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Delving into the Archives: Studying Geographic and Cultural Landscape Changes Using Cartographic and Textual Data

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Summary: Historical resources offer amass information and evidence about days past. Textual information often captures accounts of memories, experiences, stories, and facts. Illustrated or graphical information display scenes, landscapes, and infrastructure, while cartographic drawings or prints often depict or capture a moment in time. Intertwining graphical representations of places with textual data avails details and organizes historical facts about places, people and the interconnection between them.

In this paper, the authors share the work they have completed creating a historical database of pre- and post-war settlers, inventors, entrepreneurs, and laborers. Their sprawling businesses have impacted the small city, changing the geographic and cultural landscape of it. By using historical resources, the authors have developed modern historical maps to tell the story of the history of the city and their people. Thematic analysis will be discussed, including covering business types, longevity, and loss due to urbanization and transportation development.

Background

When studying and investigating the history of a city - its manufacturers, businesses and its residents, common resources sought by researchers include historical city directories, fire insurance plans and historical maps. These will provide statistical information about the types of businesses, number of residents, and a timespan account of geographical, economical and cultural changes and developments. As one of the most detailed historical record of every address, household, business and building, the Vernon’s city directory for Kitchener-Waterloo (Ontario Canada), published by Henry Vernon & Sons, offers statistics, facts, and clues about life in Berlin/Kitchener throughout the years (Kitchener was named Berlin up until 1916). Whether it is to study family history, business retention, impacts of war and/or industrialization, extracting and analyzing information from these historical gems will aid in the discovery and learning process. Using the spatial information, along with the business advertisements, researchers can visualize the textual and graphical components, creating opportunities for new connections. The researchers took a collective approach and collated and geocoded the city directory information, offering the results in an ArcGIS Online web-map. Every geocoded csv file has been made available for download as well, encouraging researchers to map their own topics of interest.

Introduction

Today, in the era of digital scholarship, researchers are finding different ways to ask questions, conduct
research, preserve, display, and publish their work. The historical directory web-map draws on the ideas and findings of several researchers who have used GIS technology to analyze the historical evolution of city landscapes. Susan Wardwick (1990) created a classroom assignment in her geography class having students use city directories to trace historic residential and commercial districts. Using the city directory of Sacramento, California for the year 1940, students collected the information and used GIS to create a map, displaying the location of residences, food businesses, gas stations, barber shops, churches and schools. More recently, Jennifer Brackhan (2009) used GIS at ten-year intervals to study and display changes in restaurant types and their geographic patterns. Using city directories, Brackhan studied restaurant growth and diversity in ethnic restaurants. M. Hayek, et al (2010), studied abandoned and contaminated sites, collecting abandoned building information from city directories, and using GIS to display the location and possible contaminant based on spatial proximity to brownfield land. For many years now, researchers have depended on city directories for population-based and business-related studies. P. Rosenbaum, et al (1993) used city directories to collect occupational data for a cancer study. Richard Still (1953) studied mortality rates of Seattle Grocery Wholesalers and obtained grocery listings from the directories, and Sidney Goldstein (1954) used city directories as sources of migration data.

In this paper the authors answer research questions using 100 years of digitized and mapped textual historical data. They examine the types of businesses that existed over 100 years ago. They explore the changing landscape – from demolished buildings to street expansions. They analyze the shift from manufacturing to technological automation and innovation, and share patterns of occupation progressions. They highlight unique historical businesses and their changing locations and street addresses. Using ArcGIS Online, they offer researchers access to explore and visualize the development of the city.

Objectives

The overall goal of this initiative is to support deep learning and enhance critical thinking and geospatial skills by creating, disseminating and mobilizing new research using modernized accessible historical primary resources. The objectives of this project are as follows:

1. To provide researchers and the general public with an easily-accessible online tool that will allow local historical research to be conducted visually, in a map format, modernizing traditional research methods
2. To promote geospatial literacy and offer researchers experience using Geographic Information Sciences (GIS) technology, along with analytical tools to ask and answer questions around data distribution
3. To study and analyze local business and residential information found in city directories, and share findings with academic researchers, community organizations and the general public
4. To outreach and work with organizations in sharing this resource locally and abroad
Methodology

Presenting Transcribed Historical Directory Information in an Arc Online Web Application

This methodology section covers the steps taken to import geocoded csv files for spatial presentation in the ESRI Web App (Content Creation Software), creating feature layers, creating the map to host the feature layers, and creating the Web App using the web map. The key to creating a successful ESRI Web App is strong base data. The viability of the end research dataset is very much dependent on the historical data it is built upon. Large gaps and difficult to summarize data require more creative (expensive and time consuming) solutions to pull approachable analytical information from. An easy way of vetting datasets for HGIS projects is to ensure the raw data is relatively simple to collect, is continuous, has location, and can be translated into rows and columns (database type structures for maximum flexibility). In a cleaned database rules-based csv format the dataset can be shared and visualized very easily with spatial software. Since the dataset has been thoughtfully created it is easily interpreted by ESRI’s web products. Several web maps have been created and discussed in this paper, and the methodology is similar for all of them. The methodology discussed here is for the two main web maps created that display Businesses and Residents for the years 1901-2000. Within these two groups the csv files were created for each year. For simplicity, the Businesses were placed into one table containing all the years of csv’s from 1901 to 2000. This way of storing base data is easy to migrate and present in any visual or analysis software.

