in the flow line data recording unit 201 and is stored in the purchase index information recording unit 402 through the purchase index analysis unit 302.

In the purchase index analysis unit 302 as above,

together with data directly relating to sales such as the conversion rate or the number of visitor, information relating to a behavior of purchasing such as a movement distance or a walking speed of a visitor, and a stop time is also calculated. For example, if a movement distance in the store is long, or a walking speed is slow, opportunities of looking at various products increase, so it is considered that the movement distance and the walking speed influence on the purchase. Therefore, there is an effect of quantitatively evaluating behaviors of a customer who contributes to the sales from various angles, by individually calculating indexes of such behaviors of purchasing.

The inter-personal distance information stored in an inter-personal distance information recording unit 401 and the purchase index information stored in the purchase index information recording unit 402 are respectively stored in a data storage unit 403. Results of the inter-personal distance information and the purchase index information stored in the data storage unit 403 until now are displayed on a result display unit 501.

The people flow sensor 101 corresponds to a unit that detects coordinates or a posture of a person from an image recorded by a CCD sensor, a CMOS sensor, a security camera, or the like or a unit that projects electromagnetic waves

such as ultrasonic waves, microwaves, and infrared rays and detects a coordinate position or a posture of a person by detecting reflected waves. In this manner, by detecting a person in a store, flow line data as illustrated in FIG. 2 is output.

FIG. 2 is a diagram illustrating the flow line data in a table format, and the data are listed in chronological order in the vertical direction of the table. Contents of the time-series data are listed in the horizontal direction, and in the column of ID: 0201, identification numbers assigned to flow lines of detected people are shown. When a new flow line is detected in the measurement area, a new ID can be assigned at any time. The column of Time 0202 shows time stamp information indicating time when the time-series data is received. The column of Coordinates of Person 0203 shows coordinate information indicating positions of detected people as XY coordinates on a floor plane that is a measurement target, in units of millimeters. The column of Height of Head 0204 shows height coordinates indicating heights of heads of the detected people from the floor, in units of millimeters.

In the column of Status 0205, in case of detection for the first time, "appear" is displayed, and in case of detection for the last time, "disappear" is displayed. In addition, with respect to a person having the same ID in

the column of ID: 0201, when the column of Coordinates of Person 0203 changes, it is determined as "walking". When the column of Coordinates of Person 0203 does not change, if Height of Head 0204 is equal to or longer than 80% of the body length, it is determined as "standing upright" in the column of Status 0205. If Height of Head 0204 is less than 80% of the body length, it is detected as "crouching" in the column of Status 0205.

In addition, it is possible to detect that a hand stretches from the body of a detected person, and in this case, it is detected as "hand stretching" in the column of Status 0205. When "hand stretching" is detected, coordinates of a fingertip of the stretching hand are displayed in the column of Coordinate of Hand 0206. The column of Coordinate of Hand 0206 shows space coordinate information indicating positions of fingertips of hands of detected people who stretch hands as XYZ coordinates in the floor space, in units of millimeters. The data that is recorded in the flow line data recording unit 201 of FIG. 1 includes all or any one of Data 0201 to 0206 in the horizontal axis of FIG. 2.

FIG. 3A illustrates an installation example of a people flow sensor in a vending machine installation location, and FIG. 3B illustrates a flow line shown based on a position when a person is detected at that time. In

FIG. 3A, 0301 and 0302 indicate vending machines, 0303 indicates a people flow sensor mounted on the ceiling, and 0304 indicates an entrance.

In FIG. 3A, the plurality of people flow sensors 0303 are installed at positions where it is possible to exhaustively detect all the locations from where customers enter to where the customers move until the customers select and purchase products at the vending machine 0301 or 0302.

In FIG. 3B, 0305 and 0306 are vending machines and correspond to the vending machines 0301 and 0302 of FIG. 3A. When a person enters the measurement range, the people flow sensor 0303 records time and position coordinates, and a diagram obtained by plotting the time and position coordinates is FIG. 3B. In FIG. 3B, position coordinates in a circumstance in which two people enter a measurement area 0309 at the same time are plotted and shown as flow lines of 0307 and 0308.

The inter-personal distance analysis unit 301 uses flow line data recorded by the flow line data recording unit 201 and calculates inter-personal distance and approach time in the store. The calculated structure is illustrated in FIG. 4. In FIG. 4, a circumstance in which there are two people of a person P1 and a person P2, the person P1 stops at that position (the position is displayed as P1: 411), and the person P2 walks (each position at time t_a to time t_e

of the person P2 is displayed as P2: 421 to P2: 425) is assumed. For example, in FIG. 4, a case where the person P2 moves at time t_b to time t_c is considered. At the time t_c , a distance between P1: 411 and P2: 423 is calculated from the coordinates of P1: 411 and P2: 423, and in this case, a distance is 0.5 m or more and less than 1.0 m, so a structure in which $t_c - t_b$ is added to time when another person is 0.5 m or more and less than 1.0 m at P1: 411 is obtained.

In case of implementing this algorithm, (a) position coordinate information of all people in the store, (b) time information of approaching within a predetermined distance in all combinations of two people among people staying in the store, and (c) time information when an inter-personal distance of the two people is calculated in the last time, with respect to all combinations of two people among the people staying in the store are necessary, and thus it is required to update the information each time of reading the flow line data.

Here, it is assumed that time when another person approaches within 1.0 m is calculated, processing at the time t_c of FIG. 4 is described. With respect to (a), position coordinates of the person P1 and the person P2 are updated, and the distance between P1: 411 and P2: 423 at the time t_c is calculated. At the time t_c , P1: 411 and P2:

423 are within 1.0 m, and thus $t_c - t_b$ is added to the approach time (within 1.0 m) of the person P1 and the person P2 in (b). Here, the time t_b is time immediately before the time t_c when the distance between the person P1 and the person P2 is calculated, and this uses the information of (c). Also, time when the approach distance between the person P1 and the person P2 is calculated for the last time in (c) is updated to t_c , and the processing proceeds to processing of the time t_d . Here, a part where information of (a), (b), and (c) is recorded is described as the in-store staying recording unit 3011. An in-store staying recording unit 3011 is included in the inter-personal distance analysis unit 301 as a part of the inter-personal distance analysis unit 301.

