

# ***Volunteered Geographic Information and Arches***

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# Outline

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- **Introduction**
- **Research Tools and Data**
- **Case Study: Chi-Shi Community in Tainan City**
- **Case Study: Nou-Li Community in Hua-Lien County**
- **Conclusions**

# Introduction

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- **GIS data source:**

- primary data: captured using surveying techniques such as satellite imaging, aerial photography, SONAR (sound navigation and ranging), RADAR (radio detection and ranging), LIDAR (light detection and ranging), GPS (global positioning system), and electronic total station; census data; field survey
- secondary data: obtained by processing or analyzing primary data, e.g., scanning maps, heads-up digitizing, data conversion, and photogrammetry

- **Due to much progress of geospatial technologies in recent years, acquisition of high-quality spatial and temporal information has become much more efficient and cost-effective than past few decades.**

- Remote sensing images
- GNSS (Global Navigation Satellite Systems)
- Mobile mapping: bicycles, cars, boats, aircrafts, and UAS (unmanned aerial systems)

# Introduction

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- The emergence of Internet and Web provides an exceptional base for incubating new technologies for disseminating geographic information.
- Rapid development of ICT (information and communications technology) in recent years has enabled Web users with all sorts of tools to access information stored on a server, and even construct a website to let obscure users create, assemble, edit, and disseminate information with little or no restrictions on the content.
- Using GPS enabled mobile devices such as smart phones, tablet PC, digital cameras, and vehicles mounted with GPS, or sensors for capturing environmental data that are carried on body, almost anyone can be a mobile sensor for collecting geographic information, whether a young child or a field scientist with highly developed skills. Combining Web tools, this type of geographic data can be disseminated voluntarily by individuals. Goodchild (2007) coined this as **volunteered geographic information (VGI)**.

# Introduction

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- **Wikimapia** and **OpenStreetMap** both are compelling examples of VGI. They are collaborative mapping projects that encourage general public to participate in describing geographical objects in the world, and provide free geospatial data for anyone to use and share.
- Traditionally, scientific research is usually conducted by professional scientists of government, private companies, academic and research institutes. Through carefully designed experimental process the research results are generally more reliable, however, the scales of research are often constrained by available resources such as manpower, equipment, budget, and time.
- In comparison, citizen science, also known as civic science, is a type of scientific research that links general public with professional scientists to conduct research at multiple stages, which may include identifying research questions, collecting data, developing research methods, analyzing data, and interpreting results.

