FootfallCam™

Data Integrity Policy

F100304-04

Revision History

Revision Number	Description of Revision	Date of Revision
1	Initial Draft	May, 21 2014
2	Revision	August, 29 2014
3	Initial Release	February, 09 2015
4	Revision and Update Data Patching Methodology	June, 20 2016
5	Update Formatting	April 03 2018

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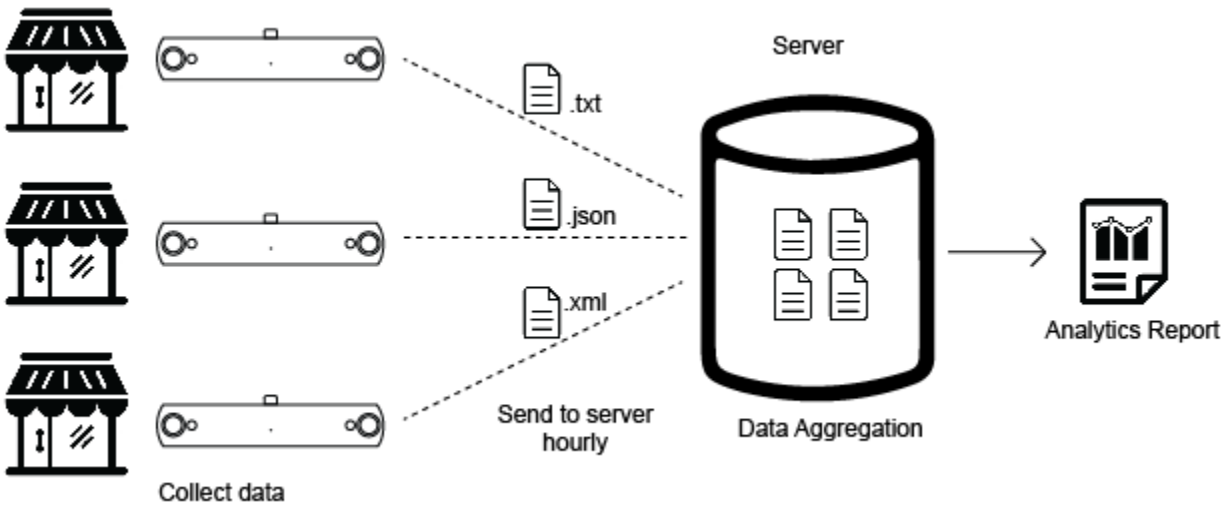
1.0 Data Flow

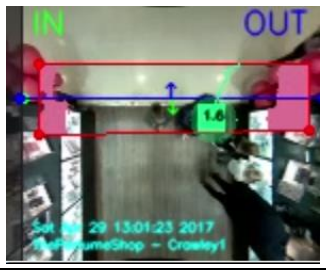
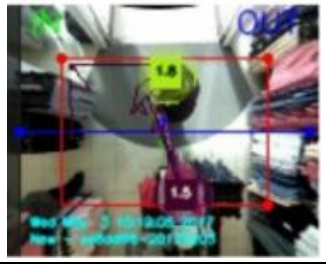
Data flow is the movement of source data and exchange of data format within a system from data collection, data aggregation, data processing to final reports. Data will be directly captured from device and transferring data from input to database storage and reports generation. Every raw input will be stored and retained for long period of time for future recovery. Understanding the structure, process and flow of data flow helps organisation to ensure database integrity and data security.

1.1 Data Collection

The data captured from FootfallCam people counter calculates visitors count, timestamp, MAC address of devices detected within coverage area. All the raw data will be uploaded into the cloud server per hourly basis and aggregated in server level. These aggregated data allow us to analyse the store performance and customer behaviours throughout the different parts of analytics and process. Analytics are designated to capture aggregate information, trends and patterns of collective behaviours on discrete time.



The key function of FootfallCam is used for counting people who are coming into the premises. It is mounted perpendicularly on the top of the entrance door. FootfallCam people counting system is mainly using a series of video process algorithm to perform video analytics to count human traffic in bi-directional. FootfallCam is equipped with dual lenses which can facilitate depth into 3D vision same as human eyes. By using this concept, 3D vision allows FootfallCam to generate depth map that can differentiate the kids, trolley and objects and excluded them from counting. Kids below 1.3 meters are not counted because the purchasing power of kids are relatively small. Visitors who are pushing a shopping trolley are counted as one. When the person takes the U-turn at the store front, he is not entering the store, it would not be counted as well. As a result, FootfallCam can accurately count the number of people coming in and out of the premises by using 3D stereovision.