An example of the information recorded in the in-store staying recording unit 3011 is illustrated in FIGS. 5A to 5C.

FIG. 5A illustrates an example in which coordinate information of the in-store staying customer of (a) is recorded in the in-store staying recording unit 3011. The horizontal axis 0501 of FIG. 5A indicates IDs of detected people, and position coordinates of the people in the store in a processing step are recorded.

FIG. 5B is a table showing an example in which time information in case of approaching within a predetermined

distance (here, within X m, in a case where $X = 1.5$ is illustrated in FIG. 5B) with respect to all combinations of two people among the people staying in the store of (b) is recorded in the in-store staying recording unit 3011. In FIG. 5B, all of the horizontal axis 0503 and the vertical axis 0502 indicate IDs corresponding to the people in the store and time of approaching within 1.5 m with respect to respective combinations of two people in the store is accumulated and recorded.

All of the horizontal axis 0505 and the vertical axis 0504 of FIG. 5C are IDs corresponding to people, and FIG. 5C shows an example in which final approach distance determination time when distances between the two people (inter-personal distance) with respect to all combinations of two people among the people staying in the store are calculated for the last time is recorded in the in-store staying recording unit 3011.

The information of the in-store staying recording unit 3011 as shown in FIGS. 5A to 5C is updated from the data of the flow line data recording unit 201 in FIG. 1, and a flowchart of an algorithm of generating the data of the inter-personal distance information recording unit 401 of FIG. 1 is illustrated in FIG. 6. In FIG. 6, whenever flow line data is called from the flow line data recording unit 201, position coordinates of the called person in the in-

store staying recording unit 3011 are updated, a distance from another person in the store is calculated, approach time within X m is updated when the distance is within X m, and time when a distance between the called person and another person in the store is calculated for the last time is updated. In addition, if the called person is detected for the last time, the information of the person in the in-store record is stored in the inter-personal distance information recording unit 401 of FIG. 1, and thereafter information relating to a disappeared person is deleted from the in-store staying recording unit 3011.

The flowchart of FIG. 6 is described. The flowchart of FIG. 6 includes Loop Processing 1 of sequentially reading flow line data, Loop Processing 2 of reading information of another person in the store in the in-store staying recording unit 3011, and Loop Processing 3 of reading information of another person in the store in the in-store staying recording unit 3011 with respect to a newly appeared person.

First, in Loop Processing 1, in the inter-personal distance analysis unit 301, loop is performed until all flow line data is read from the flow line data recording unit 201 in a chronological order of the recorded time (S601). First, ID: 0201 of a person that is sequentially read is set as P3, Coordinates of Person 0203 is set as C1, and recorded time

0202 is set as T1 (S602).

Subsequently, whether Status 0205 of the person corresponding to the read ID: 0201 corresponds to new appearance (whether 0205 is appear) is checked (S603).

When the status does not correspond to new appearance (in case of No in S603), the position coordinates of the person P3 in the in-store staying recording unit 3011 are updated to the coordinates C1 (S604), and the processing enters Loop Processing 2.

In Loop Processing 2, loop is performed from S606 to S609 until information of all people other than the person P3 in the store is read from the in-store staying recording unit 3011 (S605). Firstly, information of one person other than the person P3 is read, the ID of the read person other than the person P3 is set as P4, the position coordinates are set as C2 (S606), and final approach distance determination time T2 between the person P3 and the person P4 is read from the in-store staying recording unit 3011 (S607). Next, the distance between the person P3 and the person P4 is calculated from the coordinates C1 and the coordinates C2, and the approach time is updated by adding a time difference between the time T1 and the time T2 to the approach time of the person P3 and the person P4 in the in-store staying recording unit 3011 in case of the distance is within the reference distance of X m (S608).

Subsequently, the final approach determination time between the person P3 and the person P4 in the in-store staying recording unit 3011 is updated to the time T1 (S609). With the above, the processing of Loop Processing 2 for one time ends, and the processing returns to S605 (S610).

In S605, completion determination of Loop Processing 2 is performed, and the processing gets out of Loop Processing 2 when there is no information of a person other than the person P3 that is not read in the in-store staying recording unit 3011, and Loop Processing 2 is repeatedly performed when information of a person other than the person P3 that is not read remains in the in-store staying recording unit 3011 (S605).

Meanwhile, when it is determined that Status 0205 of the person P3 corresponding to ID: 0201 read in S603 corresponds to new appearance (in case of Yes in S603), an information recording unit of the person P3 corresponding to the read ID: 0201 is added to the in-store staying recording unit 3011 (S611), and the processing enters Loop Processing 3.

In Loop Processing 3, loop is performed from S613 to S615 until information of all people other than the person P3 in the store is read from the in-store staying recording unit 3011 (S612). Firstly, information of one person other than the person P3 is read, and the ID of the read person

other than the person P3 is set as P5 (S613). Next, final approach determination time between the person P3 and the person P5 in the in-store staying recording unit 3011 is set as the time T1 (S614), and the approach time between the person P3 and the person P4 is recorded as 0 (S615). With the above, the processing of Loop Processing 3 for one time ends, and the processing returns to S612 (S616). In S612, the completion determination of Loop Processing 3 is performed, the processing gets out of Loop Processing 3 when there is no information of a person other than the person P3 that is not read in the in-store staying recording unit 3011, and Loop Processing 3 is repeatedly performed when information of a person other than the person P3 that is not read remains (S612).

