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Web-based Multimedia Mapping for Spatial Analysis and Visualization in the Digital Humanities: a Case Study of Language Documentation in Nepal

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Abstract

There has been a growing interest in utilizing geographic information systems (GIS) in the digital humanities and social sciences (DH). GIS-based DH projects usually emphasize spatial analysis and cartographic capability (e.g., displaying the locations of people, events, or movements), however, GIS alone cannot easily integrate multimedia components (e.g., descriptive text, photographs, digital audio, and video) of DH projects. Multimedia mapping provides a unique approach to integrating geospatial information in digital map format and multimedia information, which is useful for DH integration into spatial analysis and visualization. As cartographic mapping and GIS evolve from a traditional desktop platform to the World Wide Web, it is of significance to design and develop a Web-based multimedia mapping approach that could carry out spatial analysis and incorporate multimedia components, which is greatly beneficial to the DH applications. Our objectives of the language documentation research project in Nepal were to (1) use geo-tagging equipment to collect audio and visual recordings of three types of socio-linguistic data: language attitudes and practices interviews, free-form narratives, and elicited vocabulary and grammatical paradigm sets, from representative speakers of the four endangered languages in twenty-six Manang villages; (2) design and develop a Web-based, interactive multimedia atlas that can display data points corresponding to the speakers, links to the three types of data gathered in multimedia format, provides friendly user interface for the manipulation and spatial analysis of all the data. It is anticipated that the Web-based, interactive, and multimedia language atlas can bring all local and international stakeholders, such as the speech communities, linguists, local government agencies, and the public, together to raise awareness of language structures, language practices, language endangerment, and opportunities for preservation, all through this easy-to-use means that enhance the geo-spatial representation in engaging visual and sensory (multimedia) formats. Google Maps API and JavaScript are employed to develop this online, interactive, and multimedia language atlas.

Keywords Multimedia mapping · Spatial analysis · Visualization · Digital humanities · Language documentation · WWW

Introduction

There has been a recent and noticeable increase in connections between humanities and geography (including geographic information system (GIS)), particularly in visualizations and in projects that spatially represent historical, narrative, and textual descriptions. This movement has been termed by Harris et al. (2011) as the "Geohumanities." By "humanities," we mean spatial considerations of disciplines concerned with the human condition, and involving largely qualitative, introspective and speculative methods of inquiry (e.g., literature, anthropology, philosophy, history, communication studies, and languages/linguistics). The linkages between social sciences and GIS geography have been substantive and productive, particularly in the rapidly expanding realm of the digital humanities (DH) (cf. Goodchild and Janelle 2004).

In such projects, mapping is used in the spatial visualization of multimedia information, including digital still images, sound, and video. One discipline that is poised to greatly

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benefit from a deeper collaboration with GIS is that of linguistics, particularly applied dimensions such as typology, sociolinguistics, historical linguistics, and language documentation and description. Examples of such notable interdisciplinary collaboration include the AUTOTYP linguistic typology project (http://www.spw.uzh.ch/autotyp/), *Der sprechende Sprachatlas* "The Speaking Language Atlas" (http://sprachatlas.bayerische-landesbibliothek-online.de), and *The Linguistic Atlas of the Middle and Atlantic States* (http://us.english.uga.edu/lamsas/) (Kirk and Kretzschmar 1992). Recent geolinguistics publications also reflect this shift in collaborative momentum (cf. Auer and Schmidt (2009), Lameli et al. (2011), and Gawne and Ring (2016)).

At the same time, in a recent paper on sampling in dialectology research, Buchstaller and Alvanides lament that until recently, "The majority of sociolinguistic work [could] be described as spatially naïve, using geographical space merely as a canvas…on to which the results of linguistic analysis [could] be mapped." (2013: 96). This need for inclusion and testing of different types of spatial factors alongside social ones is increasingly being addressed in regions like the USA and Great Britain (Trudgill 1974; Auer and Schmidt 2009; Lameli et al. 2010; Buchstaller and Corrigan 2011; Cheshire et al. 1989, 1993; Labov et al. 2006; Kretzschmar 1996; Kretzschmar et al. 2014; Britain 2009 and also the rise of "geohumanities" Dear et al. 2011), but is still in its infancy in other regions of the world (but cf. Stanford 2009 for a report on adjusted spatial factors on language practices and tonal patterns of Sui communities in China).

Compounding this general gap, precious few quantitative studies have investigated language attitudes and practices in linguistically diverse areas. This gap is unfortunate because it is often these attitudes and reports of language practices that can shed light on shifting ideologies as precursors to endangerment in areas where languages compete among each other and with prestige varieties (Giles et al. 1977; Coupland et al. 2006). In the Nepal scenario, two of the languages in our larger documentation project (Manange and Gurung) are threatened but viable, while the other two (Nar-Phu and Gyalsumdo) are highly endangered (technically moribund), with very few active younger speakers. Our overall aim, therefore, is to build an online, interactive atlas that contributes towards what Britain (2009: 142) terms "socially rich spatiality," taking into account speaker practices and networks as they intersect with geo-physical location.

The potential for mutual benefit in the GIS-linguistics and GIS-language documentation collaborative contexts cannot be overstated and is the focus of this paper. Increasingly, language documentation (particularly of vulnerable or threatened speech communities) relies on an awareness and understanding of the spatial-temporal interplay of language practices, structural variation, and contact dynamics, all working together to form a more comprehensive profile of the contributing variables to the survival and threat scenarios of these languages. Spatial visualization of documentation, through maps and atlases, for example, also benefits grammatical description in itself as a product or output, as grammars vary widely in their coding and conceptualization of space-time continua (e.g., Slobin 1996; Bickel 1997; Harrison 2008). This variation can be more deeply appreciated in tandem with GIS applications as relevant to the language communities.