		
Kids not counted	People with trolley counts as 1	U-turned not counted

We have done many installations in retail stores which have multiple wide entrances. Our calibration and accuracy tuning team will help calibrate the counter setting after the counter has been mounted on the ceiling. Our tuning specialists will draw the floor space on the counting area on each counter, apply the counting line, and make sure there is no double counting of the person

on the counter. A video verification report with the video footage will be generated and sent to users after the calibration and accuracy tuning has been done.

With the rising popularity of Wi-Fi enabled devices, FootfallCam is using Wi-Fi counting to measure the metrics more than just the visitors' INs and OUTs by video counting. FootfallCam people counter is a Wi-Fi hotspot itself within a 100-meter radius. It can detect the Wi-Fi signals emitted by the smartphones. It is also able to differentiate visitors based on the unique identifier associated with the Wi-Fi enabled devices. The Wi-Fi tracker will detect the unique MAC ID and signal strength of the mobile device of the visitor around the entrance. By combining Video and Wi-Fi technology, FootfallCam can measure a deep customer insight, for example outside traffics, turn in rate, visit duration, returning customer, and sales conversion.

1.1.1 Types of Raw Data

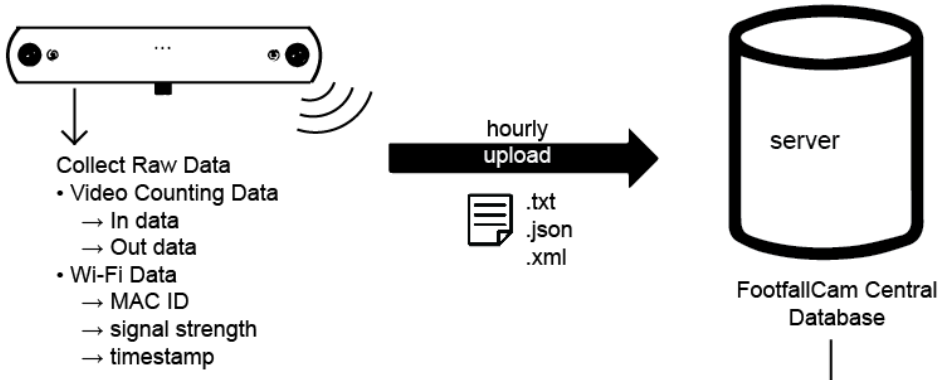
There are two types of data collected from people counter which are video counting raw data and Wi-Fi raw data. Video counting data includes visitors count IN and OUT data. Visitor count measures the number of people entering and leaving the store through video counting technology. Our software will support multiple counters and the counts from different counters can be combined in our web-based reporting software. Users can combine the counts of the two counters and view the total traffic IN and OUT or users can view the total IN and OUT individually.

The Wi-Fi data includes MAC ID address, Wi-Fi signal strength, and time stamp will be collected from the crowd around the location where the counter is installed. Wi-Fi dongle plugged in the counter will be the module that constantly grabs the Wi-Fi signal sent by the Wi-Fi enabled devices such as smartphones, tablets and etc. Every phone would transmit a Wi-Fi beacon signal every 2 to 8 seconds. Each Wi-Fi beacon signal transmitted carries a Mac address which is unique to each phone. By tracking the Mac address, the counter can identify each unique visitor. The signal strength of probes can give an approximate location of each person. The frequency of these signals varies, depending on smartphone vendor and device status.

Mac ID is process in the counter with the signal strength and time stamp as the table shown:

Hashed Wi-Fi Mac Address	Detected Time (Time Stamp)	Signal Strength
aaa	12/2/2017 1:00pm	-65
bbb	12/2/2017 1:03pm	-66
ccc	12/2/2017 2:09pm	-100
ccc	12/2/2017 2:30pm	-70
ccc	12/2/2017 2:45pm	-80

Due to privacy concern, MAC addresses store in our database has been hashed at counter level. It is a one-way hashing. Therefore, we can't view the original MAC address information of customers.