In the step in which Loop Processing 2 or Loop Processing 3 ends, whether Status 0205 of the person corresponding to the read ID: 0201 with respect to the sequentially determined person P3 is the final detection of the person P3 (whether 0205 disappears) is checked (S617), the information of the person P3 in the in-store staying recording unit 3011 is recorded in the inter-personal distance information recording unit 401 when the status corresponds to the final detection (in case of Yes in S617) (S618), all information relating to the person P3 in the in-store staying recording unit 3011 is deleted (S619), and

the processing of Loop Processing 1 for one time ends, and returns to S601 (S620). When Status 0205 of a person corresponding to the read ID: 0201 does not correspond to the final detection of the person P3 (in case of No in S613), the processing of Loop Processing 1 for one time ends as it is and returns to S601 (S620).

In S601, completion determination of Loop Processing 1 is performed, and Loop Processing 1 is repeatedly performed when read flow line data remains, and Loop Processing 1 ends when read flow line data does not remain (S601).

An example of analysis data obtained from the measurement of FIGS. 3A and 3B is illustrated in FIG. 7. FIG. 7 is a diagram illustrating analysis data in a table format and lists data per person in the vertical direction of the table. In the horizontal direction, purchase index information and inter-personal distance information are shown.

In the column of Purchase Determination 0702, results of the purchase determination performed by the purchase index analysis unit with respect to the person of the corresponding Person ID: 0701 are recorded. In the column of Operation Time 0703, time of each action detected with respect to the person of the corresponding Person ID: 0701 is indicated in units of seconds. Here, duration time of

"walking", "standing upright", and "purchasing action" is recorded, and with respect to "walking" and "standing upright", the duration time of the statuses of "walking" and "standing upright" in the statuses output in the column of Status 0205 of FIG. 2 is indicated. The "purchasing action" is duration time of a status in which "crouching" or "hand stretching" is detected in the column of Status 0205 of FIG. 2. In addition, in the column of Operation Time 0703, for example, items such as walking time or standing upright time may be included, until the purchase is determined.

In the column of Movement Distance 0704 of FIG. 7, movement distances during when people corresponding to Person IDs: 0701 are detected are recorded in units of meters. In addition, in the column of Time Until Buying 0705, when purchase is determined in the column of Purchase Determination 0702, time from the detection to the purchase determination is indicated. In addition, in the column of Staying Time of Another Person 0706, time when another person different from Person ID: 0701 comes close to Person ID: 0701 is output as a list.

Note that, here, the staying time of another person is divided into five steps of less than 0.5 m, 0.5 m or more and less than 1.0 m, 1.0 m or more and less than 1.5 m, 1.5 m or more and less than 2.0 m, and 2.0 m or more, and results

obtained by calculating staying time of another person in each range are shown. The ranges of the time are divided into optimal ranges from the store forms or analysis results. For example, the store form is classified into three steps of less than 10 square meters, 10 square meters or more and less than 50 square meters, and 50 square meters or more according to the floor area, into three steps of less than 4 employees, 4 employee or more and less than 20 employees, 20 employees or more according to the number of employees, or into three steps of less than 500 types, 500 types or more and less than 3,000 types, and 3,000 types or more according to the number of types of products.

Further, these are combined, the number of points of each level is set, for example, as 1, 2, and 3 points, and group classification is performed stepwise, so that the store is set as a small scale if the value obtained by adding the points is less than 5 points, the store is set as a medium scale if the value is 5 points or more and less than 8 points, and the store is set as a large scale if the value is 8 points or more. Further, the reference distances according to the groups are set as 70 cm, 120 cm, and 170 cm, and time during when another person stays within the reference distances is recorded.

In this manner, by simultaneously recording the items such as staying time of another person, a purchase

circumstance, and an operation time, data that enables to analyze the inter-personal distance and purchase circumstance can be stored and thus has an effect of being useful for management strategies in a store.

The result display unit 501 displays the inter-personal distance information and the purchase index information as analysis results of an approach distance or time from the data storage unit 403 and a purchase circumstance. The result display unit 501 can simultaneously display information from the inter-personal distance information recording unit 401 and the purchase index information recording unit 402. The relationship between the inter-personal distance, time of an action taken by each person, the stop rate, or the conversion rate is visually shown in a dashboard. The result display unit 501 can perform not only comparison based on data continuously taken in the same measurement area but also perform comparison with a result of an area in the different measurement range such as relationship between an inter-personal distance and a conversion rate or a stop rate in another store. In addition, the information that can be displayed on a dashboard can be output as a report in a document format.

Here, an example displayed on the result display unit 501 of FIG. 1 is illustrated in FIG. 8. In FIG. 8, Histogram

801 indicating average time during when another person exists within 1.5 m as one index indicating an approach distance with another person or approach time in the horizontal axis and a conversion rate as an example of a purchase index in the vertical axis is shown. Herein, the distance is set as within 1.5 m, but the value of index is various according to a store form or the like, in practice. In the vertical axis, a conversion rate calculated from a corresponding person in each range of the horizontal axis is indicated, and accordingly, a degree of congestion in which a conversion rate becomes the highest in a retail store is calculated from an inter-personal distance and approach time.

In FIG. 8, the conversion rate becomes the highest, when average time during when another person exists within 1.5 m is a value in a certain degree, and this result means that the conversion rate decreases when the store is too congested or contrarily when there are too less customers. It is possible to conduct analysis by using an approach distance with another person and approach time, as indexes of the ideal degree of congestion for increasing such a conversion rate.

In addition, in this analysis, when there is no one else in the store and there is only one person in the store, the conversion rate, the in-store staying time, the flow

line length, and the like are respectively measured as purchase indexes when there is no one within 1.5 m.

According to the present embodiment, the relationship between inter-personal distance in a store and sales can be analyzed by the above analysis. This makes it possible to compare the difference in purchasing indexes such as staying time in a store, stop time, a movement distance, and a walking speed during congestion time when there are many other people in an actual store and during an off-peak period when the store is empty, and there is an effect of being useful for store management by presenting the optimum degree of congestion for promoting a behavior of purchasing.

