Data Modelling for ADIS lifts systems

Data Generators

Lift sensors at lobby and inter-floors:

Records the in and out flow of the passengers on the ground floor at regular Time intervals

For the same time intervals also captures the trip round number, floor name and also inter-floor in and out flow of passengers.

Combines both these activities in a comma Delimited file and generates an id based log files of Data, whose structure is shown below.

Raw_file.csv

```
id,Trip_number,Time_Stamp,Floor Name,Lobby In,Lobby Out,InterFloor In,InterFloor Out
1,1,0:05:00,Ground Floor,11,0,0,0
2,1,0:15:00,First Floor,0,0,0,1
3,1,0:25:00,Second Floor,0,0,0,2
4,1,0:35:00,Thrid Floor,0,0,0,5
5,1,0:45:00,Fourth Floor,0,0,0,1
6,1,0:55:00,Fifth Floor,0,0,0,1
7,1,1:05:00,Sixth Floor,0,0,0,0
8,1,1:15:00,Seventh Floor,0,0,0,1
9,1,1:25:00,Eight Floor,0,0,0,0
10,1,1:35:00,Ninth Floor,0,0,0,0
11,2,1:45:00,Ground Floor,10,0,0,0
12,2,1:55:00,First Floor,0,0,0,1
13,2,2:05:00,Second Floor,0,0,1,1
14,2,2:15:00,Thrid Floor,0,0,8,5
15,2,2:25:00,Fourth Floor,0,0,0,0
16,2,2:35:00,Fifth Floor,0,0,4,0
17,2,2:45:00,Sixth Floor,0,0,5,0
18,2,2:55:00,Seventh Floor,0,0,0,0
19,2,3:05:00,Eight Floor,0,0,0,0
20,2,3:15:00,Ninth Floor,0,0,4,4
21,3,3:25:00,Ground Floor,0,21,0,0
```

Figure: Raw Data in log file

Features Captured from the Data Generators

- Lobby traffic in flow to the lift
- Lobby traffic out flows from the lift
- Current Lift trip-round-number
- Lift current floor name
- Current Time stamps per each data capture
- Inter floor traffic into the lift
- Inter floor traffic out from the lift

Targets extracted from the captured features

- Observed building population (This is the population in the building for the existing time-stamps. This involves a one to one relation from the features set to the target set.)
- Lift population (This is the population in the lift for the existing time-stamps. This involves a one to one relation from the features set to the target set.)
- Average journey time for all the Data set (This is a scalar quantity, which is computed on the whole log file level and has a Many to one relation from the features set to the target set)

- Observed weighting Time (This a Dependent feature on the 'Observed building population' and 'Average journey time for all the Data set'. This involves a one to one relation from the features set to the target set.)

Analysis Aims and Solutions

1. List the different stakeholders who would be interested in lift performance (a "stakeholder" is any person or group who have an interest in or may be affected by the lift performance).
   Building designers to make informed design decisions for regulating building traffic.
   Occupants of the buildings. So, that they can offer a hassle free commute and avoid long waiting times.
   Building maintainer's to make informed decisions about building management and emergency evacuation process.
   Commute systems designers at Airports, Rail Stations etc...

2. List other performance measures that it would be useful or important to measure – make sure these cover all of the stakeholders. (Hint: there are lots of these).
   These are mentioned above. But are also provided here.
   - Observed building population (This is the population in the building for the existing time-stamps. This involves a one to one relation from the features set to the target set.)
   - Lift population (This is the population in the lift for the existing time-stamps. This involves a one to one relation from the features set to the target set.)
   - Average journey time for all the Data set (This is a scalar quantity, which is computed on the whole log file level and has a Many to one relation from the features set to the target set)
   - Observed weighting Time (This a Dependent feature on the 'Observed building population' and 'Average journey time for all the Data set'. This involves a one to one relation from the features set to the target set.)

3. What would a suitable data representation look like? Please design a series of tables (as would be suitable to put in a database or spreadsheet). Make sure that the data representation (with very simple arithmetic calculations) is adequate to calculate the above measures, and any other measures that you deem important (and that those calculations are fairly easy and unambiguous).
   Schema Modelling:
   a) Events_Data Table
      Schema:
      Id (BigInt)
      Trip_number (Int)
      Time_Stamp (timestamp hh:mm:ss)
      Floor_Name (String)
      Lobby_In (Int)
      Lobby_Out (Int)
      InterFloor_In (Int)
      InterFloor_Out (Int)
      Description:
      This table is built by parsing the raw log file.
   b) Average_journey_time

Schema:

This a Scalar quantity, calculated in hh:mm:ss.

Description:

This is computed based on the whole Data set and was the average time required to transmit between the Ground floor and the Top-most floor.