Creating the ESRI Web App

The visual component of this project was created using the Organization site of the ESRI Web App. All the Business csv’s were added and built into a Feature Layer. To create the base map for the ESRI Web App a Web Map needed to be created. This map creation tool has many of the creative features of Arc Pro but is web based. All of the Business feature layers were added and their visibility set to how the ESRI Web App was going to be presented to the world. This particular App was developed to start with the earliest year as visible and the rest hidden so as to not overwhelm the user with too much data. The base map for business was set to a dark theme in an effort to use light points, and as a contrast, the Residents map has a bright background using dark points. Since this is a web based tool each Feature Layer needs to be addressed individually. The unique symbols style of point chosen was Firefly to ensure individual points pop against the base map and as the points are aggregated the points draw the eye more. The dataset contains hyper-links to business advertisement images and these were differentiated by coding an expression in Arcade (ESRI scripting/expression language).

IF(IsEmpty($feature.Image_Links), "00000", "FF0000")

This expression runs every time the layer opens and differentiates the colour of the points depending on...
if a hyper-link is present in the attribute row.
Clustering is key to keeping the map clean at all zoom levels and different devices. The cluster radius
was kept low and the number labeling was not enabled because of the number of points represented in
close proximity. The cluster label was changed to represent the count of features in the cluster and in-
structions “Browse Features” to view individual attributes.
Popups were configured in a way to best show the data, highlighting the year and business at the top,
the fields were reordered, and the administrative fields removed from view (e.g. Lat and Long).
The point features are labeled by their Current Address and only show up at the “Building” visible
range. This gives context to the point data without overwhelming the web page with too much data. The
map legend was not enabled for the web map since this tool is not able to edit out the number of features
clustered and that information does not serve a meaningful purpose on the end product web map.
The best way to present the web map was to incorporate it into a chosen layout in the ESRI App Creator
tool (Sidebar). Here the web map and its layers are placed within a layout that is setup for headers,
attribute and map location search, themes, additional map details, accessibility compliance and an ability
to be viewed on different devices, such as tablet and phone screens.
There are two settings in the Web App content creation tool. The first is Express and it walks the user
through the essential steps in creating the final site based on the web map.
Map: allows movement between the web map and Web App creation software for changes to the core
layers. Also, this is where the Accessibility description is.
About: this is where the App title and splash screen are input.
Sidebar: add all the layers from the web map and enable them. Here Details was used as a legend
(Knowledge of HTML table structures and image classes within a span is required to create the right
presentation).
Interactivity: this is where all the layers are configured as searchable and what attributes can be
searched. In the Business web map the Business Name and Historical Address were set as the searchable
attributes and the ‘all sources’ was enabled. The ‘all sources’ brings all the layers into the search so one
can search one name across all layer years.
Theme & Layout: dark or light depending on preference and the location of all the common map tools.
Publish: push your final product to the web. This ESRI Web App needs to be made public to be viewed
outside the Organization. Publishing also provides an iframe to place the app within a previously created
site to seamlessly incorporate within research output.
A few tweaks were required within the Web App Creation Software to have the research present
correctly for the final product envisioned. As with most Content Creation software customization is limited
but there are sections that one can access the source code.

<p style="font-size:25px;text-align:center;">Kitchener: 1901-2000 (UW Geospatial Centre)</p>
<br/>
<p style="font-family:Georgia;font-size:15px;text-align:justify;">Kitchener Vernon City Directories from 1901-2000 have</p>
Issues Encountered

As with any emerging technology there are issues with customization and creative control. Here are some issues encountered and overcome with either acceptance or web stack development expertise.

Without having experimented with several different online ESRI Content Creation Solutions it is hard to determine the correct path to take in development or know which is best for the desired outcome. Creating web maps for each layer and trying to assemble them in one of the various content creation solutions. This was a time sink as there are no clear and quick to absorb instructions on what base maps the different Web App Creation Tools need. Or, if creating a Web App is the appropriate presentation for the research data.