GIS is defined as a computer program for the capture, storage, manipulation, visualization, and spatial analysis of geospatial features (e.g., points, lines, or polygons) and their attributes (Chang 2015). The attribute data of the geospatial features in GIS are commonly alphanumeric values stored in an attribute table, thus termed as structured data. Therefore, the spatial analysis of GIS is often conducted using a structured query language (e.g., "Country_Name" = "Nepal"). As a result, GIS has traditionally lacked the ability to integrate non-structured data, such as digital photographs, digital audio and digital video clips (i.e., multimedia components). In the past two decades, a new trend of developing multimedia mapping systems has been seen in the literature. Multimedia mapping refers to the integration of computer-assisted mapping systems and multimedia technologies that allow one to incorporate not only geospatial information in digital map format, but also multimedia information. The development of multimedia mapping techniques has gone through several stages, including the emergence of interactive maps and electronic atlases (Openshaw and Mounsey 1987; Rhind et al. 1988; Shepherd 1991), the development of "hypermaps" in the 1990s (Wallin 1990; Laurini and Milleret-Raffort 1990; Cotton and Oliver 1994; Cartwright 1999), the integration of hypermedia GIS systems (which features hypertext, hyperlinks and multimedia) and GIS in the late 1990s and early 2000s (Shiffer 1998; Bill 1998; Hu 1999; Soomro et al. 1999; Chong 1999; Hu et al. 2003; Yagoub 2003; Goryachko and Chernyshev 2004; Belsis et al. 2004). After having compared the various multimedia mapping techniques, ranging from desktop-based multimedia mapping to Web-based hypermedia GIS, Hu (2012) pointed out that the former relies heavily on computer programming languages (e.g., Visual Basic), and digital mapping software (e.g., ArcView, ArcGIS, or MapObjects) with local data storage, local access, and single user. The media format is often in Microsoft Windows with large file sizes, such as .tiff for images, .avi for digital video, and .wav for digital sound. The latter relies on both computer programming languages (e.g., Visual Basic) and markup languages (e.g., HTML), and Internet map server (IMS) (e.g., MapObjects IMS, ArcGIS IMS) with remote data storage, network access, and Internet users. The media format is often Web-based with small file sizes, such as jpeg for images, .mov for digital video, and .wav for digital sound. In both cases, the multimedia map application developers must invest in dedicated computer hardware (e.g., Web server, data server) and computer software (e.g., map server), plus IT personnel. The developer often faces a steep learning curve to become knowledgeable about the coding in native language of the map server. Now, as cartographic mapping system and GIS evolve from traditional desktop platform to Web-based online platform, there is a need and an opportunity, to develop a Web-based multimedia mapping approach to integrating geospatial information in digital map formats and multimedia information, which is of significance for DH-centered visualization and spatial analysis.

Our objectives in our language documentation research in Nepal were to (1) use geo-tagging equipment to collect audio and visual recordings of three types of socio-linguistic data: language attitudes and practices interviews, free-form narratives, and elicited vocabulary and grammatical paradigm sets, from representative speakers of the four endangered languages in 26 Manang villages; (2) design and develop a Web-based, interactive, and multimedia atlas that can display data points corresponding to the speakers, links to the three types of data gathered in multimedia format, provides friendly user interface for the manipulation and spatial analysis of all the data. It is anticipated that the online atlas can bring all local and international stakeholders, such as the speech communities, linguists, local government agencies, and the public, together to raise awareness of language structures, language practices, language endangerment, and opportunities for preservation, all through this easy-to-use means that enhance the geo-spatial representation in engaging visual and sensory (multimedia) formats. The following section describes our methods and the atlas design and functionality.

Methodology

Study Area

As alluded to, Nepal has a high degree of linguistic diversity, with approximately 100 languages attested (CBS 2012; Kansakar 2006). Most are "tribal" languages (indigenous, locally bounded, and strongly connected to community cultural identification and practices), concentrated in a couple of villages over a small area. As an example, the Manang District is both culturally and linguistically heterogeneous and can be divided into four ethno-linguistic areas across 26 villages: Manang Gurung and Gyalsumdo to the south (where Manang Gurung and Gyalsumdo speakers live), the Nar valley to the north (where Nar-Phu speakers live), and the upper Manang valley in the west (where Nyeshangte speakers live) (Fig. 1). All languages in this area are Tibeto-Burman.

The Manang District is appropriate for a case study of Web-based multimedia mapping as it intersects with geo-linguistics and language documentation and it has undergone rapid environmental, economic, and infrastructure development and changes over the past 15 years, including the ongoing construction of its first motorable road and the population shifts associated with this (see Laurance 2014 for commentary on road-building impacts). Some Manang communities have also witnessed population movements associated with both the rise of boarding schools in the capital Kathmandu, and also the rise of migrant worker opportunities where young adults relocate to Gulf States like Saudi Arabia, Bahrain, and United Arab Emirates for long-term employment (Hildebrandt et al. 2015). These changes have mixed impacts. On the one hand, they can benefit rural communities by connecting them to business and other opportunities available only to more centrally located marketplaces. On the other hand, these changes can trigger language shift as local residents (particularly younger ones) may emigrate away from their areas of traditional language practice for education and job opportunities. These changes introduce new, complex variables behind language contact and language endangerment beyond just social variables, and further motivates a spatial perspective of language practices and patterns in this area.

Data Source and Data Set

The primary data source was the sociolinguistic interviews conducted in the 26 villages of the Manang District across the four language groups.[1] There was a total of 87 interviews conducted between 2012 and 2014. Each interviewee was asked a total of 61 questions (see Appendix for the full set of questions). The data sets for this project included the descriptive text from the interviews gathered from locally originating and residing speakers of the four languages, geographic coordinates in longitude (x) and latitude (y) of the residences where each interview took place, digital photographs, and digital video clips. Digital photographs were taken using Cannon SLR 40-D digital camera and saved in JPEG format. Digital video clips were acquired using a Sony Handycam HDR-XR550 digital video camcorder and stored in MPEG format. As part of the project agreement with the funding agency, the multimedia content from this project were archived with the SHANTI (Sciences, Humanities, and Arts Network of Technological Initiatives) Collection (http://shanti.virginia.edu/wordpress/?page_id=414). SHANTI is housed in the University of Virginia as a publisher of websites and other digital content on languages and cultures of the Tibetan Plateau and greater Himalayan region. In addition, Google Maps was employed as the base map for the integration or "mashup" of the multimedia information

[1] All interviews began with an oral consent process (originally composed in English and given in Nepali, the regional contact language), which was based on a script approved by SIUE's Institutional Review Board (IRB) for informed consent in research involving human subjects. This consent process included respondent awareness that his/her information would be made available for public access, through audio-visual and through still (photograph) images.