In addition, according to the present embodiment, it is possible to quantitatively evaluate the subjective sense of distance or approach time to another person in the store after entering the store in a retail store such as a shopping mall or a convenience store, and thus the analysis of relevance between the information and a conversion rate or a behavior of purchasing also leads to an effect of being useful for store management.

[Embodiment 2]

The inter-personal distance analysis unit 301 described in Embodiment 1 detects how many people exist in a measurement area and calculates distances between respective people. However, in the present embodiment, an

example in which not only a simple distance but also recognition with each other is also considered, and an inter-personal distance after recognition of a counterpart is calculated is illustrated with reference to FIGS. 9A to 10C.

FIGS. 9A and 9B illustrate a circumstance in which there are people two by two: a person P6: 911 and a person P7: 912, and a person P8: 913 and a person P9: 914 in a plan view of the floor. The reference numeral 0901 in FIG. 9A and the reference numeral 0902 in FIG. 9B denote product shelves that block the view.

FIG. 9A illustrates a status in which two people of the person P6 and the person P7 exist near the corner of the product shelf 0901. The status is a status in which the existence of the person P6 and the person P7 is not mutually recognized since the product shelf 0901 blocks the lines of sight of the person P6 and the person P7 each other. The blockage can be determined from the fact that a straight line 921 is caught by a part of the product shelf 0901 when the person P6: 911 and the person P7: 912 are connected with the straight line 921. Accordingly, in the status of FIG. 9A, for example, even if the inter-personal distance between the person P6: 911 and the person P7: 912 is within the reference distance recording the staying time with another person, the person P6: 911 is in a status of not recognizing

the person P7: 912, and thus it can be determined that the approach distance with another person and the staying time do not correspond to the approach distance with another person and the staying time in which the people are mutually recognized.

Meanwhile, FIG. 9B illustrates a status in which the person P8: 913 can identify and recognize the person P9: 914, and the approach distance and the staying time with another person in which the people are mutually recognized are updated, if the inter-personal distance between the person P8: 913 and the person P9: 914 is within the reference distance in which the staying time of another person is recorded. This can be determined from the fact that a straight line 922 that connects the person P8: 913 and the person P9: 914 does not intersect with the area of the product shelf 0902. In addition, in case of the determination whether the people recognize each other, a function of estimating the direction of the body from a direction of a hand, a travelling direction, or the like and determining whether the direction faces the direction where another person exists or is within a field of view is included. In addition, obstacles can include the height of shelves and the visibility of the opposite side and can be set for each store.

FIG. 10A is an example of a configuration diagram of

an analysis apparatus 20 according to the present embodiment, to which an analysis unit that performs recognition determination of another person is incorporated. The same configurations as those described with reference to FIG. 1 according to Embodiment 1 are denoted by the same reference numerals, and the description thereof is omitted.

In FIG. 10A, an in-store arrangement/floor information input unit 202 is provided in order to determine whether two people in the store are mutually recognized based on an in-store arrangement diagram. Whether a person who corresponds to the flow line data recognizes another person who stays in the store is determined by an inter-personal recognition analysis unit 303 based on the flow line data recorded in the flow line data recording unit 201 and the in-store arrangement/floor information input from the in-store arrangement/floor information input unit 202.

As a result of the determination by the inter-personal recognition analysis unit 303, if it is determined that the person recognizes the another person, approach distance of the another person and the time during when the another person stays near the person are calculated by the inter-personal distance analysis unit 301, and the result thereof is recorded by the inter-personal distance information recording unit 401. The inter-personal recognition analysis unit 303 determines whether another person is recognized by

using any one of whether there is no obstacle between the two people by the method described with reference to FIGS. 9A and 9B, whether the person faces the direction of the counterpart by estimating the direction of the body from the direction of the hand, the travelling direction, or the like, or whether the approach distance is within a certain reference distance (the reference distance can be set per store).

In addition, instead of the configuration of the analysis apparatus 20 illustrated in FIG. 10A according to the present embodiment, the inter-personal recognition analysis unit 303 can be arranged after the inter-personal distance analysis unit 301 as in an analysis apparatus 21 illustrated in FIG. 10B. In this case, the result analyzed by the inter-personal distance analysis unit 301 is received, the inter-personal recognition analysis unit 303 determines whether another person is recognized, and the result analyzed by the inter-personal distance analysis unit 301 is reflected to the inter-personal distance information recording unit 401, when it is determined that the another person is recognized.

In addition, like an analysis apparatus 22 illustrated in FIG. 10C, there may be a process of processing the flow line data recorded in the flow line data recording unit 201 and the in-store arrangement/floor information input from

the in-store arrangement/floor information input unit 202 in parallel, by the inter-personal distance analysis unit 301 and the inter-personal recognition analysis unit 303, and reflecting the result of the inter-personal distance analysis unit 301 and the result of the inter-personal recognition analysis unit 303 to the inter-personal distance information recording unit 401.

In addition to the effect described in Embodiment 1, according to the present embodiment, the degree of congestion that is subjectively felt in a store in practice can be quantitatively evaluated by determining whether another person is recognized and calculating an approach distance with another person or approach time. Accordingly, since a degree of congestion that a customer actually felt, the degree of congestion that has been unable to be measured for each customer who enters the store can be measured, the relationship between the subjective degree of congestion and the behavior of purchasing can be analyzed and thus has an effect of capable of being used for a measure for promoting the behavior of purchasing.

[Embodiment 3]

As a third embodiment of the present invention, an example of detecting a queue that can be formed inside and outside of a store from an inter-personal distance and a behavior pattern of a customer and analyzing a relationship

between a purchase index such as the number of visitors or a conversion rate and a queue or waiting time is described with reference to FIGS. 11 and 12.

