Offices located throughout the east coast

MassDOT Crash Geocoder Solution

GIS-T

Presented by
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Jenniferlnzana, MassDOT

April 26, 2019
Presentation Overview

- Solution Overview
- System Components
  - Crash Geocoding Engine
  - Crash Geocoder API
  - Crash Data Bridge
  - Interactive Crash Locator
  - Crash Data Portal
- Technical Aspects
Key Objectives

- Replace and enhance the existing crash geocoder and validator system
- Leverage Planning’s move to use of Esri Roads and Highways
- Provide web services to validate and geo-locate crash data in real time
- Develop a new crash database that will:
  - interface with the new geocoder and validator system
  - be the system of record for crash locations
  - support a new, public-facing crash data portal
  - provide real-time synchronization with the RMV Crash Database
  - provide relevant data redaction within key workflows
- Provide comprehensive reporting & analytics tools for both public and authorized users
**Solution Overview**

**Crash Map/Geocode Portal**
- Crash Geocoder API
- Public Crash Viewer
- Reporting
- Interactive Crash Locator
- Geocoding Engine
- Internal Crash Viewer
- Visualization & Analysis
- Data Extraction
- Crash Map Services

**Crash Data Server**
- Reference Layers
- Roads & Highways
- Interactive Queue
- Crash Geodatabase

**Authentication Portal**

**RMV**
- Crash Data Bridge
- RMV Crash Database

**Crash Analysis Server**
- Big Data Store
Geocoding Engine

Crash Map/Geocode Portal
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Big Data Store

Crash Analysis Server
Geocoding Engine

- Multi-tiered, composite, geocoding algorithm
- Validates locational input to determine if geocoding can be conducted
- Leverages all reference data (Streets/Addresses, R&H, Landmarks)
- Geocodes using all inputs in a tiered, rule-based, configurable environment
- Returns coordinate, status, source, score/confidence, linked/derived data (e.g., R&H data)
Geocoding Methods Supports

1. At-intersection
2. Near-intersection
3. Address
4. Route and Exit Number
5. Route and Milemarker
6. Learned Point
   a. Intersection
   b. Segment
   c. Landmark
7. Rotary
8. Field Coordinates
Crash Geocoder API

- Web service for real-time geocoding of crashes
- Accepts multiple locational input parameters
- Invokes the Geocoding Engine
- Returns geocoding results to caller

Operational Modes
- Geocoding only (return location/results) (LEAs)
- Geocoding and subsequent processing

Capabilities
- Adds Point Feature/Record to Crash Geodatabase
- Adds Record to Interactive Queue
- Records geocoding results for performance reporting
- Provides feedback to police officers (30 mph on I-90)
Law Enforcement Agency (LEA) Web Form

<table>
<thead>
<tr>
<th>AT INTERSECTION:</th>
<th>NOT AT INTERSECTION:</th>
</tr>
</thead>
<tbody>
<tr>
<td>City/Town Name</td>
<td>Middleton</td>
</tr>
<tr>
<td>Route#</td>
<td>[Select]</td>
</tr>
<tr>
<td>Direction</td>
<td>[Select]</td>
</tr>
<tr>
<td>Name of Roadway/Street</td>
<td>Bellingham Court</td>
</tr>
<tr>
<td>At</td>
<td>[Select]</td>
</tr>
<tr>
<td>Name of Intersecting Roadway/Street</td>
<td>Meeting House Square</td>
</tr>
<tr>
<td>Also At Intersection With</td>
<td>[Select]</td>
</tr>
<tr>
<td>Name of Intersecting Roadway/Street</td>
<td>[Select]</td>
</tr>
</tbody>
</table>

Output Coordinate System
Decimal Degrees

Submit  Reset

Results
Candidate description
Score: 0.0
X/Y: 42.593271236505413 / -71.0115699833