Having to script in Arcade to present simple symbology. While not difficult it can be intimidating. The App tool at times drops layers and one needs to be aware before publishing. This is an edge case since this Web App is pushing the limits of ESRI’s Web Creation Software with the number of layers being presented.

These tools provided by ESRI are an amazing way to get HGIS research from source material to a global audience in shorter times than ever before. The “normal” way to present HGIS as standalone content on the web is: to spool up various servers (Database and Internet Information Service), migrate the dataset to be stored within a database, create a connection from the backend database to the frontend webpage (coding: in React or Angular, compile into JavaScript within Node.JS, incorporating a secure Database Connection) all hosted on a secured internet enabled server, connect all of this to a mapping API (Application Protocol Interface like Leaflet) frontend, then customize the interface to have a map and table with appropriate markers that have clustering. ESRI has made these steps more approachable for researchers to push their work out to the world to make the promotion of further research possible.

Results: Data Visualizations

Street Name Changes

House numbers and street names have changed considerably over the years. For example, what was once was Dan Street, is now Wellington North, and Pinke is now Weber. In the early 1900s there was
John Street, which is unrelated to the current John Street. Finding what was and what is presently is certainly a game of connecting the dots and discovering clues about potential relations. Because of this, the project team developed two lists of streets—a current one and a historical one. The historical street addresses were created by analyzing all of the city directory street changes (usually by following a household over time), and confirming, when possible, using historical maps and fire insurance plans. *Figure 1* shows an entry from the 1954 directory when Willow Street still existed. *Figure 2* shows the 1955 directory where it was removed.

After some significant time and research, project team members found a historical map (Figure 3) that showed the location of Willow Street. Knowing this allows the team to look at other maps to determine that Willow Street in fact changed to Linwood Street, which was eventually demolished and overbuilt and replaced with a parking lot (Figure 4).
Figures 3 and 4: Historical Map (left) that shows the location of Willow Street. Modern map (right) that shows it was replaced by a parking lot.

Figure 5 shows the webmap that captures all known street changes.

Business Developments: Growth over Time

With access to a century worth of business information, as well as their business advertisements, the city directories offer a wealth of information on the types of businesses, their sales, longevity and growth. Throughout the years positions have come and gone, slowly being replaced by automation or computers. Positions that are unheard of today like creamery testers, confectionary dippers, tire time keepers, sidewalk inspectors, basket-makers, or milkman, to name a few. Additionally, occupation progressions didn’t always have a natural path. For example, an accountant one year was a piano salesman

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the next. An engineer became a fireman. A watchman became an electrician. A stenographer turned into a nurse. Perhaps schooling and training was not required as much and therefore allowed for continuous job variety. There were lots of service-type positions, like piano tuners, typewriter and sewing machine repairers, hemmers, and stitchers. Stenographers were predominantly female, as were dressmakers and operators. Manufacturers changed names over the years and some clearly employed a large percentage of the residents in the city. In 1901, the largest number of manufacturers were cigar makers, followed by button manufacturers and glove manufacturers. Cigars gained even more popularity over the decades, increasing to 5 cigar manufacturers by 1911, and continuing well into the mid 1940s. In 1907 there was a large increase in furniture manufacturers which continued to be strong for decades to come. That year also saw the beginning of rubber manufacturing and a few automobile manufacturers as well. By 1920, the city of Kitchener was booming with a variety of manufacturers making furniture, buttons, gloves, rubber, candy, glue and sugar. Berlin/Kitchener is probably best known for manufacturing shoes, rubber products, and furniture. Some well known names include Hydro City Shoe, Oscar Rumpel, Dominion Tire, Dominion Rubber, Merchants Rubber, Kaufman Rubber, Canadian Consolidated Felt, Hibner Furniture, and Ahrens Shoe.

Figure 6 lists and summarizes some of the manufacturers and businesses in 1919.

<table>
<thead>
<tr>
<th>17 Butchers</th>
<th>9 Button manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 carriage maker</td>
<td></td>
</tr>
<tr>
<td>6 cleaning and pressing</td>
<td></td>
</tr>
<tr>
<td>11 candy and ice cream shops</td>
<td></td>
</tr>
<tr>
<td>12 Dentists</td>
<td></td>
</tr>
<tr>
<td>11 dress makers</td>
<td></td>
</tr>
<tr>
<td>20 furniture makers</td>
<td></td>
</tr>
<tr>
<td>13 garages</td>
<td></td>
</tr>
<tr>
<td>3 glove manufacturers</td>
<td></td>
</tr>
<tr>
<td>Over 140 insurance companies!</td>
<td></td>
</tr>
<tr>
<td>20 music teachers</td>
<td></td>
</tr>
<tr>
<td>34 nurses</td>
<td></td>
</tr>
<tr>
<td>6 restaurants</td>
<td></td>
</tr>
<tr>
<td>4 rubber manufacturers</td>
<td></td>
</tr>
<tr>
<td>7 shirt and collar makers</td>
<td></td>
</tr>
<tr>
<td>15 shoe repairers</td>
<td></td>
</tr>
<tr>
<td>12 tobacconists</td>
<td></td>
</tr>
<tr>
<td>4 vet surgeons</td>
<td></td>
</tr>
</tbody>
</table>

Figure 6: Manufacturers and Businesses in 1919 in Kitchener, Ontario.