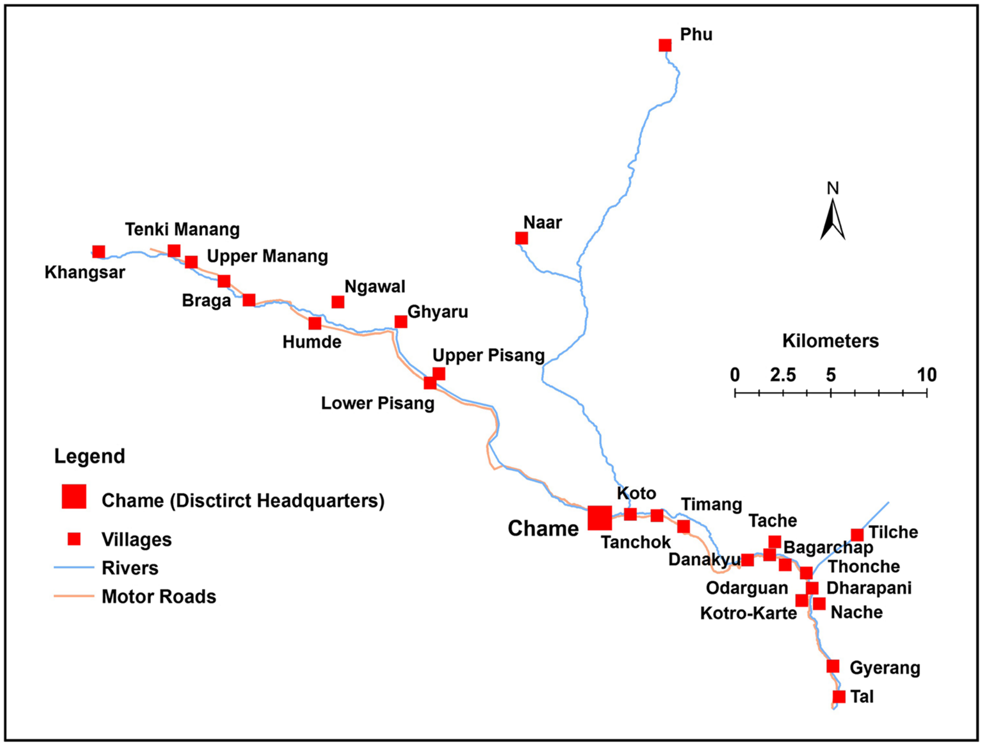

Fig. 1 Locations of 26 villages in the Manang District of Nepal

collected during the sociolinguistic interviews. The next sections describe the process of data preparation ("Use of XML to Store the Data" section), data loading and display on Google Maps ("Use of jQuery JavaScript Library to Load the XML File onto the Google Maps" and "Use of Google Maps JavaScript API V3 to Display the Data" sections , respectively), and how the user interface for spatial analysis and visualization was developed ("Use of JavaScript, XHTML, and CSS to Design the User Interface and Functions for Spatial Analysis and Visualization" section).

Use of XML to Store the Data

There are various ways to store and prepare the spatial data for display on Google Maps. Among them, XML is the simplest and easiest method to use due to its free and open source. XML (Extensible Markup Language, stored with the extension .xml in plain text format) is similar to HTML but does not have any predefined tags and is platform independent. The authors defined the tags based upon project-specific requirements. Below is an example of the XML file (e.g., Languages_pts_2016.xml) that contains the information for one sociolinguistic interview, including the speaker ID, the language name, the village name, the coded interview questions and responses (e.g., Aindex, Bindex), interviewee age group, longitude (*x*), latitude (*y*), picture ID, video link, and other information. For each interview, all relevant information was placed in a pair of <pt> and </pt> tags, each representing the point location of the interview. There are currently 87 pairs of such tags in the entire XML file.

```
<pt speaker-id="Taal_G_M2" language_name="Gurung" village_name="Tal Village" Aindex="5" Bindex="3"
Cindex="2" C1index="1" Eindex="3" Gindex="1" Hindex="8" Iindex="3" Jindex="1" Kindex="1" Lindex="1"
Mindex="2" Nindex="1" Oindex="1" Pindex="4" agegroup="61+" x="84.37319167" y="28.46783889"
picid="DSC00973.jpg" video="https://audio-video.shanti.virginia.edu/video/gurung-man-describes-history-
village-taal"/></pt>
```

Notepad++, a free source code editor which supports several programming languages running under the Microsoft Windows environment (http://notepad-plus-plus.org/), was used to prepare the XML data file. It was also used to edit all of the JavaScript code for the project. For those using different platforms, such as macOS or Linux, there are numerous open-source editors, such as Sublime Text and Atom.

Use of jQuery JavaScript Library to Load the XML File onto the Google Maps

jQuery is a cross-browser JavaScript library designed to simplify the client-side scripting of HTML. It is a free, open-source software designed to create dynamic Web pages. Therefore, jQuery (version 2.1.4) is selected in our application. There are two ways to integrate jQuery library to the application. One way is to download the jQuery library and place it at the same place where the main Web page (e.g., index.html) is located, which is illustrated with the following code in HTML.

```
<script type="text/javascript" src="jquery.min.js"></script>
```

Another way is simply to point to the URL where the jQuery library is located, as shown below.

```
<script type="text/javascript" src="http://ajax.googleapis.com/ajax/libs/jquery/2.1.4/jquery.min.js"></script>
```

The code below shows how the XML content (i.e., Languages_pts_2016.xml) is uploaded to the Google Maps using JavaScript jQuery.get function ($.get in short) at the initialization of the Google Maps (i.e., *function initMap()*) and *jQuery(data).find("pt").each(function(){ });* is used to retrieve the information for each data point (notice the <pt> and </pt> tags in the xml file mentioned above). A variable, xmldoc, is declared to withhold the information (e.g., language_name, village_name, picid, and video) for each point. Another variable, latlng, is declared to withhold the locational information (i.e., longitude (*x*) and latitude (*y*)).

```
$.get("Languages_pts_2016.xml"), {}, function (data) {
    jQuery(data).find("pt").each(function () {
      var xmldoc = jQuery(this);
      var latlng = new google.maps.LatLng(parseFloat(xmldoc.attr("y")),
                        parseFloat(xmldoc.attr("x")));
      var speaker_id = xmldoc.attr("speaker-id");
      var language_name = xmldoc.attr("language_name");
      var village_name = xmldoc.attr("village_name");
       ……………………………
       ……………………………
});
}
```

