SVT Analytics project Report

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Abstract

Retailing today is not working in the same way as they used to be. The ability to accurately see where and what people are doing throughout the mall gives management a greater capacity to cater for customer and tenant needs. In our project, we will generate heat map of customer traffic and replay history screenshots captured from surveillance. Retailers can upload their maps of store and set the position of each color zone according to the allocation of each camera.

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Introduction

Retailing today is not working in the same way as they used to be. New Challenges and requirements for modern retailers spring up every day – retailers need much more accurate feedback of customers such that they can maximize customers' satisfaction. Also they need to make precise decision about what kinds of merchandize they should sell and the quantity and location to keep in stock. In these circumstances, traditional man-powered computing will not be able to follow the pace of fast growing requirements of both retailers and customers.

The ability to accurately see where and what people are doing throughout the mall gives management a greater capacity to cater for customer and tenant needs[1]. The main mechanism we implement to fulfill the requirement is based on Video Analyzing (VA). VA is one of the basic methodologies to implement Business Intelligence (BI). The aim of BI is to provide historical, current and predictive views of business operations.

During this project, we will realize at least the minimum features of VA of Customer Behavior such as generating heat map of customers dwell time and making comparison among daily sales. The ultimate purpose is to help retailers and stores forecast sales trend and make decision based on our VA results to optimize their business efficiency.

Motivation and Objectives

Motivation

When we go through some malls or retail stores, we might find that the arrangements of merchandize and the allocation of labors could be optimized in some level. These kinds of experiences are initial motivation for this project.

Retailing today is a tough business as store owners face many challenges. One of the main reason for these is that businessmen are using modern computing tools to help them make decisions or even predictions. Such automatic and intelligent analysis is forcing the competition of sale business becoming much fiercer than ever before. This is also the main reason for SVT Analytics invests to develop this smart statistics system

Objectives

We can generate different kinds of heat chart from camera data. Also, we can intuitively get information about customer traffic, volume of business and revenue, etc. Analysis and precise decision should be made to help retailers to maximize the capability of automatically analyzing video to detect and determine temporal events not based on a single image. By generating data and doing analysis mentioned below, we can roughly realize our purpose which is to optimize business efficiency.

Related Work

Selection of Media Player

There are mainly 3 scenarios we should consider:

> **Scenario 1 -** Play video records that is already completed - *Player should be launchable (not hard) from our interface, be able to play completed H.264 files (start at any given time).*
>
> **Scenario 2 -** More than Scenario 1, play video record while the file is not completed - *Player should be able to play the file while we are appending to the end of the video.*
>
> **Scenario 3 -** More than Scenario 2, user can start the video at a given time – *Player should be startable at a given time.*

There are lots of options when we play some already completed video files in our system. I list four of them with details in Scenario 1.

While playing some file and that file is still growing concurrently, things become a little complicated. If we don't need to stick with MP4, an option would be to write the raw h264 stream to the server. Then we don't have the former issue. VLC/MPlayer can play raw h264 streams and no container is needed. In this case playback is not supported which means user can not start the video (which is being writing) at a given time.

If we need to stick with some video format such as .MP4, we can write the file as so called fragmented MP4 file. A fragmented MP4 file contains multiple self-contained small pieces of the video - each with its own table of contents. It would enable us to play the file before the complete recording has finished. This is not an issue about media plays but implementation in our future work.

As an early stage, Prof. Wolf suggested that we can capture screenshots with a speed of 1 frame/second as history file and make these screenshots startable at a specific time while the surveillance is still streaming video data.