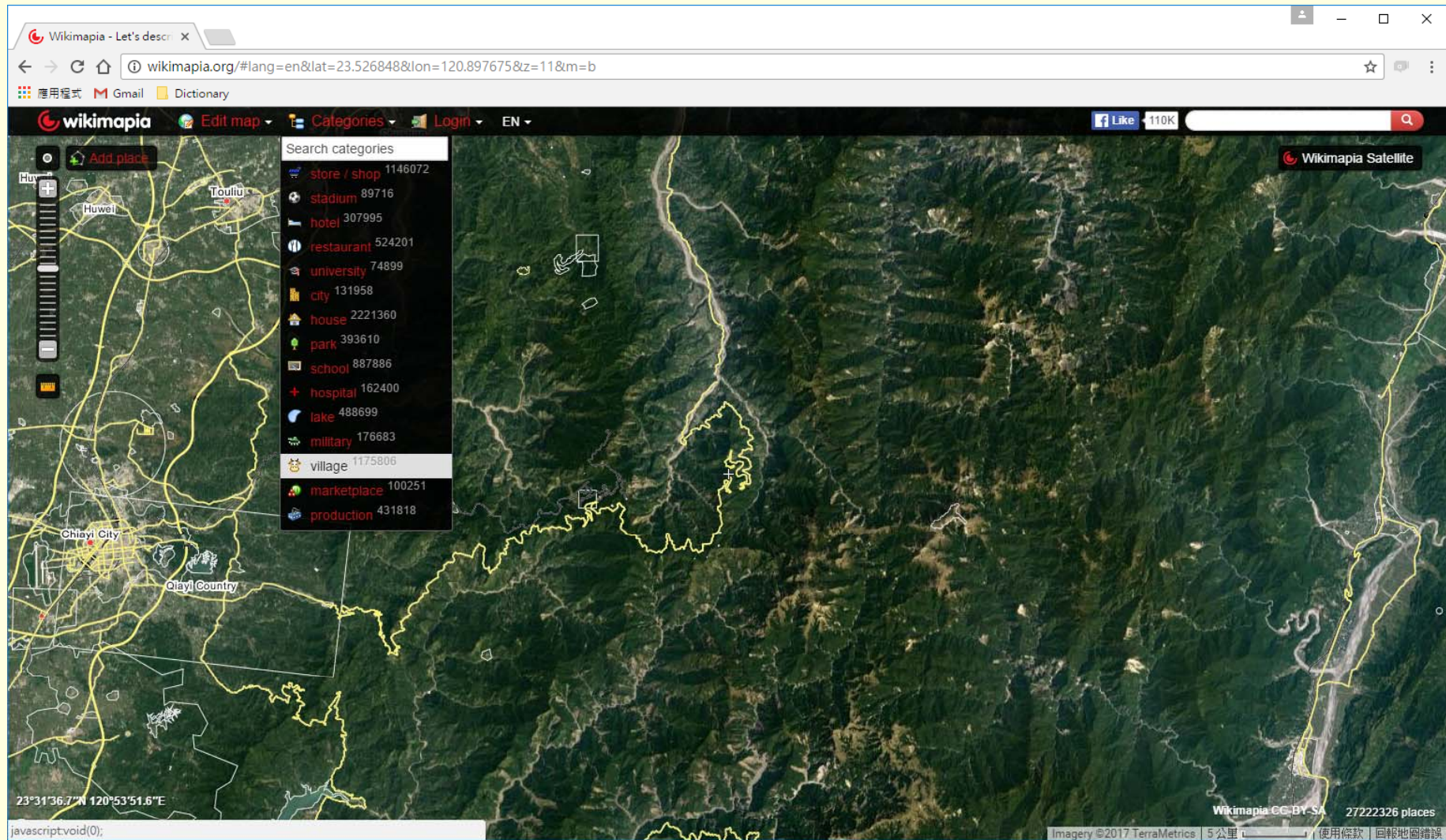
# Introduction

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- **Started in December 1900, the renowned Audubon's 'Christmas Bird Count' (CBC) is a pioneer project that exemplifies the concept of citizen science in the field. A total of 27 observers participated in the first CBC at 25 locations in the United States and Canada.**
- **Over the years the CBC has engaged many volunteers from different countries to participate in counting birds on Christmas. During the 116th CBC season (14th December 2015 to 5th January 2016), 76,669 observers contributed their efforts, and resulted in observation of 58,878,071 birds, and 2,607 species (Fig. 1) [4][5].**