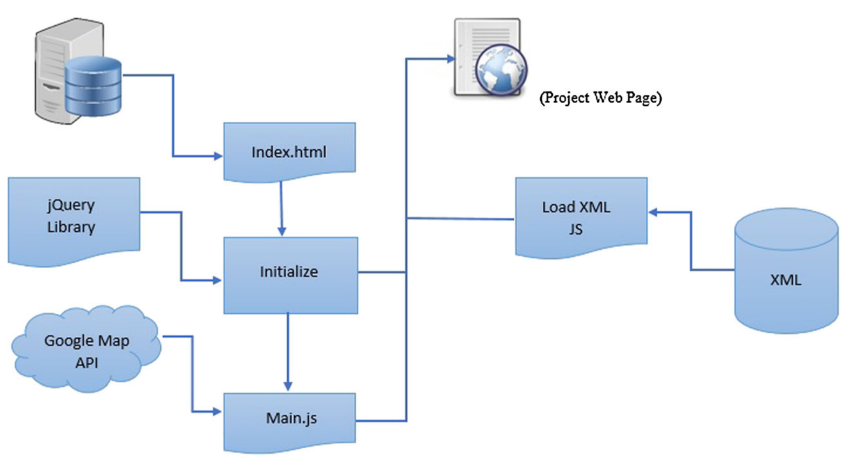

Fig. 2 Conceptual framework for the integration of the Google Maps API, XML, and HTML for Web-based multimedia mapping

Use of Google Maps JavaScript API V3 to Display the Data

The launch of Google Maps in 2005 has revolutionized Web mapping service applications on the Internet. Based on Asynchronous JavaScript and XML (AJAX), a new type of client/server interaction was introduced in Google Maps to maintain a continuous connection between the client and the server for immediate downloading of additional map information (Peterson 2008). In addition to implementing a better client/server interaction, Google also provides programmers free access to its code in the form of an Application Programming Interface (API). In other words, the API consists of a set of routines or functions that can be called by a programmer using JavaScript. Linking the Web page with the Google Maps API is straightforward in version 3, using a single HTML, shown below:

```
<script type="text/javascript" src="http://maps.google.com/maps/api/js?sensor=false"></script>
```

This is a standard HTML directive to include an external JavaScript file, served by maps.google.com. This element is added to the <div>… </div> section of the Web page where the map is loaded.

The next key step is to initialize the API and load the map onto the Web page as follows. First, we created a *initMap()* function to launch the Google Maps. In the *initMap()* function, we defined the center of the map to be displayed on the

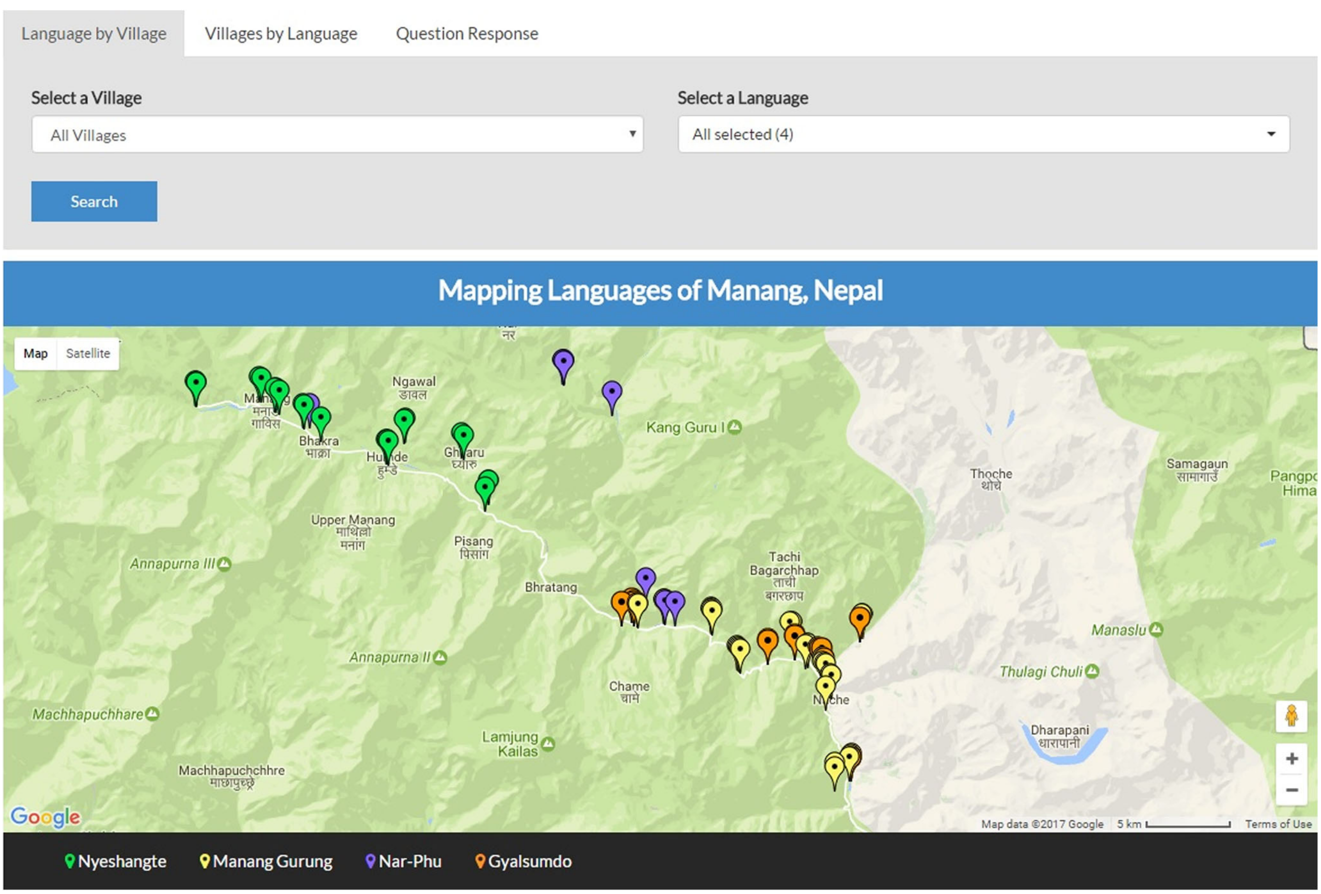

Fig. 3 Initial launch of the Web-based multimedia atlas, which displays the three tabs, the Google Maps, the locations of all 87 sociolinguistic interviews across four languages in Manang, Nepal, and the map legend