Formula:

Average_journey_time = $\sum_{Time=00:00:00}^{Time=24:00:00} \frac{Time\_Stamp_{topmostfloor} - Time\_Stamp_{Groudfloor}}{Tuple\_Count}$

=> Average_journey_time = $\frac{sum(TimeStamp_{topmostfloor})}{\max(Trip\_number)} \_ \frac{sum(TimeStamp_{GroundFloor})}{\max(Trip\_number)}$

c) Processed_Data Table

Schema:

Id (BigInt)

Time_Stamp (timestamp hh:mm:ss)

Observed_Population (BigInt)

Lift_Population (Int)

Observed_weighting_Time (Sec/person hh:mm:ss)

Description:

This table is built by parsing the 'In and Out flow Data' table.

Formula:

Observed_Population = $\sum_{Time=00:00:00}^{Time=Current-Time-Stamp} (Lobby\ In - Lobby\ Out)$

Lift population = $\sum_{Time=00:00:00}^{Time=Current-Time-Stamp} (Observed\_Population + InterFloor\ In - InterFloor\ Out)$

Observed_weighting_Time = $\frac{Average\_journey\_time}{(Observed\_Population - Lift\_Population)_{Current\_Time\_Stamp}}$

4. For "Average waiting time per passenger" and at least 2 other performance measures, describe how they can be easily calculated from your data model. Preferably write the SQL code you would use to calculate the waiting and journey times.

Calculations of Average_journey_time:

Calculation of $\frac{sum(TimeStamp_{topmostfloor})}{\max(Trip\_number)}$:

```
Select SumTimeStamp/MaxRoundCount as First_Answer
from
(select sum(Time_stamp) as SumTimeStamp, max(Round_Count) as MaxRoundCount ,
FloorName as FloorName
from
Raw_file
group by
FloorName)
where
FloorName = "Ninth Floor";
```

Calculation of $\frac{sum(TimeStamp_{GroundFloor})}{\max(Trip\_number)}$:

```
Select SumTimeStamp/MaxRoundCount as Second_Answer
from
```

(select sum(Time_stamp) as SumTimeStamp, max(Round_Count) as MaxRoundCount ,
FloorName as FloorName
from
Raw_file
group by
FloorName)
where
FloorName = "Ground Floor";

Average_journey_time = First_Answer- Second_Answer

5. Describe a simple but sensible algorithm or set of rules which could run a lift control mechanism. In what ways would this simple lift control mechanism work well, and in what ways might it not work well in the real world? What other complications might be important to turn this into a real-world, operational lift controller?
    - Import the raw log_file and split the data based the comma delimiter.
    - Load this parsed data into the Events Table.
    - Calculated the Average_journey_time from the Evets Table Data.
    - Calculate the Observed_Population, Lift population and Observed_weighting_Time the given Time_stamp and load the new data into the Processed_Data Table.

Software Architecture:

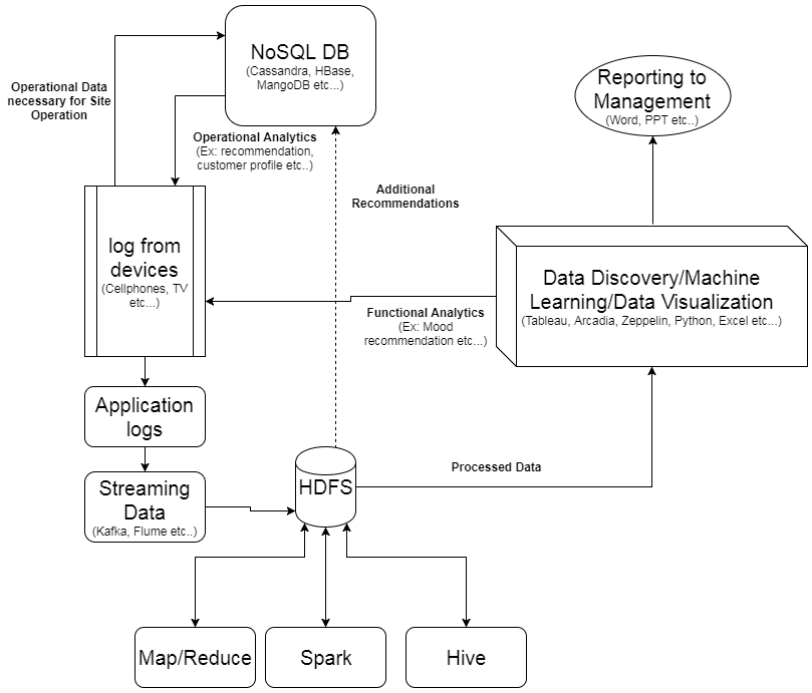

Figure: Data Pipe Line (credits: Korivi. Ranga Nanda Kishore)

References

http://peters-research.com/index.php/support/articles-and-papers/39-measuring-and-simulating-elevator-passengers-in-buildings