A store having an in-store plan view as in FIG. 11 is assumed. The reference numeral 1101 in FIG. 11 denotes an actual store, and the reference numerals 1102 to 1108 denote product shelves. In addition, the reference numeral 1109 denotes a cash register counter, the reference numeral 1110 denotes an entrance, the reference numeral 1111 denotes a queue waiting a payment in the cash register that is formed in the store, and the reference numeral 1112 denotes a queue waiting for admission that is formed outside the store due to entry restrictions. Further, a person P10: 1121 is a clerk who operates a cash register at the cash register counter 1109, and a person P11: 1122 is a customer who pays at the cash register counter 1109. Here, with respect to the queue 1111 or 1112, a lined-up status is determined by using any element of the inter-personal distance with another person, in-store position information that is assumed to form the queue 1111, a walking speed of the surroundings, stop time, and retention time.

The configuration diagram of an analysis apparatus 30 according to the present embodiment is illustrated in FIG. 12. In the configuration of the analysis apparatus 30 according to the present embodiment illustrated in FIG. 12,

the same configurations as described with reference to FIG. 1 according to Embodiment 1 and FIGS. 10A to 10C according to Embodiment 2 are denoted by the same reference numerals, and the description thereof is omitted.

In the configuration of the analysis apparatus 30 according to the present embodiment illustrated in FIG. 12, a queue determination analysis unit 304 determines a queue from in-store arrangement/floor information input from the in-store arrangement/floor information input unit 202, coordinate and time information of a person recorded in the flow line data recording unit 201, and inter-personal distance information calculated by the inter-personal distance analysis unit 301. The queue determination analysis unit 304 includes a function of calculating the length of the queue 1111 or 1112 and waiting time in case of being determined as the queue 1111 or 1112.

The information relating to the waiting time and the length of the queue that is determined as the queue status and calculated by the queue determination analysis unit 304 is transmitted to the purchase index information recording unit 402. In addition, the approach distance or approach time with another person in case of the queue is transmitted to the inter-personal distance information recording unit 401 in a status of capable of being recorded by distinguishing from the approach distance and time with

another person that are generated when a person freely goes around the inside of the store.

In addition, the purchase index analysis unit 302 of FIG. 12 includes a function of regarding people who stay at a payment position that is the position of the person P11: 1122 of FIG. 11 for a certain period of time or more as purchasers with respect to the number of visitors, calculating the number of people, and calculating a conversion rate as a proportion of purchasers to the visitors.

The queue 1111 in FIG. 11 is a queue waiting for a payment that is formed in the store, and the queue 1112 is a queue waiting for admission that is formed outside the store due to entry restrictions. The analysis apparatus 30 according to the present embodiment illustrated in FIG. 12 can analyze how much the length, waiting time, and the like of the queue that are calculated by determining and analyzing the queues 1111 and 1112 respectively influence on the conversion rate or the number of visitors and can analyze the influence on the purchase index of the queue formed inside and outside of the store.

According to the present embodiment, in addition to the effects described in Embodiments 1 and 2, there is an effect of analyzing the influence on the purchase index of the queue that is formed inside and outside of the store.

[Embodiment 4]

As a fourth embodiment of the present invention, a configuration of an analysis apparatus 40 when an inter-personal relationship is estimated from the inter-personal distance and the approach time obtained by measurement is illustrated in FIG. 13. In the configuration of the analysis apparatus 40 according to the present embodiment illustrated in FIG. 13, the same configurations as the configuration described with reference to FIG. 1 according to Embodiment 1, the configuration described with reference to FIGS. 10A to 10C according to Embodiment 2, and the configuration described with reference to FIG. 12 according to Embodiment 3 are denoted by the same reference numerals, and the description thereof is omitted.

In the analysis apparatus 40 according to the present embodiment illustrated in FIG. 13, it is assumed that a position of an employee in the store is known from position information of a smart phone or possession of an RFID tag in advance. Whether a person is an employee is determined by an employee determination unit 305 by comparing the position information of the employee acquired by an employee position information acquisition unit 203 and flow line data recorded in the flow line data recording unit 201. Note that, a method for specifying an employee includes causing an employee to wear clothing with special reflective

materials in advance and detecting the materials; or detecting an employee based on face information or clothing learned by image recognition.

After the employee determination unit 305 identifies whether each person is an employee, the inter-personal approach distance and the approach time are calculated by the inter-personal distance analysis unit 301, and a group attribute determination unit 306 determines whether the person is an acquaintance based on the information. As the determination method, for example, if a person is not determined as an employee, a person who is within 1.5 m for 20 seconds or more is set as an acquaintance. Here, a distance or time as a reference is determined in view of a store form and a circumstance of the surroundings. In addition, whether a person is an acquaintance can be determined in view of the timing of entering or leaving the store, walking speed, and the like.

The inter-personal distance information and approach information from the group attribute determination unit 306 are recorded in an acquaintance information recording unit 404, an another person approach information recording unit 405, and an employee approach information recording unit 406.

When neither is determined as an employee by the employee determination unit 305, the number of people who

are within 1.5 m for 20 seconds or more to be determined as acquaintances by the group attribute determination unit 306 and the time during when both are in a distance within 1.5 m are recorded in the acquaintance information recording unit 404.

When neither is determined as an employee by the employee determination unit 305, for example, the number of people who stay within 1.5 m for less than 20 seconds and are not recognized as acquaintances, total time during when a person who is not determined as an acquaintance stays within 1.5 m, or the like is recorded in the another person approach information recording unit 405.

With respect to a person determined as an employee by the employee determination unit 305, for example, time during when a customer who is not an employee stays within 1.5 m from the person is defined as customer serving time to the customer, and the customer serving time for each customer is recorded in the employee approach information recording unit 406. Total customer serving time for a customer having an acquaintance by each employee, a total of customer serving time for a customer not having an acquaintance, and the like are also calculated. In addition, with respect to a person who is not determined as an employee by the employee determination unit 305, if there is an employee within 1.5 m from the person, it is assumed that

the person is in contact with the employee (is a served customer), the staying time during when the employee is within 1.5 m is assumed as customer serving time. The customer serving time of each visiting customer is recorded in the employee approach information recording unit 406.