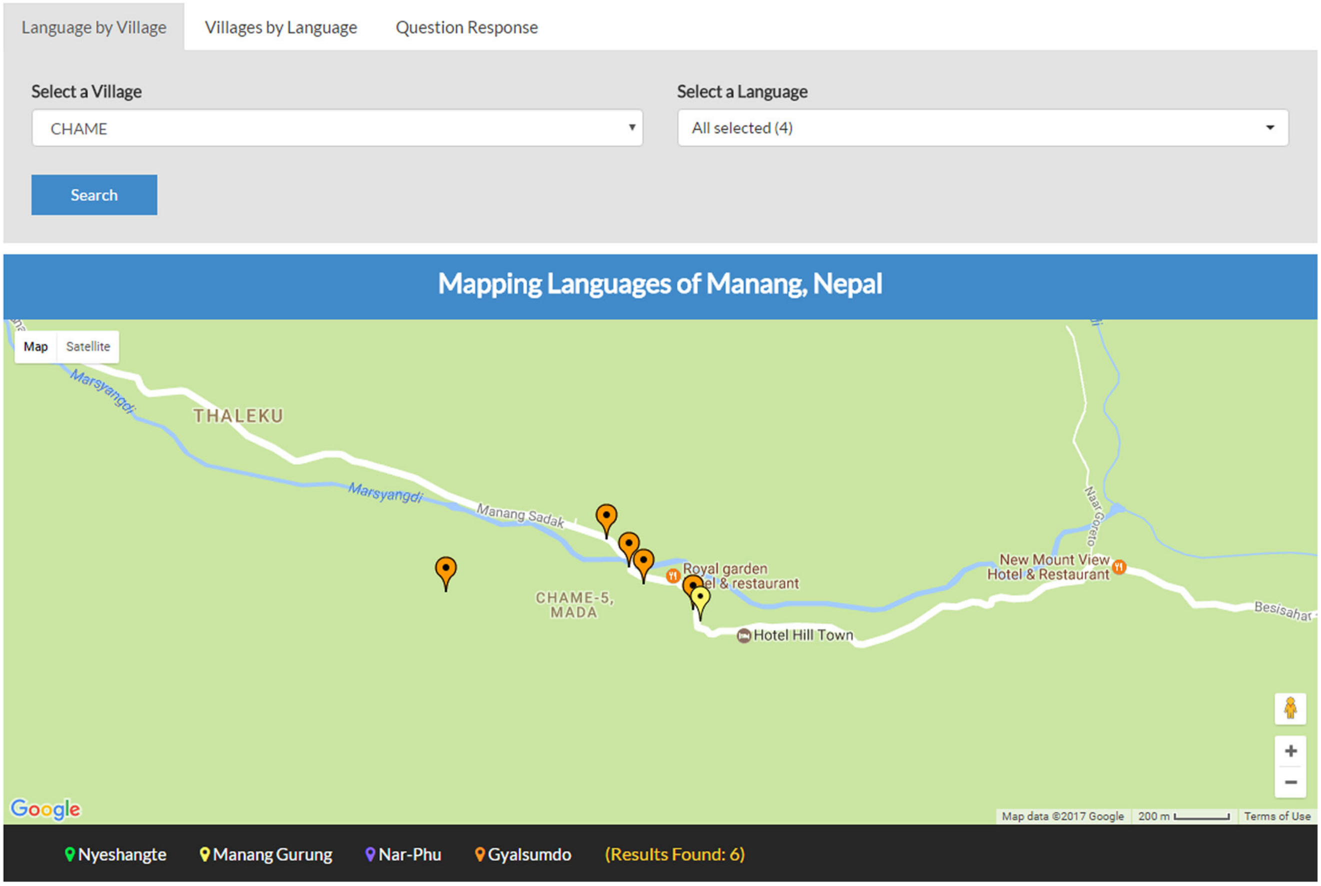

Fig. 4 Search result from Languages by Village tab: in this case, the user selected Chame village. There were six sociolinguistic interviews conducted in Chame village. The marker icons on the map also indicate Gyalsumdo and Gurung as the mother tongue languages as reported in the interviews

Web page at 28.576671° N, 84.257245° E. Another function, *pushMapData()*, was developed to load all data points from the xml to the map. A third function, *AddMapLegend*, was developed to load the map legend.

```
function initMap(){
    var defaultLatLng = new google.maps.LatLng(28.576671, 84.257245);
    var mapOptions = {
        zoom: 11,
        center: defaultLatLng,
        scaleControl: true,
        mapTypeId: google.maps.MapTypeId.ROADMAP
    }
    map = new google.maps.Map(document.getElementById("map_canvas"), mapOptions);
    pushMapData(); //Note: load all points from xml to map
    AddMapLegend("Language"); //Note: load the language legend
}
```