Value Date Time	IN	OUT	Outside Traffics
2017-07-31 10:00:00.000	39	19	44
2017-07-31 11:00:00.000	34	25	31
2017-07-31 12:00:00.000	43	33	32
2017-07-31 13:00:00.000	82	42	41
2017-07-31 14:00:00.000	50	36	24
2017-07-31 15:00:00.000	56	51	37
2017-07-31 16:00:00.000	75	68	34
2017-07-31 17:00:00.000	55	58	31

FootfallCam 3D Plus only stores the raw data in the device itself for 30 days. FootfallCam device acts as a transmitter to transfer all the raw data to our database for aggregation purpose. Counter serial number is a unique number which is the communication channel between transmitter and receiver to ensure that all the data stored to the correct branch. All the raw data will be constantly uploaded to the central server (every hour) for further aggregation. FootfallCam gathers all these raw data, and then forwards it securely to the FootfallCam Cloud in hourly basis for processing and analysis. Only the aggregated data and timestamp will be stored permanently in cloud server. Users may view the aggregated data hourly, daily or weekly footfall trend from FootfallCam Analytic Centre.

1.1.2 Usage of Raw Data

All the raw data such as IN data, OUT data and Wi-Fi data (unique MAC address, timestamp) collected in the counter will be uploaded to the central server for aggregation. Only the aggregated data and timestamp will be stored permanently in cloud server for further processing in metrics measurement, in order to produce analytic reports in various forms. All the metrics measurement includes visitors count, outside traffic, turn in rate, visit duration (dwell time), returning customer and sales conversion.

Visitors Count

Visitor count measures the number of people entering and leaving the store through the use of video counting technology. It is capable of measuring in hourly, daily, and weekly trends and ensures that the accuracy will achieve at least 95% by using video footage.

Outside Traffics

Outside traffics count is based on the total unique hashed MAC address detected within a period of time with signal strength (default: -85 dBm) for less than 5 minutes and deduct number of IN data. Every smartphone emits Wi-Fi signal carries with a unique MAC address. When visitors outside walk pass in front of the store, FootfallCam system will collect the Wi-Fi data (unique MAC address, timestamp) and calculate the number of people that passed by the store.

Hourly Date Time	Number of MAC ID
2017-07-12 09:00:00.000	50
2017-07-12 10:00:00.000	80
2017-07-12 11:00:00.000	100
2017-07-12 12:00:00.000	140
2017-07-12 13:00:00.000	150

Visit duration

When a customer enters the store, the FootfallCam system will detect a new MAC address with high signal strength emitted from mobile device carried by the visitor. The Mac ID is hashed and sent to the database to be stored with a timestamp. When the same customer exits the store, the counter will receive the same MAC ID with high signal strength again. It indicates that the person is going out the store and our system will count the visitor duration of that customer by comparing with the new timestamp. The visit duration of the customer is calculated as the difference between the timestamps.

Hashed Wi-Fi Mac Address	First Seen	Last Seen
aaa	2017-02-12 13:00:00.000	2017-02-12 13:15:00.000
bbb	2017-02-12 13:03:00.000	2017-02-12 13:50:00.000
ccc	2017-02-12 14:00:00.000	2017-02-12 14:45:00.000

Returning Customer

When a new unique MAC address is detected, it categorizes the visitor as a new customer. FootfallCam will remember the hashed MAC address and store into database for 30 days. When the same MAC address is detected again, the system will categorize the visitor as a returning customer. FootfallCam analytics can identify the number of returning customers in relation to new customer.

Note:

All the enhanced reports that involve calculation or formula application such as daily report, weekly report, turn in rate, sales conversion, etc will be process in server level.

1.1.3 Data Granularity

The single most important for FootfallCam database developer is determining the appropriate level of granularity of the data that will reside in the data warehouse. When the level of granularity is properly set, data implementation flow from raw data until aggregated data can be run smoothly; when it is not properly set, every other aspect such as data monitoring, data storage and database performance will have problem. Therefore, granularity affects how efficiently raw data can be transferred from counter level and determines the types of analysis and aggregation that can be done in FootfallCam database.

The primary issue of granularity is that of getting it at the right level. When FootfallCam people counter installs at an entrance with huge traffic flow, there will be large amount of Wi-Fi data detected and collected at the counter level. Storing raw data at too high degree of granularity will affect the database performance in managing large volume of raw data. Detailed raw data is so voluminous, and it can be unusable. As a result, FootfallCam chooses to transform the inactive portion of raw data into valuable aggregated data and store into database.