Architecture

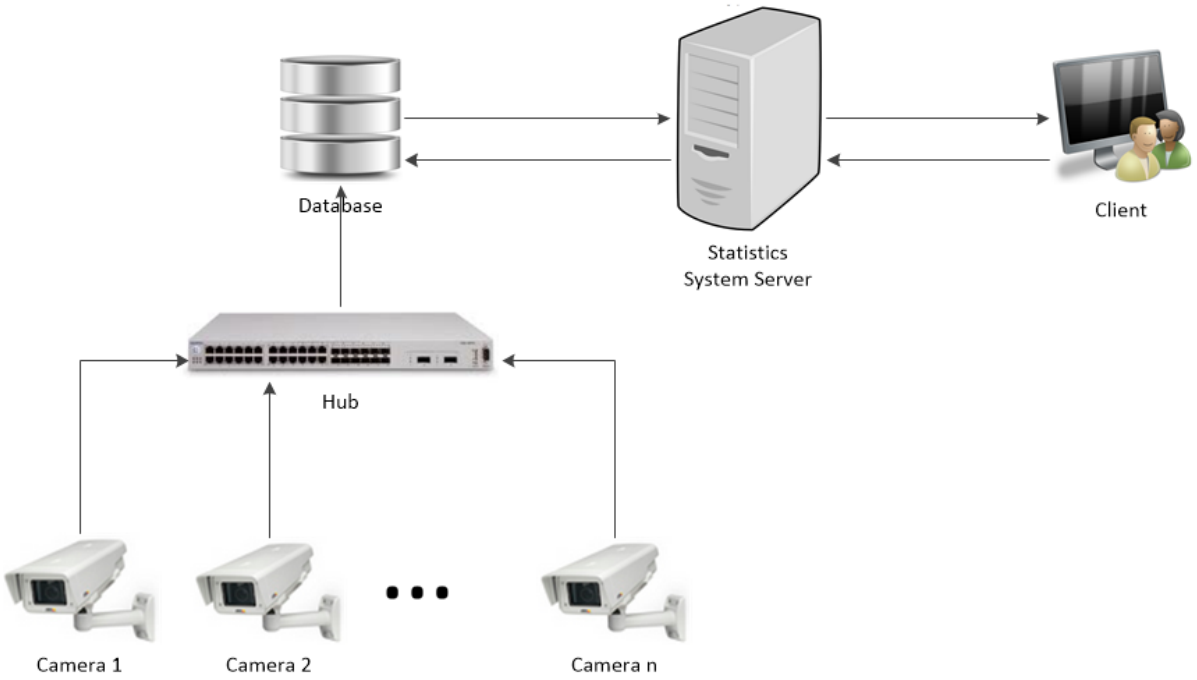

Figure 1. The structure of In-Store Customer Traffic Statistics System

- Each surveillance camera of one specific store will hold a special Camera Id
- Snapshot captured by each camera will be stored in database and the server will use some algorithm provided by SVT Analytics to estimate the number of customer within the snapshot.
- Server stored the count number into database
- Once user makes some request to generate a heat map about customer traffic of some specific time period, server will calculate the average number that corresponding to each camera and feedback this average as a color to the heat map.
- User can upload a new map of their stores
- On the existed floor map, user can drag a rectangle and name it with the camera ID that would recording that area

Implementation

The system is basically a web based application that we have implemented and will use a local database which contains real data provided by third-party as a source to generate customer traffic heat map.

- **Video Capturer and Reviewer**
    - As it is very hard to directly play the early part of the video record while it is still growing, Prof Wolf suggested us to capture screenshots by the speed of 1 frame/second and play these images instead of play video directly. The following two figures (Figure 2 & 3) indicate how the results might look like.

- The screen on the right is real time video comes from an Axis camera which is streaming H.264 video, the screen on the left is used to play screenshots. The red button is used to start recording (capturing screenshots). The slider on the bottom is used to select time of some specific screenshot and once press the play button, it will start playing that image.