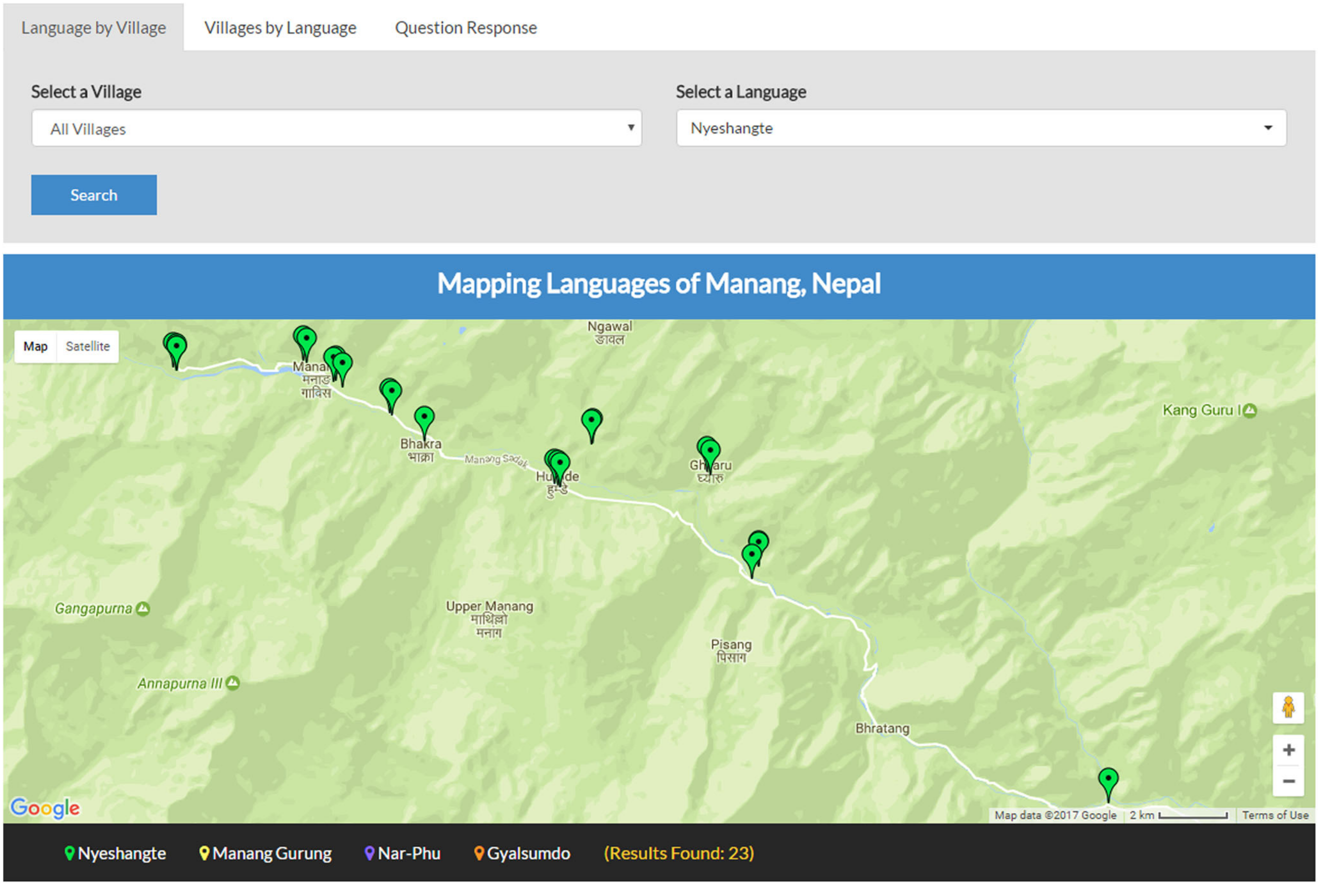

Fig. 5 Search result from Villages by Language tab: in this case, the user selected Nyeshangte language, all locations of interviews with this language are displayed on the map

Use of JavaScript, XHTML, and CSS to Design the User Interface and Functions for Spatial Analysis and Visualization

In the design of the Web-based multimedia digital atlas, the layout design was adopted. There are three rows. The first row contains three tabs, the second row is the map container and the third row contains map legends. The three tabs serve as a user interface for spatial analysis and visualization. The first tab is named *Languages by Village*. With this tab, the user can search for the language identified by interviewees as their mother tongue. To do so, the user can first select a village from a dropdown list of all the villages where linguistic interviews were conducted, and click the Search button. The Google map is zoomed into that selected village and customized marker icons that represent locations where the sociolinguistic interviews were conducted in that village are shown on the map. In this case, there are four customized marker icons for four different languages—the green balloon for "Nyeshangte," the yellow balloon for "Manang Gurung," the purple balloon for "Nar-Phu" and the orange balloon for "Gyalsumdo." In addition, tooltips (e.g., language name) to the markers are provided. In addition, these marker icons are clickable. When the user clicks on an icon, it will launch a Google Maps API standard Info-window in which the speaker ID, age, mother tongue, residential picture, and a link to the video clip of associated recordings will be displayed.

The second tab is named *Villages by Language*. With this tab, the user can search for all the villages in Manang District where a selected language is spoken. To do so, the user can first select a language from the dropdown list of the four languages, and click the Search button. The search result will be displayed on the map as customized marker icons. Similarly, each marker icon is clickable. The third and last tab is *Question & Response*. With this tab, the user can select an interview question from the question dropdown list (see Appendix for the entire list of the sociolinguistic survey questions), and click the Search button. The search results will be displayed on the map as different marker icons, each representing an answer to that question. This function provides the user a tool to further examine the spatial distribution of language practices and attitudes in Manang languages.

Inside second row is the map container where the Google Maps is displayed. A few standard Google Maps controls, such as Pan and Zoom controls, Map Scale control, and Map Type control–Roadmap and Satellite, are available for the user to interact with the map or satellite imagery. The last row is where the map legend is placed. If the user selects the first tab or the second tab, the map legend contains four customized marker icons that represent four different languages; if the user selects the third tab, the map legend contains customized marker icons that represent different responses for the interview questions.

Finally, all the pieces were assembled. JavaScript is the native language of Google Maps. In addition, Google Maps is built from HTML and formatted with CSS (Cascading Style Sheet). Therefore, JavaScript, HTML, and CSS are used to develop the functionalities. These include creation of a user interface in the form of tabs using bootstrap and Ajax, uploading XML data file via jQuery, displaying points of locations for the sociolinguistic interviews with customized marker icons via Google Maps API, and providing the spatial analysis functions via Google Geocoder. Figure 2 illustrates a conceptual framework for the integration of the Google Maps API and other JavaScript libraries in the World Wide Web environment.

In Fig. 2, the workflow begins with a user-initiated request for the URL of our project website: https://mananglanguages.isg.siue.edu/atlas/. With the request, the server finds the page from the requested location and loads the default page, in this case, Index.html. The server then sends the response back to the user with the content of the project page. We are using JavaScript, which is client-sided in its scripting, so all of the code execution takes places in the client browser and reduces the load on the server. This makes our server fast enough to process additional incoming requests. On the client side, the server loads the JQuery Library, including the Google Map API. It then loads a custom written JavaScript, which sends request to the server to retrieve and load the data from our XML into the background. This makes the script dynamic and more responsive to the user. When all processes are executed completely, the user can see the map, with various marker icons plotted on the map with respective legends.