Landmark
-71.0115699833  42.593271236505413
**LEA - Reverse Geocoding**

```
<table>
<thead>
<tr>
<th>Coordinates</th>
<th>-71.29543275874514</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>42.37120576387265</td>
</tr>
</tbody>
</table>

**Coordinates:**

<table>
<thead>
<tr>
<th>City/Town Name</th>
<th>WALTHAM</th>
</tr>
</thead>
</table>

**AT INTERSECTION:**

<table>
<thead>
<tr>
<th>Route#</th>
<th>Direction</th>
<th>Name of Roadway/Street</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PERE AVENUE</td>
</tr>
</tbody>
</table>

**NOT AT INTERSECTION:**

<table>
<thead>
<tr>
<th>Route#</th>
<th>Direction</th>
<th>Address#</th>
<th>Name of Roadway/Street</th>
</tr>
</thead>
<tbody>
<tr>
<td>189</td>
<td></td>
<td>PERE AVENUE</td>
<td></td>
</tr>
</tbody>
</table>

**At:**

<table>
<thead>
<tr>
<th>Route#</th>
<th>Direction</th>
<th>Name of Roadway/Street</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E</td>
<td>VILLA STREET</td>
</tr>
</tbody>
</table>

**Also At Intersection With:**

<table>
<thead>
<tr>
<th>Route#</th>
<th>Direction</th>
<th>Name of Intersecting Roadway/Street</th>
</tr>
</thead>
</table>

**Feet of:**

<table>
<thead>
<tr>
<th>Mile Marker</th>
<th>Exit Number</th>
</tr>
</thead>
</table>

**Feet:**

<table>
<thead>
<tr>
<th>Route#</th>
<th>Intersecting Roadway/Street</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VILLA STREET</td>
</tr>
</tbody>
</table>

**Landmark:**

<table>
<thead>
<tr>
<th>Route#</th>
<th>intersecting Roadway/Street</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Longitude</th>
<th>42.37101076387265</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latitude</td>
<td>42.37101076387265</td>
</tr>
</tbody>
</table>
```
# Crash Data Bridge

## Crash Map/Geocode Portal
- Crash Geocoder API
- Public Crash Viewer
- Reporting
- Interactive Crash Locator
- Geocoding Engine
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## Crash Data Server
- Reference Layers
- Roads & Highways
- Interactive Queue
- Crash Geodatabase

## Crash Analysis Server
- Big Data Store

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**RMV**

- Crash Data Bridge
- RMV Crash Database
Crash Data Bridge

- Synchronizes RMV Database with Crash Geodatabase
- Identifies crashes for geocoding
- Submits crashes to Geocoding API
- Updates RMV database with results
  - Crash Location (Coordinates)
  - Crash Status/Metadata
  - Roadway Data (e.g., Roads & Highways)
- Handles crashes added to RMV database WITH a location or W/O a location
Interactive Crash Locator

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Crash Analysis Server:
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RMV:
- Crash Data Bridge
- RMV Crash Database

Crash Location Request

Crash Location Results
Interactive Crash Locator

- Interactive, operator-assisted geocoding/location of crashes
  - Processing of geocoding “rejects” (interactive queue)
  - Refine/Adjustment of existing crash locations
- Adjust locational input parameters
- View and analyze all candidates (and select)
- Manually locate the crash (visually)
- Improved workflow using an “assigned work” queue
- Built-in communication capabilities for providing feedback for police, RMV, Planning, etc… fostering good communication between end users and other departments or external agencies
Interactive Crash Locator (ICL)
Crash Data Portal

Single point of entry for public and authorized users

- Provides guided workflows
- Adheres to the Commonwealth of Massachusetts’ branding styles and statewide agency navigation
- Dashboard and report preview panels and galleries
- *Simple metrics made available on the front page to peak interest in available crash information*
Dashboards
SHSP Fatal and Serious Injury Trends Dashboard
RMV Fatality Information Dashboard
Statewide Crashes by Severity and Year
Query and Visualization Tool

Crash data review and analysis

- Ability to query crash, vehicle, and person level crash data
- View crash data in tables, on maps or in dynamic charts
- Queries can occur in both a basic, parameterized fashion or using an advanced, integrated SQL query builder
- Data usage tracking for improvements and enhancements
Query and Visualization (Q&V) tool
Q&V – Selecting Fields
Q&V – Basic Query

Basic Search Help

The basic query is a parameter-driven search. This search supports selecting criteria specific to a crash but also vehicle and person-type details as well. Results for this search can be displayed on a crash level identifying all crashes meeting the selected criteria, on a vehicle level for all vehicles involved in crashes, or on a person level for all persons involved in crashes.

Upon submitting the search, the results screen will display showing all records meeting the search criteria. The related crashes will display as points on the map based on the location they occurred. After reviewing the results, the search can be refined by returning to the basic search form. Otherwise, by navigating to the spatial tab, the results can be refined to a specific area on the map based on several location types.