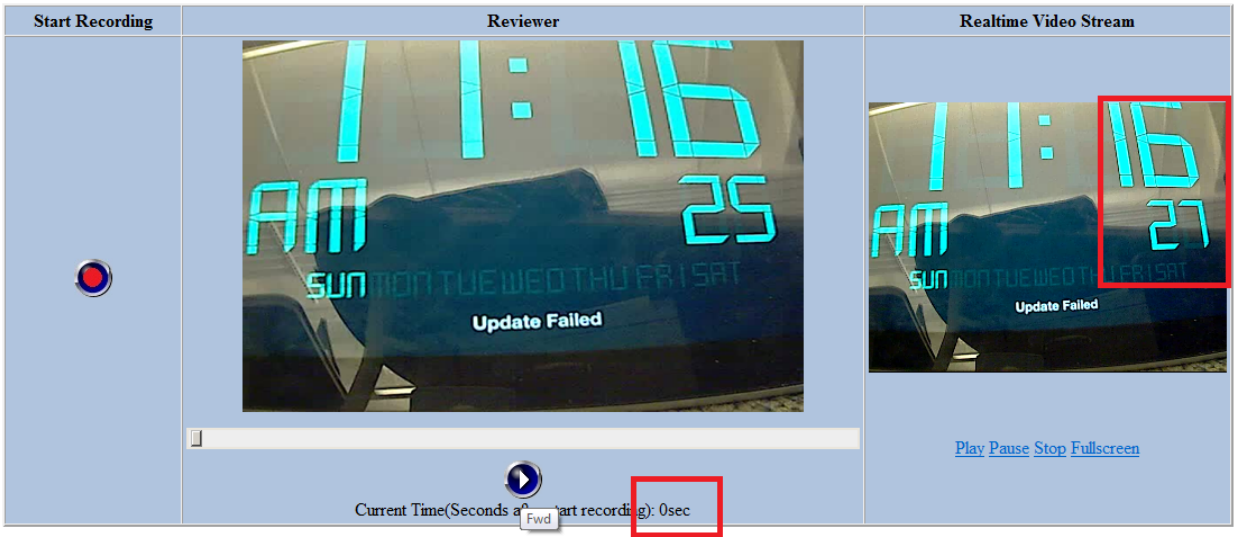

Figure 2. Press 'Rec' button and the system will start to take screenshots

(* If user does not drag slider to select time, the reviewer will play records (screenshots) with several seconds latency compared to real time video)

Figure 3. Select time start at 20th second while the real time video is not affected

- **Index page**

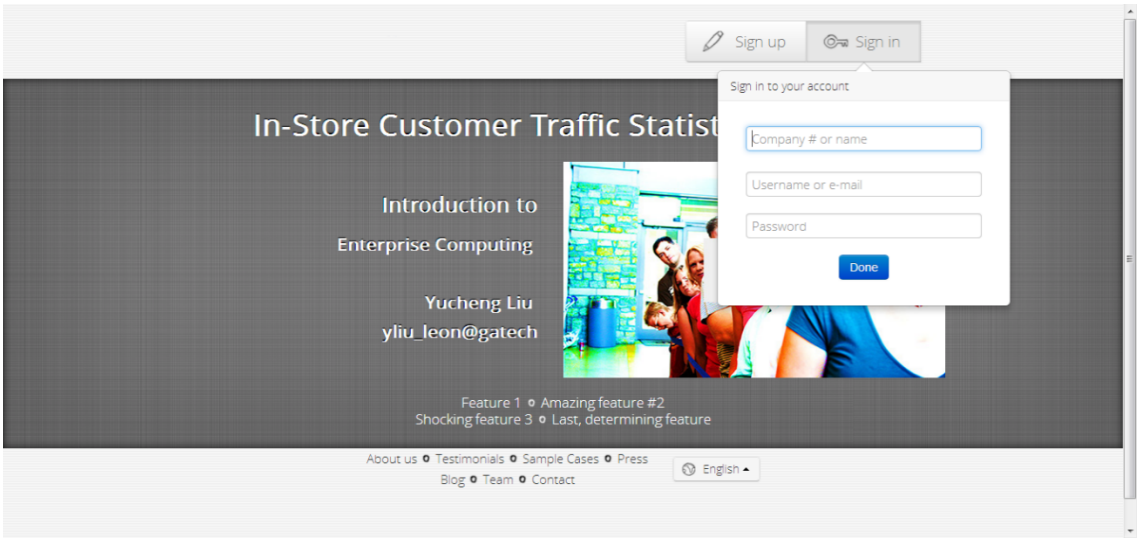

Figure 2. Main page for users to log in to our system

  - This [Figure 2] is the main page for store holder to log in and check the statistics information.