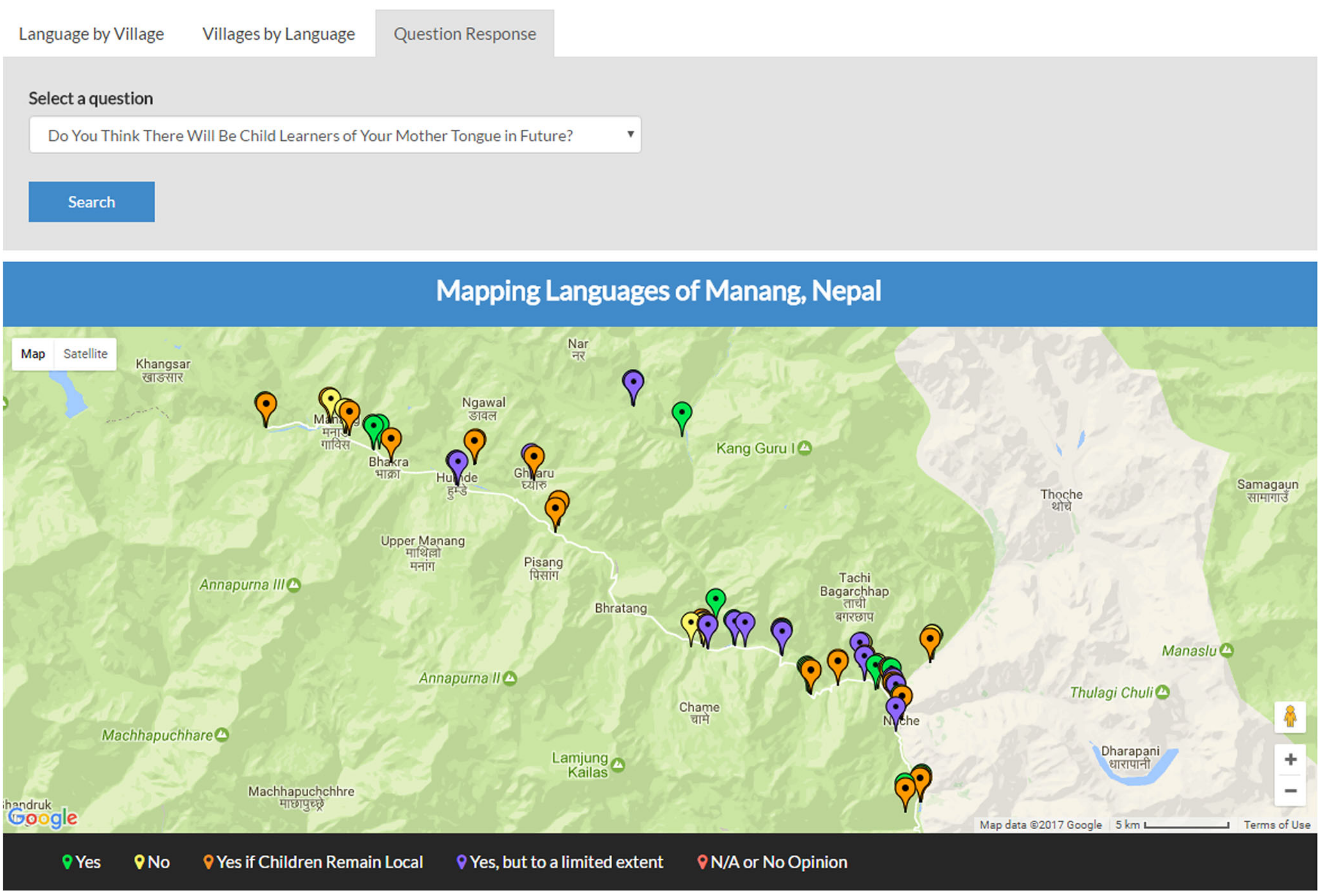

Fig. 6 Search result from the Question & Response tab. Here, the user selected the question "Do you think there will be child learners of your mother tongue in future?" The different marker icons on the map indicate different answers from the interviewees

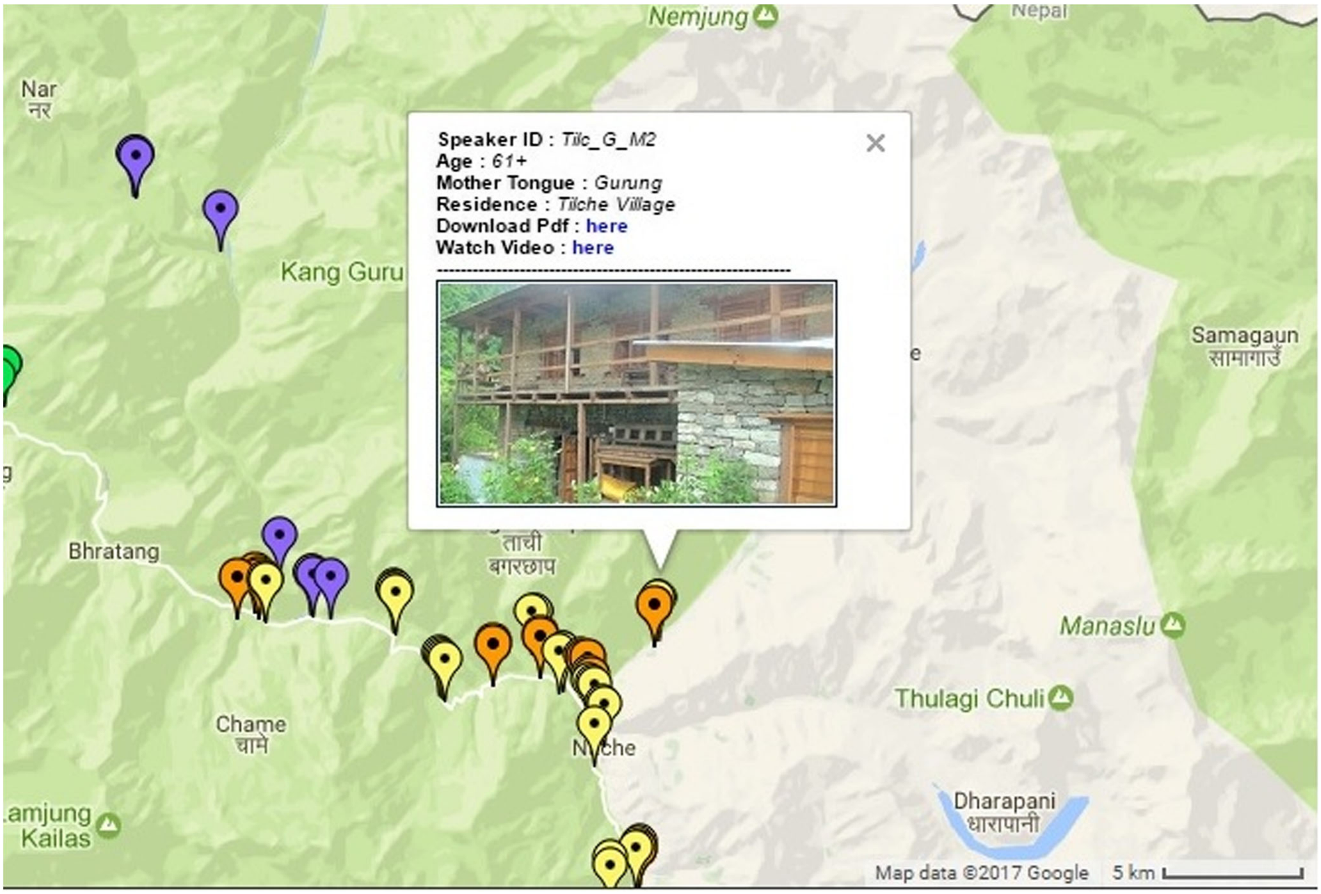

Fig. 7 When the user clicks on a marker icon on the Google Map, an Info-window is launched to display all relevant information, including the speaker id, age, mother tongue, village name, a link to download the transcript of the questions and responses, and a hyperlink to the video clip of the interview (see Fig. 8)