- Step 1: Select Criteria in one of the collapsible panels
- Step 2: Submit the search
- Step 3: View results
- Step 4: Refine search parameters
Q&V – Spatial Query
Q&V – Visualize Results
Crash Data Reporting

Robust report authoring and delivery platform

- Current users are restricted by MS Excel’s limitations
- Deployed SQL Server Reporting Services
- Using this technology, we’re able to provide report definition configurability, scheduling, and email distribution that didn’t exist in existing system
### Standardized Reports

<table>
<thead>
<tr>
<th>Report Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Police Agency TEST UPDATE</td>
<td>This report displays the number of Crash Reports entered into RMV's Crash Data System (CDS), broken down by police agency. Reports cover a four year range. You will be asked to select a year range.</td>
</tr>
<tr>
<td>Older, Younger, and JOL Driver Related Crashes by Injury Type</td>
<td>This report displays the number of crash Reports entered into RMV’s Crash Data System (CDS) involving older drivers (65+) and younger drivers (+ 21) , broken down by year. Reports cover a 5 year range. You will be asked to select the date range.</td>
</tr>
<tr>
<td>Fatal Crashes by Town</td>
<td>This report displays the number of fatal Crash Reports entered into RMV’s Crash Data System (CDS), broken down by police agency (state or town). Reports cover a ten year range. You will be asked to select a year range.</td>
</tr>
<tr>
<td>Reports Entered by Police Agency by Month</td>
<td>Description coming soon...</td>
</tr>
<tr>
<td>Driver Distractions in Crashes</td>
<td>Description coming soon...</td>
</tr>
<tr>
<td>Crashes by Severity</td>
<td>This report displays the number of Crash Reports entered into RMV’s Crash Data System (CDS), broken down by crash severity. Reports cover a five year range. You will be asked to select a year range.</td>
</tr>
<tr>
<td>Pedestrian, Cyclist and Motorcyclist Crashes by Injury Type</td>
<td>This report displays the number of crash Reports entered into RMV’s Crash Data System (CDS) involving bikes, motorcycles, pedestrians, broken down by year. Reports cover a 5 year range. You will be asked to select the date range.</td>
</tr>
<tr>
<td>Persons Involved in Crashes by Age Group</td>
<td>Description coming soon...</td>
</tr>
<tr>
<td>Grant Application - Crashes at a Glance</td>
<td>A report that facilitates applications for community grants involving traffic and safety issues.</td>
</tr>
<tr>
<td>Injury Severity and Safety Systems by Person Type Involved in Crashes</td>
<td>Description coming soon...</td>
</tr>
<tr>
<td>Bicycle, Pedestrian, Motorcycle Injury Type</td>
<td>2015</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Cyclist: Fatal injury</td>
<td>11</td>
</tr>
<tr>
<td>Cyclist: Non-fatal injury</td>
<td>1,038</td>
</tr>
<tr>
<td>Cyclist: Not Reported</td>
<td>49</td>
</tr>
<tr>
<td>Cyclist: Property damage only (none injured)</td>
<td>302</td>
</tr>
<tr>
<td>Cyclist: Reported but invalid</td>
<td>0</td>
</tr>
<tr>
<td>Cyclist: Unknown</td>
<td>4</td>
</tr>
<tr>
<td>Cyclist: Total</td>
<td>1,404</td>
</tr>
<tr>
<td>Motorcycle: Fatal injury</td>
<td>53</td>
</tr>
<tr>
<td>Motorcycle: Non-fatal injury</td>
<td>1,440</td>
</tr>
<tr>
<td>Motorcycle: Not Reported</td>
<td>52</td>
</tr>
<tr>
<td>Motorcycle: Property damage only (none injured)</td>
<td>441</td>
</tr>
<tr>
<td>Motorcycle: Reported but invalid</td>
<td>0</td>
</tr>
<tr>
<td>Motorcycle: Unknown</td>
<td>10</td>
</tr>
</tbody>
</table>

Created Date: 4/9/2019
## 2015-2019 AGAWAM Crashes at a Glance

<table>
<thead>
<tr>
<th></th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Fatal crashes</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Serious Injury crashes</td>
<td>3</td>
<td>6</td>
<td>12</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total crashes entered into RMV crash system</td>
<td>554</td>
<td>589</td>
<td>602</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Pedestrian crashes</td>
<td>7</td>
<td>1</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Pedestrian fatalities</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Pedestrian injuries</td>
<td>4</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Bicyclist crashes</td>
<td>1</td>
<td>4</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Bicyclist fatalities</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Bicyclist injuries</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Motorcycle crashes</td>
<td>7</td>
<td>12</td>
<td>11</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Motorcycle fatalities</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Motorcycle injuries</td>
<td>5</td>
<td>8</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total young driver (age 16-20) crashes</td>
<td>119</td>
<td>145</td>
<td>133</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total older driver (age 65 and older) crashes</td>
<td>107</td>
<td>98</td>
<td>89</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