- **Dashboard**

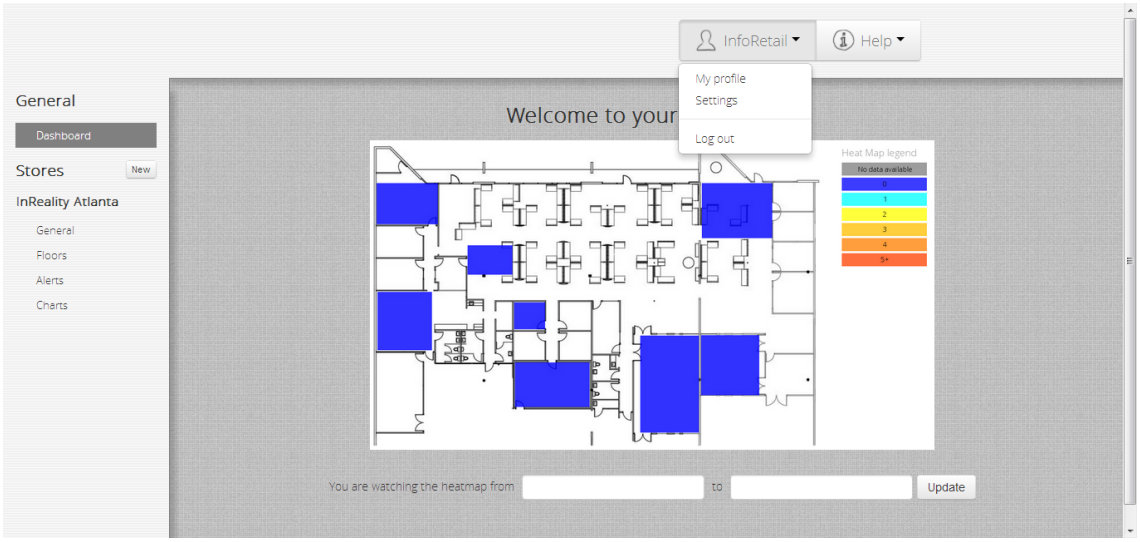

Figure 3. Dashboard

  - Dashboard is the first page users will see once they log into our system. In Figure 3 users can see the location of each zone that each camera will cover. If no start and end time is selected, then no valid data will be provided that each zone will show as invalid value.

- **Heat Map**

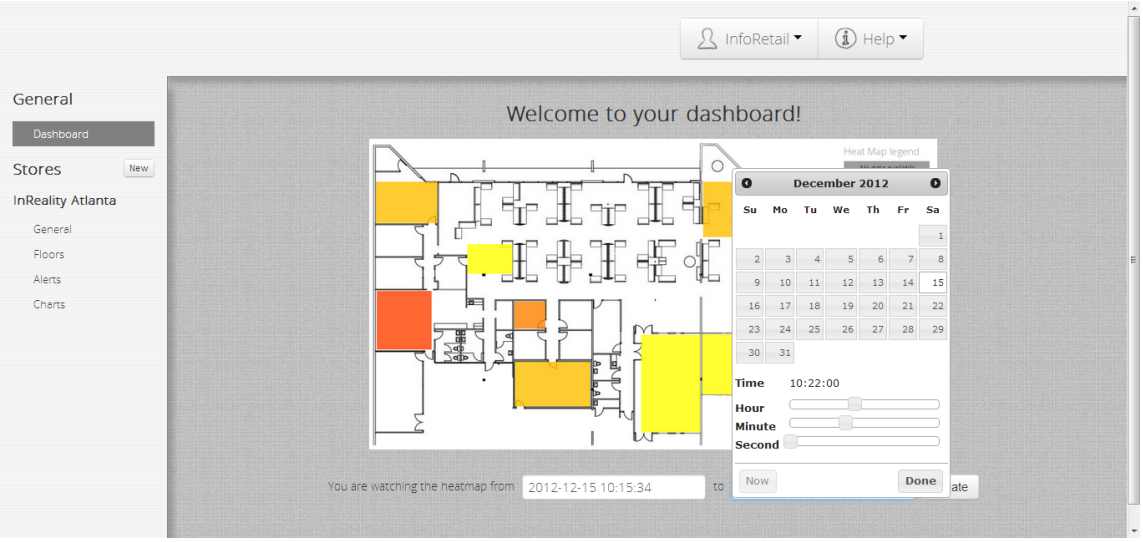

Figure 4. Heat map of traffic of each camera zone for a specific time period

  - Once user select some time period which is valid according to what surveillances have stored in database. If both starting and ending time are valid for all cameras, the heat map will be successfully generated and shown on the dashboard. If the color is redder, the more traffic is in that zone during that period, vice versa.