Results

The use of Google Maps API V3 provides an efficient and familiar mechanism to deliver digital cartographic information to Internet users with a user-friendly interaction. With Google Maps Standard Map Type control, the user is able to choose one of the two map types: Roadmap and satellite imagery. Figure 3 shows an outlook of the online map service for our language documentation project in Google Chrome. At the initial launch of the Web page, locations of the sociolinguistic interviews are displayed within the map container. Notice also that in Fig. 3, the three tabs are visible: *Languages by Village*, *Villages by Language*, and *Questions & Responses*. Figure 4 demonstrates the result when the user selects a village, for instance, Chame village, from the drop-down list and then clicks the Search button to show all the sociolinguistic interviews conducted in that village, six in this example. The different icons on the map also indicate the type of Tibeto-Burman languages, Gyalsumdo and Gurung identified as mother tongues by the interviewees in Chame. Figure 5 demonstrates the result when the user searches for all the villages where one, two, three, or four selected languages is spoken. Figure 6 demonstrates the result when the user chooses the *Questions & Responses* tab, selects a question from the drop-down list of all the questions, and clicks the Search button. Figure 7 illustrates the Info-window when the user clicks on a marker icon on the Google Map. The Info-window displays multimedia information related to the interview conducted at the marker location, including the speaker id, age, mother tongue, village name, a link to download the transcript of the questions and responses, and a hyperlink to the video clip of the interview. Figure 8 illustrates a sample video clip that may be played, and which is housed in the SHANTI Collection at the University of Virginia.

Discussion

"Methodology" and "Results" sections detailed the workflow and elements of the "Documenting the Languages of Manang, Nepal" atlas. However, this multimedia atlas is not the only example of ongoing efforts use geospatial technology in the digital humanities, particularly in geolinguistics and online, interactive language mapping. We summarize here examples

Fig. 8 Top: A video clip of a Gurung speaker that is linked from the Info-window on the atlas (Fig. 7) in which the speaker was describing his apple orchard using Gurung language; Bottom: Language transcript. The first line is the local language (Gurung), transcribed in the IPA (International Phonetic Alphabet). The 2nd line is the Nepali free translation. The 3rd line is the free translation in English. The audio was transcribed in ELAN (download is free at https://tla.mpi.nl/tools/tla-tools/elan/) and the language transcript is synchronized with the video, which was done by the THL (Tibetan Himalayan Library) using a Drupal platform

of three projects with parallels to the Manang Languages Atlas, their similarities, and their differences.

First, Saint Mary's University uses online multimedia mapping for the Mi'kmaw Place Names Digital Atlas (URL: http://sparc.smu.ca/mpnmap/). This project makes use of ArcGIS maps and not Google Maps. Additionally, Adobe Flash is required to load the content of the map in the browser. ArcGIS is not open source and can be expensive for some programs. Similarly, Flash is well known for causing spikes in CPU usage and comes with security holes. Our project uses JavaScript and HTML, and the data are encoded on an open-source XML that uses fewer computer resources.

Second, Language Landscape is a nonprofit British organization that uses maps to plot languages as they are used around the world (URL: http://languagelandscape.org). The project directors encourage people to get involved in the project by adding their own audio clips to the project, which are then displayed visually and interactively. This project uses the Google Map API for the map, JavaScript, and HTML. This map includes pins which display information in audio format which can be played in real time without page redirects. Our project similarly displays map pins related to different languages and on click, and also provides information like speaker name, age, village. Like Language Landscape, our project also includes links to other resources.

Third, Atlas of Pidgin and Creole Language Structures project spatially represents pidgin and creole languages, and their structures, from around the world (URL: http://apics-online.info/contributions#2/30.3/10.0). The map is developed using JavaScript and Leaflet JavaScript library for mobile friendly interactive maps. More information about the Leaflet JavaScript library can be found at (http://leafletjs.com/index.html). The library is open source and lightweight in terms of CPU usage. Pins are plotted to the map with various colors and also display an Info-window with hyperlinks for additional information on a given language. This map lacks legends, which results in the need to click on each pin to learn more about language types.

Conclusion

This paper has demonstrated a new and relatively easy approach called Web-based multimedia mapping that could integrate not only geospatial data but also multimedia data in the form of digital photographs, digital sound, and digital video clips—which is very useful for digital humanities and social sciences. The use of Google Maps API and JavaScript libraries allow us to employ the digital maps and satellite imagery from Google Maps with only a few JavaScript codes. The apparent benefit of using existing Maps APIs may be of value to those who do not have the resources to invest in a dedicated computer for map servers and data servers. We used only a Web host account provided by the home institution to upload the atlas Web page (index.html, 48 kilobytes) and the xml file (languages_pts.xml, 30 kilobytes). The latter stored only the "pointers" to the digital multimedia files that are related to the social linguistic interviews and narratives collected for the project (archived in SHANTI). SHANTI offers the state-of-the-art technology to deliver the multimedia content with the highest quality at a faster speed (e.g., video streaming) and is associated free of charge to this project. It is worth mentioning that for those who do not have their own video streaming service available, free video streaming professional services are provided by third parties, such as YouTube. In addition to the Google Maps API, Yahoo! Maps APIs and Bing Maps APIs can also be used for the same purposes. It is also beneficial for college students to start off with multimedia mapping technology and for organizations, such as the university in this case study, to see the benefits of the new technology.

The Web-based, interactive, and multimedia language atlas can be accessed on the Internet; therefore, it can bring all local and international stakeholders, such as the speech communities, linguists, local government agencies, and the public, together to raise awareness of language structures, language practices, language endangerment, and opportunities for preservation, all through this easy-to-use means that enhance the geo-spatial representation in engaging visual and sensory (multimedia) formats.

One example of this potential contribution may be found in Hildebrandt and Hu (2017) which, through quantitative analysis of spatial distributions of respondent answer types, demonstrates that non-structural (language attitude and use) variables reveal different degrees of vitality vs. endangerment in Nepal. The Web-based multimedia mapping approach offers a unique tool for a spatial analysis and visualization of variations in self-reported attitudes and practices across the four Manang languages, with adjusted spatial factors (e.g., location of communities to a newly built motor road, location of communities to the district headquarters, location within closely clustered communities) alongside traditional social factors (e.g., gender, age, education, occupation, and so on). As a result, this research project contributes to new understandings of the relationship between space and language practices in Nepal.

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