MassDOT makes no representation as to the accuracy, adequacy, reliability, availability or completeness of the crash records or the data collected.
Crash Tabulation Tool

Data Selector

Choose fields to add to report:
- Person Measures
  - Person Count
- Crash Measures
  - Crash Count
- Person Attributes
  - Age
  - Age of Driver - Oldest Known
  - Age of Driver - Youngest Known
  - Age of Non-Motorist - Oldest Known

Drag fields between areas below:
- Columns
  - Crash Severity
- Rows
  - Non-Motorist Type
  - Crash Count (Sum)
- Values

Pivot Data Grid:

<table>
<thead>
<tr>
<th>Non-Motorist Type</th>
<th>Fatal injury</th>
<th>Non-fatal injury</th>
<th>Not Reported</th>
<th>Property damage</th>
<th>Unknown</th>
<th>Crash Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclist</td>
<td>133</td>
<td>14,485</td>
<td>1,097</td>
<td>4,657</td>
<td>123</td>
<td>20,495</td>
</tr>
<tr>
<td>Not reported</td>
<td>98</td>
<td>3,332</td>
<td>1,446</td>
<td>3,602</td>
<td>111</td>
<td>8,589</td>
</tr>
<tr>
<td>Other</td>
<td>37</td>
<td>1,011</td>
<td>250</td>
<td>1,307</td>
<td>48</td>
<td>2,653</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>1,101</td>
<td>22,996</td>
<td>1,688</td>
<td>5,591</td>
<td>348</td>
<td>31,724</td>
</tr>
<tr>
<td>Reported but invalid</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Skater</td>
<td>5</td>
<td>274</td>
<td>20</td>
<td>73</td>
<td>3</td>
<td>375</td>
</tr>
<tr>
<td>Train/trolley passe</td>
<td>1</td>
<td>28</td>
<td>1</td>
<td>21</td>
<td>1</td>
<td>52</td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
<td>106</td>
<td>59</td>
<td>164</td>
<td>9</td>
<td>340</td>
</tr>
<tr>
<td>Grand Total</td>
<td>1,361</td>
<td>41,932</td>
<td>4,544</td>
<td>15,335</td>
<td>643</td>
<td>63,815</td>
</tr>
</tbody>
</table>

Chart Type:

Bar

Use the textbox below to create a custom label for your chart. Leaving the textbox below blank will cause your chart to use its default values.

My presentation chart
Crash Tabulation Field Filtering
<table>
<thead>
<tr>
<th>Non-Motorist Type</th>
<th>Fatal injury</th>
<th>Non-fatal injury</th>
<th>Not Reported</th>
<th>Damage only (none)</th>
<th>Unknown</th>
<th>Crash Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclist</td>
<td>133</td>
<td>14,485</td>
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<td>348</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td>1</td>
<td>28</td>
<td>1</td>
<td>21</td>
<td>1</td>
<td>52</td>
</tr>
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<td>15,335</td>
<td>643</td>
<td>63,815</td>
</tr>
</tbody>
</table>
Crash Tabulation—saving charts

My presentation chart

- Fatal injury
- Non-fatal injury
- Not Reported
- Property damage only (none injured)
- Unknown
Cloud Based Deployment

Centrally located solution using Microsoft’s Azure cloud environment

- Ensures a stable, secure, and performant suite of tools
- Supports public access to query, analyze, report, and extract the data
- Performant design that provides:
  - no more waiting for emails or data mailed on disc
  - ability to “slice and dice” crash, vehicle, and person level data in many ways
  - enhanced analytics for staff, public, & researchers
Technology Used

- **Microsoft:**
  - Windows
  - IIS
  - SQL Server
  - SSRS

- **Esri:**
  - ArcGIS Enterprise
  - Portal for ArcGIS
  - Roads & Highways
  - Open Data Portal
  - WebApp Builder

- **Angular & Kendo**
Key Successes

- Improved geocoding processes
- Enhanced access to LEA’s for better data quality
- Integration with Esri’s Roads & Highways
- Improved enterprise data model
- Leverage COTS components wherever possible
- Cloud-based solution providing stability and consistent up-time
Q&A

Steve Anderson, Principal-In-Charge
sanderson@vhb.com | 860.807.4300

Gary Stevens, Transportation Solutions Architect
gstevens@vhb.com | 518.389.3633