- **Map Configuration Page**

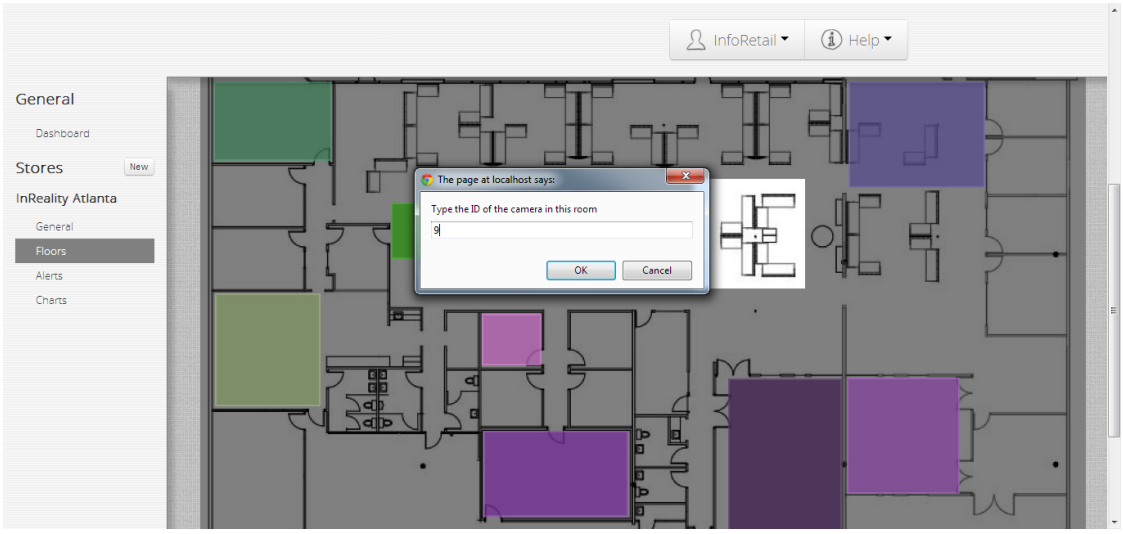

Figure 5. Floor Configuration Page

In this page (Figure 5.) user can do some customized settings for our system.

- Upload new map for their stores.

- Drag a rectangle area and press “Enter” button to arrange an ID for each camera (should be unique)
- Press “Save” to save the coordinates of zone to database

- **Database**

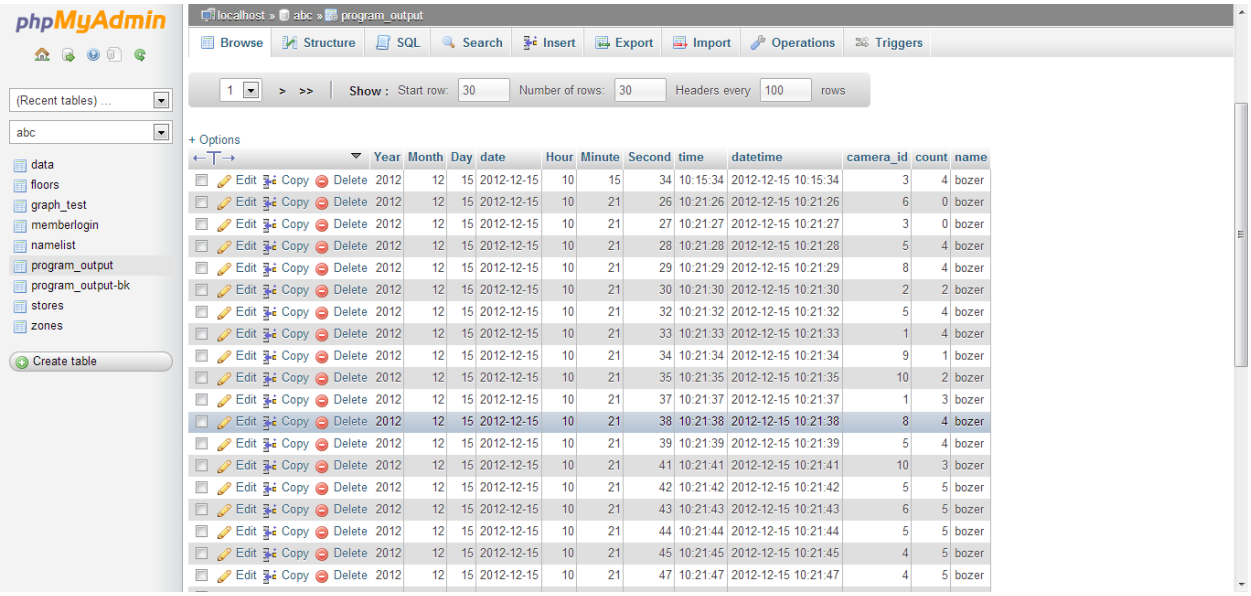

Figure 6. Database of traffic counting

  - This is the database (Figure 6) which contains information captured by each camera including date, time, camera_id and traffic count number of that snapshot. This database is provided as an useful sample by third-party.