The information of the acquaintance information recording unit 404, the another person approach information recording unit 405, and the employee approach information recording unit 406 is stored in the data storage unit 403, and the result thereof is displayed on the result display unit 501.

In the result display unit 501, the histogram described with reference to FIG. 8 according to Embodiment 1 is displayed by dividing into a case of a customer having an acquaintance and a case of a single customer, or a histogram in which the horizontal axis of FIG. 8 is indicated by staying time, stop time, a movement distance, customer serving time, the number of other people who pass by, and the like is displayed.

Here, the single customer refers to a customer not having a person determined as an acquaintance. In addition, distribution or an average of customer serving time, and purchase indexes such as a conversion rate, stop time, staying time, and a movement distance corresponding to it can be displayed. Accordingly, there is an effect of

visualizing sales of a single customer or sales of a person having an acquaintance in an actual store or leading analysis of customer serving time to sales strategies of a store.

Here, for example, a case where there are four people and one employee in a store is assumed. A vertical axis 1401 and a horizontal axis 1402 in FIG. 14 both are detected person IDs, and total time during when two people approach within 1.5 m is shown. Here, the location of the employee is known by the possession of an RFID tag, and the employee is determined by the employee determination unit 305. In addition, by comparing approach time of three people within 1.5 m, people who approach for 20 seconds or more are determined to be in an acquaintance relationship. According to the present embodiment, the time of approaching within 1.5 m is referred to as contact time, and the number of people who approach within 1.5 m are referred to as the number of contact people.

The information is recorded as illustrated in FIG. 15. FIG. 15 is a diagram illustrating analysis data in a table format, and data of Person ID: 1501 for each person who is not determined as an employee by the employee determination unit 305 is listed in the vertical direction of the table. Information on the number of contact people or contact time of the employee, the acquaintance, and another person is

displayed in the horizontal direction. The column of Person ID: 1501 indicates IDs of the detected people. The column of Acquaintance Relationship 1502 records person IDs determined as acquaintance with each person ID of the column of Person ID:1501. The column of Contact Time with Acquaintance 1503 indicates total contact time with a person determined as an acquaintance in the column of Acquaintance Relationship 1502. The column of Number of Acquaintances 1504 indicates the number of people determined as acquaintances listed in the column of Acquaintance Relationship 1502.

In the column of Number of Contact People with Employee 1505, the number of employees who have served a person of each ID is indicated, and in the column of Contact Time with Employee 1506, total time of being served is shown. The column of Contact Time other than Employee or Acquaintance 1507 indicates total contact time during when another person who is not determined as an acquaintance or an employee approaches within 1.5 m. In the column of Number of Contact People other than Employee or Acquaintance 1508, the number of people who approach within 1.5 m but are not determined as acquaintances or employees. In the column of Purchase Determination 1509, whether the person with the person ID performs purchase determination by the purchase index analysis unit 302 is recorded.

With respect to a customer who is determined to have an acquaintance in FIG. 15, the information in the column of Acquaintance Relationship 1502, in the column of Contact Time with Acquaintance 1503, and in the column of Number of Acquaintances 1504 is recorded in the acquaintance information recording unit 404 of FIG. 13. In addition, information in the column of Number of Contact People with Employee 1505 and the column of Contact Time with Employee 1506 is recorded in the employee approach information recording unit 406, information in the column of Contact Time other than Employee or Acquaintance 1507 and the column of Number of Contact People other than Employee or Acquaintance 1508 is recorded in the another person approach information recording unit 405, information in the column of Purchase Determination 1509 is recorded in the purchase index information recording unit 402, and the above information is integrated and stored in the data storage unit 403.

With respect to a person who is determined as an employee by the employee determination unit 305, customer serving time to customers 1602 to 1604 illustrated in FIG. 16, total customer serving time to Customer having Acquaintance 1605, total customer serving time to Single Customer 1606, and Number of Received Customers 1607 are recorded. FIG. 16 is a diagram illustrating analysis data

with respect to the employee in a table format and lists data per person ID determined as an employee by the employee determination unit 305 in the vertical direction of the table. In the horizontal direction, customer serving time to customers who are not determined as employees is recorded.

In the column of Employee ID: 1601, a person ID determined as an employee by the employee determination unit 305 is recorded. In the columns of 1602 to 1604, customer serving time to customers of the person IDs who are not determined as employees in the employee determination unit 305 is indicated. The column of Customer having Acquaintance 1605 indicates total customer serving time to customers having acquaintances who are determined by the group attribute determination unit 306. In the column of the single customer 1606, total customer serving time to customers not having acquaintances who are determined by the group attribute determination unit 306 is indicated. The column of Number of Received Customers 1607 indicates the number of customers who are served by each employee. The analysis data of FIG. 16 is recorded in the employee approach information recording unit 406 of FIG. 13.

In addition to the histogram of FIG. 8 described in Embodiment 1, the result display unit 501 can display information of FIGS. 14, 15, and 16 and can also display purchase indexes such as the number of visiting time and

ratios of a single customer or a customer having an acquaintance, conversion rates of the people, in-store staying time, stop time, and the like for each period.

For example, in FIG. 16, served customers of each employee can be quantitatively analyzed. The number of served customers of each employee, served customer frequencies to a single customer and a customer having an acquaintance can be visualized, and also results of Purchase Determination 1509 of FIG. 15 are shown with respect to the served customers. Therefore, a conversion rate indicating how many customers among the customers served by each employee make a purchase can be calculated. Hereinafter, characteristics of an employee who effectively promotes a behavior of purchasing of a customer are known.