FootfallCam database only stores aggregated hourly IN data, OUT data and outside traffic count data which is aggregated from Wi-Fi data. FootfallCam system will automatically transform the counting data into a convenient TXT, JSON or XML data file that can be retrieved easily via Web service application.

Counter	ValueDateTime	ValueIn	ValueOut	OutsideTraffic	Day	CameraId
36	2015-03-20 09:00:00.000	39	19	44	5	[illegible]
37	2015-03-20 09:15:00.000	34	25	31	5	[illegible]
38	2015-03-20 09:30:00.000	43	33	32	5	[illegible]
39	2015-03-20 09:45:00.000	82	42	41	5	[illegible]
40	2015-03-20 10:00:00.000	50	36	24	5	[illegible]
41	2015-03-20 10:15:00.000	56	51	37	5	[illegible]
42	2015-03-20 10:30:00.000	75	68	34	5	[illegible]
43	2015-03-20 10:45:00.000	55	58	37	5	[illegible]
44	2015-03-20 11:00:00.000	52	82	31	5	[illegible]

1.2 Retention Period of Data

The retention period of data is an aspect of records and information management of the duration of time for the data to be stored. Due to storage concern, the raw data will be only stored in people counter device temporarily for 30 days. All the counting data will be uploaded to our FootfallCam server per hourly basis and store 7 days in the server for aggregation. After the raw data has been aggregated completely, the raw data will be deleted permanently and no longer available in the server. Only the aggregated data will be stored permanently in the database, as the data is meaningful used to do the forecasting from the historical year.

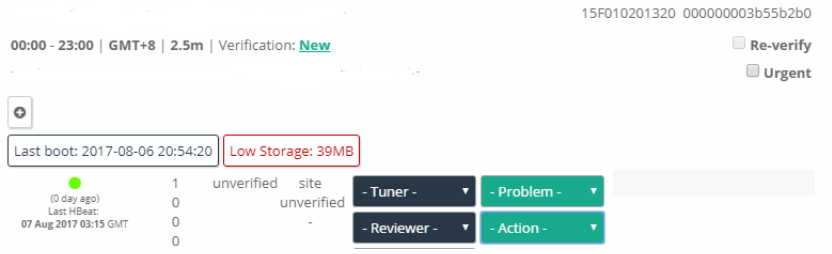
Location	Types of data	Counting Data	Wi-Fi Data
Counter Level	Raw data stores in the counter before uploading to the server for aggregation	30 days	14 days
Counter Level	Raw data stores in the counter when fail to uploading to the server due to counter offline	180 days	14 days
Server Level	Raw data stores in the server for temporary backup after the raw is uploaded to the server and aggregated successfully	7 days	7 days
Server Level	Aggregated data stores in the server	Permanent	Permanent

In a case that the store has internet connection problem that caused the counter couldn't upload the data to our server in the hourly basis, all the raw data will stay in the counter level and pending for upload. The capacity of the data storage on the counter is 180 days for counting data, and 14 days for Wi-Fi data. Once the network connection is back to normal, the data uploading will be resumed in provided the counter power turning on and running during the internet connection is down. However, if the counter power is not turned on and the device is completely offline, no data will be recorded due to physical failure.

1.3 Storage Monitoring

FootfallCam people counter has an internal storage of 8GB memory to store the raw data temporarily in the counter level. FootfallCam control panel features a centralized health check monitoring which can detect the counter disk storage status. This feature is available on the analytic manager and is applicable to all models of devices. The analytic manager will be updated once every 15 minutes with the most updated status of the counter which gives users complete visibility on the status of the counter.

When the counter is run out of storage, the counter will send an alert and notification to server showing “Low Storage” signal. This allows users and FootfallCam team alike to easily notice the issue once it has risen, and to identify the cause of the issue. FootfallCam storage monitoring teams will quickly check on the counter to ensure that all the historical raw data has been successfully uploaded to the central database. Once all the data has been uploaded completely, FootfallCam team will make sure that all the historical raw data has been aggregated and backed up in the database before cleaning the device storage of the counter.