- **Camera Search Page**

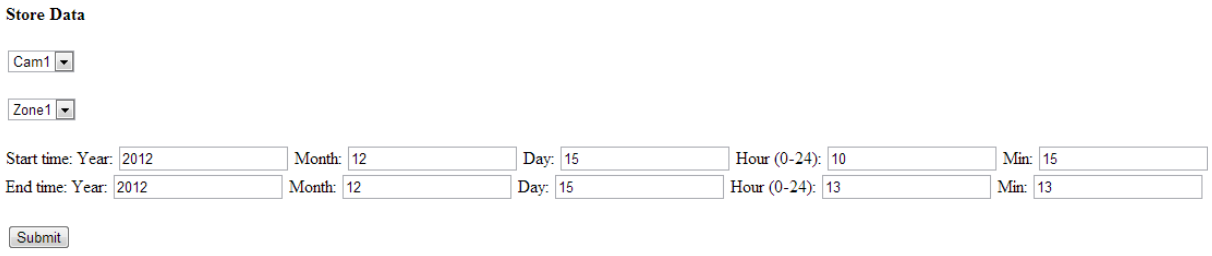

Figure 7. User can select camera and datetime to check specific information

- This is an independent page which I did not implement into the main system and we hope in the future this search page will be more user friendly. The main function of this page is that user can select Camera Id and time period they want to check

- **Frame Search Page**

Figure 8

- In this page (Figure 8) user can specify date and time to check the frame captured by the camera that they chose in the former page.
- Also we use some weather API to provide weather information of that date and time
- This page will give back the frame as follows(Figure9)

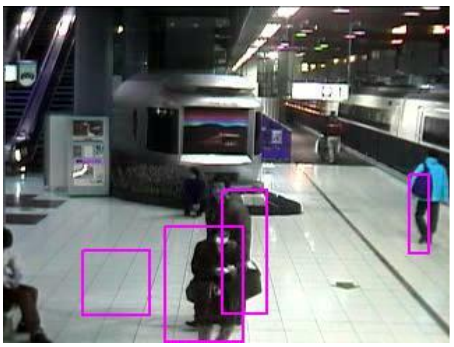

Figure 9

Platform and Development Tools

PHP:

PHP is also important to the proper functioning of our application. PHP helps extract the data from our database and display it to the user in a nice and timely manner. As mentioned before, the PHP algorithm is also used to semi-automate the gathering of the data and storing it into our database so it becomes easier to retrieve it when required.

MySQL Database:

We use MySQL as our database. We have numerous tables which have been designed so as to optimize the working of our application.

HTML/CSS, jQuery:

The design and look of our application is all due to HTML/CSS and jQuery.

Challenges

- One of the biggest challenges is to estimate number of people by analyzing video captured by surveillance camera. Fortunately this function has already been done.
- Another challenges is that at first we thought that we should separate one single view of a camera into several zones. However, after some experiment we found that the cover area of each camera is quite small and it is impossible and not necessary to separate one single camera view any more.
- The third challenge is that no media player provide the function to play the earlier part of video file while this file is still growing. Prof. Wolf suggested we capture screenshot by the speed of 1 frame/second instead and play these screenshots instead of directly playing video file.

Future Work

- **Records Review**: Instead of reviewing screenshots captured by 1 frame/second from Axis camera, we hope we can actually capture video records and user can select any specific time to start play that history video record even when the video record is still growing.
- **Safety**: Detect unusual after-hour movement in restricted areas, such as storerooms or offices or detect suspicious objects left in sensitive areas and sent alert to managers or secure guards.

[1] http://www.agentvi.com/images/Agent_Vi_Case_Study_-_Carillon_City.pdf