In addition, by collecting information in the column of Contact Time with Employee 1506 and the column of Purchase Determination 1509 in FIG. 15 and comparing a conversion rate of a person having long customer serving time from an employee and a conversion rate of a person having short customer serving time, the present embodiment becomes a material for determining whether purchase of the served customer by the employee is promoted. In the same manner, conversion rates of a customer who visits together with an acquaintance and a single customer, and the number of visitors can be collected, and thus it is possible to

provide information to be a reference for a sales policy such as of which customer a conversion rate is higher. In addition, by collecting contact time with a person other than an employee or an acquaintance, the number of people, and purchase determination, how a conversion rate becomes when there are many strangers in the surroundings and accordingly influence on a behavior of purchasing caused by a subjective degree of congestion in a store can be analyzed. Therefore, it is possible to suggest the optimal degree of congestion and the sense of distance from others.

According to the present embodiment, in addition to the effect described in Embodiments 1 to 3, quantitative analysis on how inter-personal distance or relevance between customers that are impossible in people measurement by a sensor in the related art contribute to the behavior of purchasing can be performed, and thus there is an effect of being useful for sales strategy.

[Embodiment 5]

As a fifth embodiment of the present invention, an example in which the results obtained by evaluating the inter-personal distance described in Embodiments 1 to 4 are visually displayed on the result display unit 501 is illustrated in FIG. 17. FIG. 17 is a dashboard showing distribution of degrees of congestion in an in-store diagram 1750, the reference numeral 1700 denotes a heat map of

degrees of congestion in an in-store plan view, the reference numerals 1701 and 1702 denote entrances. In addition, the reference numerals 1703 to 1728 denote product shelves, the reference numerals 1729 to 1732 denote cash register counters, and the reference numerals 1733 to 1735 denote bagging tables.

Here, in FIG. 17, the inside of the store is divided into areas of A1: 1741 to A8: 1748, approach time to another person that is total time during when another person approaches within 1.0 m around in a case where a person stays in each area is calculated, and the average value is compared.

In Legends 1736 to 1739, in each area, a proportion of approach time with another person to staying time of each person who stays in the area is averaged and substituted with time of approaching to another person for five minutes, and Legend 1736 is classified into less than 30 seconds, Legend 1737 is classified into 30 seconds or more and less than 1 minute, Legend 1738 is classified into 1 minute or more and less than 2 minutes, and Legend 1739 is classified into 2 minutes or more, and the classifications are associated with colors of the heat map (the density of hatching). Here, the classifications in the Legends 1736 to 1739 are indexes using values calculated based on the approach time with another person and correspond to an

average of time during when another person stays within a certain reference distance or an average of the number of times of entering within a certain reference distance by another person.

For example, if the area size is less than 10 m², the reference distance is set to 50 cm, if the area size is 10 m² or more and less than 20 m², the reference distance is set to 1 m, and if the area size is 20 m² or more, the reference distance is set to 1.5 m. The reference distance is used for comparison between areas. In addition, with respect to the ranges of classification of legends 1736 to 1739, the time interval and the range upper limit and lower limit of each legend are set based on the standard number of people staying in the area on weekdays and holidays and the approach time with another person.

With the above, it is possible to analyze the characteristics of each store and area, such as sizes and visitor trends. In addition, it is possible to perform more detailed analysis by providing a function to switch the display of displayed data per time period, day, week, month, and day of the week. For example, a display in the unit of a day has an effect of making it easier to determine the timing of staff rearrangement and display addition that require quick responses to changes in the number of visitors, such as when the store opens, closes, or at noon. In

addition, a display in the unit of a day of the week has an effect of comparing congestion trends and purchase trends on holidays, weekdays, weekends, and the like, and a display in the unit of a month has an effect of comparing congestion and purchase trends on seasons.

In addition, for example, it is also assumed to divide the legends and classifications in 1736 to 1739 by the ratio of single customers to area visitors determined in Embodiment 4. As a result, it becomes possible to know the areas where single customers and customers who come with acquaintances often stay, and there is an effect of capable of using the knowledge for marketing strategy by comparing the knowledge with the purchase index.

The reference numerals 1741 to 1748 denote areas obtained by dividing the inside of the store per area (A1: 1741 to A8: 1748). The heat map 1700 shows results obtained by calculating the approach time with another person in each area with colors (the density of hatching) by using the legends 1736 to 1739. As the approach time with another person, which is a subjective degree of congestion becomes longer, the area is expressed with a darker color.

In addition, in the areas divided into A1: 1741 to A8: 1748, together with the approach time with another person, information on purchase indexes such as average staying time, stop time, a conversion rate, a sales amount in that area

can be seen.

In a display area 1749, a purchase index of each area displayed by selecting the area or the ratio of the single customers or the customers having acquaintances determined in Embodiment 4 are displayed, and information such as average stay time, flow line length, and stop time for each attribute can also be displayed.

In addition, any information that can be displayed in the dashboard of FIG. 17 can be output as a report in a document format. According to the present embodiment, in addition to the effects described in Embodiments 1 to 4, a relevance between approach time to another person that is a subjective degree of congestion and a purchase index can be seen in a dashboard or a report, and thus it is possible to know in what areas customers tend to stay per attribute of customers (single customers and customers having acquaintances) for each area in the store, so the knowledge can be useful for management strategies such as product placement.

What is claimed is:

1. Apparatus for analyzing an inter-personal distance and a behavior of purchasing comprising:

a people flow sensor that detects a movement of a person in a store;

a flow line data recording unit that detects flow lines in the store of the plurality of people detected by the people flow sensor and records the flow lines as flow line data;

an inter-personal distance analysis recording unit that analyzes a distance between the plurality of people by using the flow line data recorded in the flow line data recording unit and records behavior patterns of the plurality of people obtained from the flow line data in an associating manner;

a purchase index analysis recording unit that determines and records purchase circumstances of products in the store of the plurality of people recorded in the flow line data recording unit;

a data storage unit that stores data recorded in the inter-personal distance analysis recording unit and data recorded in the purchase index analysis recording unit; and

a result display unit that displays the data stored in the data storage unit.