A webmap was created with a time slider feature to demonstrate the growth of businesses between 1903-1940. This map was created using the business entries from the historical city directories. Figure 7 is a screen capture from this online initiative.
Additional research was done to analyze the proximity between where people lived and where they worked. The researchers took the top five employers and mapped their locations and the residences of their employees. This map is displayed in Figure 8.

Business turnover was quite common throughout the years. Some businesses lasted one or two years, whereas others remained in business for over 20 or even 40 years. To this day, in business since at least 1900 is the Walper Hotel (formerly known as Walper House), the Bank of Nova Scotia, Canadian Bank
of Commerce, and Schreiter Furniture Store. Knowing exactly which businesses resided in each building for any given year is just a click away with this initiative. Users can download each transcribed year or browse through all the streets for all the years as well via the main ArcGIS Online Map. A webmap was created highlighting all current King Street buildings that have had a long history of businesses in them (Figure 9). Rubber factories, clock makers. Bakeries and confectioneries did very well in Kitchener. Family-run restaurants didn’t often last for too long. In fact, an analysis on restaurant establishments shows that between 1901 and 1930, Kitchener only had 11 restaurants. Eating outside of the home didn’t become popular until the 1950s, when there were 34 restaurants, and then in the 60s when there were almost 70 of them. A web-map was developed to showcase eateries, restaurants, dining rooms and cafés between the years 1900-1930 (Figure 10).

Figure 9: Interactive web-map listing business history for each building footprint.
Business Advertisements for Research

The modernization of ‘old data’ not only preserves the past but opens it up to those who don’t normally work with historical print materials. A city directory doesn’t only list residential and business information, but also a large number of business advertisements. These are absolute gems as they reveal types of goods, costs of goods and inflation, business longevity, and style of writing and advertising. The advertisements published in the directory were all extracted into individual images and have been linked to the business listings. Figure 11 focuses on two businesses. Pearl Laundry, a dry cleaner that was in business for over fifty years. From the ad one can learn that shirts were re-banded for 10 cents in 1901, and that mending was done free, and that decades later the business also offered rug shampooing. The second ad shows an advertisement that reveals the cost of goods at the time. Men’s fine shoes cost between $4 and $5, and ladies wear cost between $2.50-$5.00. A web-map was created to summarize different ways businesses advertisements could be used for research purposes.
Residential Mobility

When researchers combine all the annual volumes of the city directories, they are able to conduct longitudinal studies about the people. They can study where they lived, where they moved to, how frequently they moved, where they worked, how often they changed jobs, and more. Studying people over time allows researchers to understand who the people were, and to imagine what their lives were like. Placing this information into a digital atlas or spatial display permits visual connections and summarizes the movements of people and their families. The residential web-map was published to offer researchers, historians, genealogists, and the general public access to residential location information. Additional derivative maps were also created to highlight the authors’ finds. The map of Early Occupations of Residents highlights the different occupations that people had: Blacksmiths, bookbinders, Carriage Makers, Hardness Makers, Junk Dealers, Pattern Makers, Saddlers, Tobacconists, to name a few. A study of some of these residences over time show that many people stayed at the same company for 15 years or longer, often employed by furniture, shoe, or cookie manufacturers. Most residences with stable jobs did not move during this time either.

Another map was created to ensure that the people who used to live in the city were not forgotten - especially those whose homes have been demolished in the midst of urbanization. With the expansion of the city, its transportation, and development of high rises, many original buildings have been torn down. These buildings were once homes to numerous residents, and everybody who has lived there is...
listed in this map. *Figure 12* offers a sample image of one of the records.

![Figure 12: Remembering the residents and homes from the past.](image)

**Conclusion**

This initiative is the culmination of the research team collecting, cleaning, geocoding, web developing and mapping the history of the city. The primary goal of this project was to make rich historical resources easily accessible to the public so that they have the opportunity to ask and answer their own questions about the people and places within Kitchener. This paper delved into some of the research that has been conducted, however there is opportunity to study so much more with this data. With over 230,000 residential and business entries, and almost 2,000 historical advertisements, users are encouraged to peruse, download, map and analyze historical data that is often so under-utilized.

**References**