1.4 Defined KPI

Outside Traffic	Outside Traffic	Total unique Wi-Fi detected within a defined time with signal strength (default: -85 dBm) for less than 5 minutes − number of people entered the site
	Aggregation of outside traffic	**Hourly Outside Traffic** = Total unique Wi-Fi detected per hour with signal strength (default: -85 dBm) for less than 5 minutes − number of people entered the site
		Daily Outside Traffic = Total unique Wi-Fi detected whole day with signal strength (default: -85 dBm) for less than 5 minutes − number of people entered the site
	Turn in Rate	$\frac{\text{Total Number of IN within the Hour}}{(\text{Outside Traffic within the Operating Hours} + \text{Total Number of IN})} \times 100\%$
	Aggregation of Turn in Rate	**Hourly Turn in Rate** $\frac{\text{Total number of IN within the hour}}{(\text{Outside traffic within the hours} + \text{Total Number of IN within the hour})} \times 100\%$
		Daily Turn in Rate $\frac{\text{Total Number of IN within the operating hour}}{(\text{Outside traffic within the operating hours} + \text{Total Number of IN within the operating hour})} \times 100\%$
Visit Duration	Visit Duration	Time (In) − Time (out)
	Aggregation of Average Visit Duration	$\frac{\text{Summation of Time IN} - \text{Time OUT}}{\text{Number of unique MAC ID that has IN and OUT timestamp}}$
	Aggregation by Visit Duration Category	% of each visit duration category $\frac{\text{number of unique MAC ID (same category)}}{\text{number of unique MAC ID (total)}} \times 100\%$ No. of traffic count= % of each visit duration category × video count (IN)
	Visit Duration for Zone Analytics	Time of Last Seen Wi-Fi signal −Time of First seen Wi-Fi signal
Returning Customer	New Visitors	Unique Mac Device entered the site over defined period (1 month or 3 Months) × Normalization factor based on statistical model
	Aggregation	**Hourly New Visitors' Aggregation** = Num. of unique mac devices in that hour over 1 month or 3 months period
		Daily New Visitors' Aggregation = Num. of unique mac devices in that day over 1 month or 3 months period
		Weekly New Visitors' Aggregation = Num. of unique mac devices in that week over 1 month or 3 months period
	Returning Rate	$\left(1 - \frac{\text{Number of New Visitors}}{\text{Total Number of Wi} - \text{Fi Devices}}\right) \times 100\%$
	Frequency of Returning Customers	the number of visits by the same Wi-Fi device in the last 1 or 3 months
Cross Shopping	Percentage of Cross	$\frac{\text{Total Number of MAC ID appeared in more than 1 site in a given period}}{\text{Total number of unique MAC ID of all sites}} \times 100\%$

	Shopping	
	Between 2 Sites	$\frac{\text{Total Number of MAC ID appeared in both sites A and B in a given period}}{\text{Total number of unique MAC ID of all sites}} \times 100\%$
	Over a number of sites	$\frac{\text{Total Number of MAC ID appeared in } \alpha \text{ number of sites in a given period}}{\text{Total number of unique MAC ID of all sites}} \times 100\%$
	Average number of sites visited	$\frac{\text{Sum} \times (\text{Number of sites visited per Wi} - \text{Fi devices in a given period}}{\text{Total number of unique MAC ID in a given period}}$
Occupancy	Occupancy × Hour	(IN(accumulative at x hour) − OUT (accumulative at x hour)) + correction factor(x hour)
	Correction Factor (x hour)	$(\text{IN(day)} - \text{OUT(day)}) \times \frac{\text{IN(accumulative at x hour)}}{\text{IN(day)}}$
	Average hourly occupancy	$\frac{\text{Sum of all hourly occupancy within the operating hours}}{\text{Total number of operating hours}}$
Zone Analytics	Stayed in a Zone	more than 5 Wi-Fi signals, each probe has signal strength greater than X dBm within A minutes
	Passed by a Zone	more than 2 Wi-Fi signals, each probe has signal strength greater than Y dBm within B minutes.
	Duration in a Zone	last timestamp - first timestamp, of Wi-Fi probe that had signal strength greater than Z dBm within C minutes.
Sales Conversion	Percentage	$\frac{\text{Number of Transactions}}{\text{Number of IN Visitors}} \times 100\%$
	Revenue per Visitor	$\frac{\text{Sales Volume}}{\text{Number of IN visitors}}$

END OF PREVIEW

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