2. The apparatus for analyzing an inter-personal

distance and a behavior of purchasing according to claim 1,
wherein the inter-personal distance analysis recording unit analyzes a distance between the plurality of people by using the flow line data and records the distance in association with behavior patterns of the plurality of people,

detects positions of the plurality of people detected by the people flow sensor,

thoroughly measures the distance between the plurality of people,

records time information when the positions of the plurality of people are detected,

determines behavior patterns taken by the plurality of people of which positions are detected from position coordinates of the plurality of people, positions of hands, and positions of heads, and

records the behavior patterns of the plurality of people in association with the distances between the plurality of people.

3. The apparatus for analyzing an inter-personal distance and a behavior of purchasing according to claim 2,

wherein, when thoroughly measuring the distance between the plurality of people,

the inter-personal distance analysis recording unit determines whether the plurality of people can mutually

recognize counterparts by using layout information of product shelves in the store and thoroughly measures the distance between the plurality of people when it is determined that the plurality of people can mutually recognize the counterparts.

4. The apparatus for analyzing an inter-personal distance and a behavior of purchasing according to claim 2, wherein the inter-personal distance analysis recording unit analyzes the distance between the plurality of people by using the flow line data and records the distance in association with the behavior patterns of the plurality of people, and

determines a direction of a body of a specific person from a direction of a hand, a foot, a head, or a face, a travelling direction, a walking speed, and the like of the specific person in the plurality of people and estimates whether the specific person recognizes the plurality of people other than the specific person.

5. The apparatus for analyzing an inter-personal distance and a behavior of purchasing according to claim 2, wherein the inter-personal distance analysis recording unit determines whether the plurality of people are acquaintances each other by using information on changes in the thoroughly measured distance between the plurality of people and the recorded time information, and adds

information that the plurality of people are acquaintances each other to the recorded information in which the behavior patterns of the plurality of people are associated with the distance between the plurality of people.

6. The apparatus for analyzing an inter-personal distance and a behavior of purchasing according to claim 2, wherein the inter-personal distance analysis recording unit includes an employee determination unit that identifies and detects an employee of the store from customers of the store, and when the distance between the plurality of people is thoroughly measured, the employee and the customer are identified, and the distance is measured.

7. The apparatus for analyzing an inter-personal distance and a behavior of purchasing according to claim 1, wherein the result display unit displays a relationship between average time during when there is another person within a predetermined distance from the respective people and conversion rates of the respective people with respect to the respective people among the plurality of people detected by the people flow sensor in a graph or displays a distribution in the store of the average time during when there is another person within a predetermined distance from the respective people with respect to the respective people of the plurality of people

detected by the people flow sensor.

8. A method for analyzing an inter-personal distance and a behavior of purchasing by using an analysis apparatus including a people flow sensor, a flow line data recording unit, an inter-personal distance analysis recording unit, a purchase index analysis recording unit, a data storage unit, and a result display unit, the method comprising:

recording flow lines in a store of a plurality of people detected by the people flow sensor as flow line data in the flow line data recording unit;

analyzing a distance between the plurality of people from the flow line data by the inter-personal distance analysis recording unit, recording the distance in association with behavior patterns of the plurality of people obtained from the flow line data, and determining and recording purchase circumstances of products in the store of the plurality of people recorded in the flow line data recording unit by the purchase index analysis recording unit;

storing data recorded in the inter-personal distance analysis recording unit and data recorded in the purchase index analysis recording unit in the data storage unit; and

displaying the data stored in the data storage unit on the result display unit.

9. The method for analyzing an inter-personal

distance and a behavior of purchasing according to claim 8,
wherein the inter-personal distance analysis recording unit analyzes a distance between the plurality of people by using the flow line data and records the distance in association with the behavior patterns of the plurality of people,

detects positions of the plurality of people detected by the people flow sensor,

thoroughly measures the distance between the plurality of people,

records time information when the positions of the plurality of people are detected,

determines the behavior patterns taken by the plurality of people of which positions are detected from position coordinates of the plurality of people, positions of hands, and positions of heads, and

records the behavior patterns of the plurality of people in association with the distances between the plurality of people.

10. The method for analyzing an inter-personal distance and a behavior of purchasing according to claim 9,

wherein, when the distance between the plurality of people is thoroughly measured by the inter-personal distance analysis recording unit,

whether the plurality of people can mutually recognize

counterparts by using layout information of product shelves in the store is determined, and the distance between the plurality of people is thoroughly measured, when it is determined that the plurality of people can mutually recognize the counterparts.

11. The method for analyzing an inter-personal distance and a behavior of purchasing according to claim 9, wherein the inter-personal distance analysis recording unit analyzes the distance between the plurality of people by using the flow line data and records the distance in association with the behavior patterns of the plurality of people, and

determines a direction of a body of a specific person from a direction of a hand, a foot, a head, or a face, a travelling direction, a walking speed, and the like of the specific person in the plurality of people and estimates whether the specific person recognizes the plurality of people other than the specific person.

12. The method for analyzing an inter-personal distance and a behavior of purchasing according to claim 9, wherein the inter-personal distance analysis recording unit determines whether the plurality of people are acquaintances each other by using information on changes in the thoroughly measured distance between the plurality of people and the recorded time information, and adds

information that the plurality of people are acquaintances each other to the recorded information in which the behavior patterns of the plurality of people are associated with the distance between the plurality of people.

13. The method for analyzing an inter-personal distance and a behavior of purchasing according to claim 9, wherein, when the distance between the plurality of people is thoroughly measured, the inter-personal distance analysis recording unit identifies an employee of the store from customers of the store and measures the distance.

14. The method for analyzing an inter-personal distance and a behavior of purchasing according to claim 8, wherein a relationship between average time during when there is another person within a predetermined distance from the respective people and conversion rates of the respective people with respect to the respective people among the plurality of people detected by the people flow sensor based on the data stored in the data storage unit is displayed on the result display unit in a graph, or a distribution in the store of the average time during when there is another person within a predetermined distance from the respective people with respect to the respective people of the plurality of people detected by the people flow sensor is displayed on the result display unit.