# Wikimapia

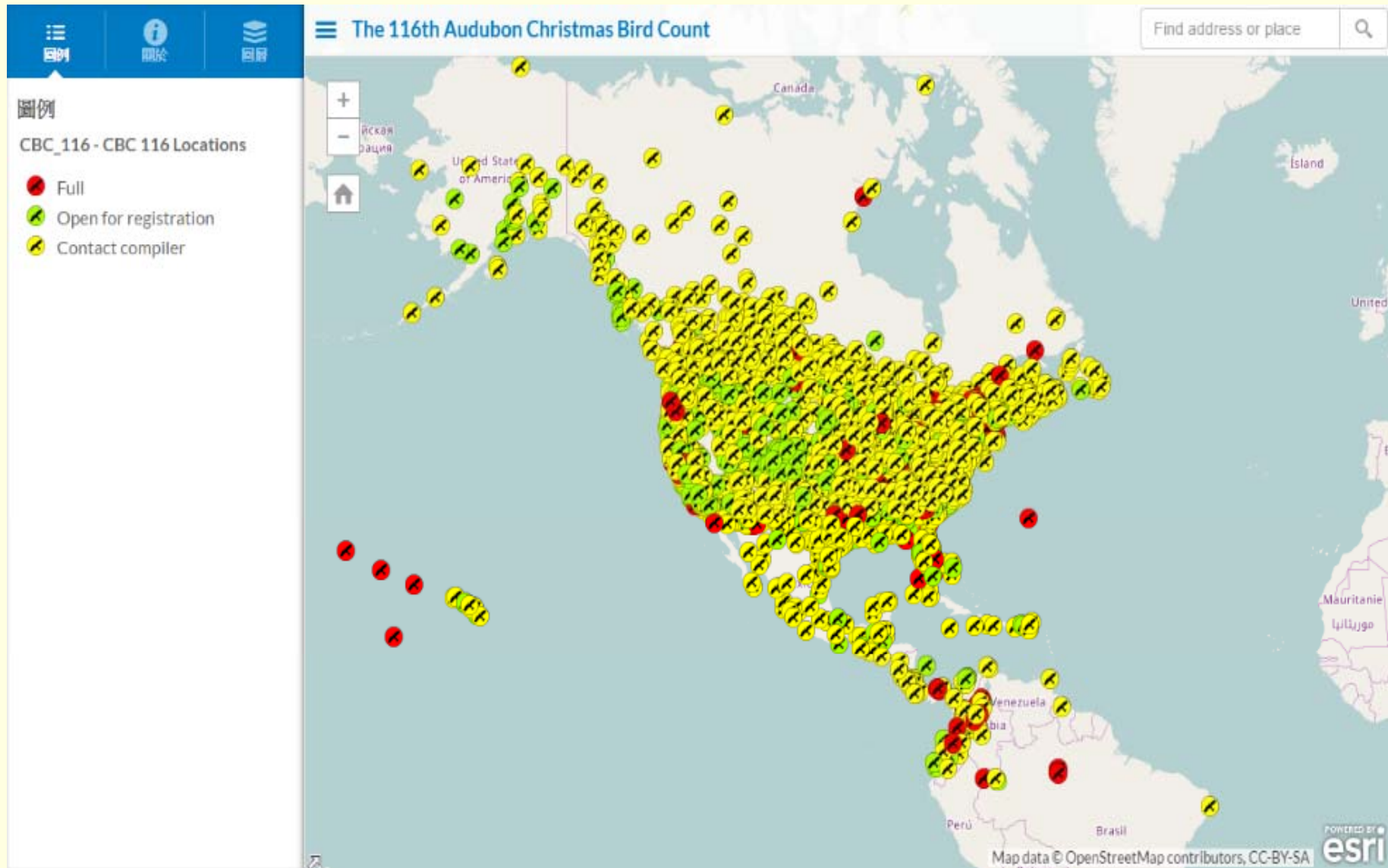


# OpenStreetMap

The screenshot shows the OpenStreetMap Taiwan website interface. At the top, there is a navigation bar with the OpenStreetMap logo and the text "OpenStreetMap 台灣". To the right of the logo is a "登入" (Login) button. Below the logo, there are several menu items: "首頁" (Home), "什麼是 OSM" (What is OSM), "台灣社群活動" (Taiwan Community Activities), "台灣化地圖" (Localized Map), "新聞公告" (News/Announcements), "教學文件" (Tutorial Documents), and "聯絡我們" (Contact Us). Below the navigation bar, there is a breadcrumb trail: "首頁 > 台灣化地圖". The main content area displays a map of a road network. A "Base Layer" menu is open on the right side of the map, showing three options: "OSM 臺灣" (OSM Taiwan), "OSM 布農" (OSM Bunun), and "OSM Mapnik". The map shows a road network with various road types and labels, including "快速路六段", "東西向快速公路 觀音大溪線", "高上路一段308巷", "高上路一段309巷", "高上路一段", "高上路一段392巷", "雙連坡一管區", "雙連坡一管", and "平榮路". The map also shows elevation contours and various landmarks.



# Locations of the 116th Audubon Christmas Bird Count



# Research Tools and Data

## ■ GPS logger



# Research Tools and Data

- GPS logger software used for matching GPS data and photos

The screenshot displays the 'New Project' window of 'GPS Photo Tagger'. The interface includes a menu bar (檔案(E), 照片(P), 軌跡(T), 上傳(U), 工具(O), 說明(S)), a toolbar with various icons, and a Google Map. A path is plotted on the map with several red circular markers. A popup window is open over one of the markers, displaying the following information:

Lat:24.985518, Lon:121.573478,  
Ele:33.850090 - [顯示位置](#) - [編輯](#)  
2011年8月23日 下午 03:13:02

Below the popup is a small thumbnail of a photograph showing a parking lot with several cars.

On the right side of the window, there is a table with the following columns: 照片名稱, 日期, 景點, 緯度.

照片名稱	日期	景點	緯度
DSCF1110.JPG	2011年8月23日 下午 0:	Lat:24.985803, L 24°59'9"	
DSCF1111.JPG	2011年8月23日 下午 0:	Lat:24.985518, L 24°59'8"	
DSCF1112.JPG	2011年8月23日 下午 0:	Lat:24.985795, L 24°59'9"	
DSCF1113.JPG	2011年8月23日 下午 0:	Lat:24.985530, L 24°59'8"	
DSCF1114.JPG	2011年8月23日 下午 0:	Lat:24.985867, L 24°59'9"	
DSCF1115.JPG	2011年8月23日 下午 0:	Lat:24.985808, L 24°59'9"	
DSCF1116.JPG	2011年8月23日 下午 0:	Lat:24.985808, L 24°59'9"	

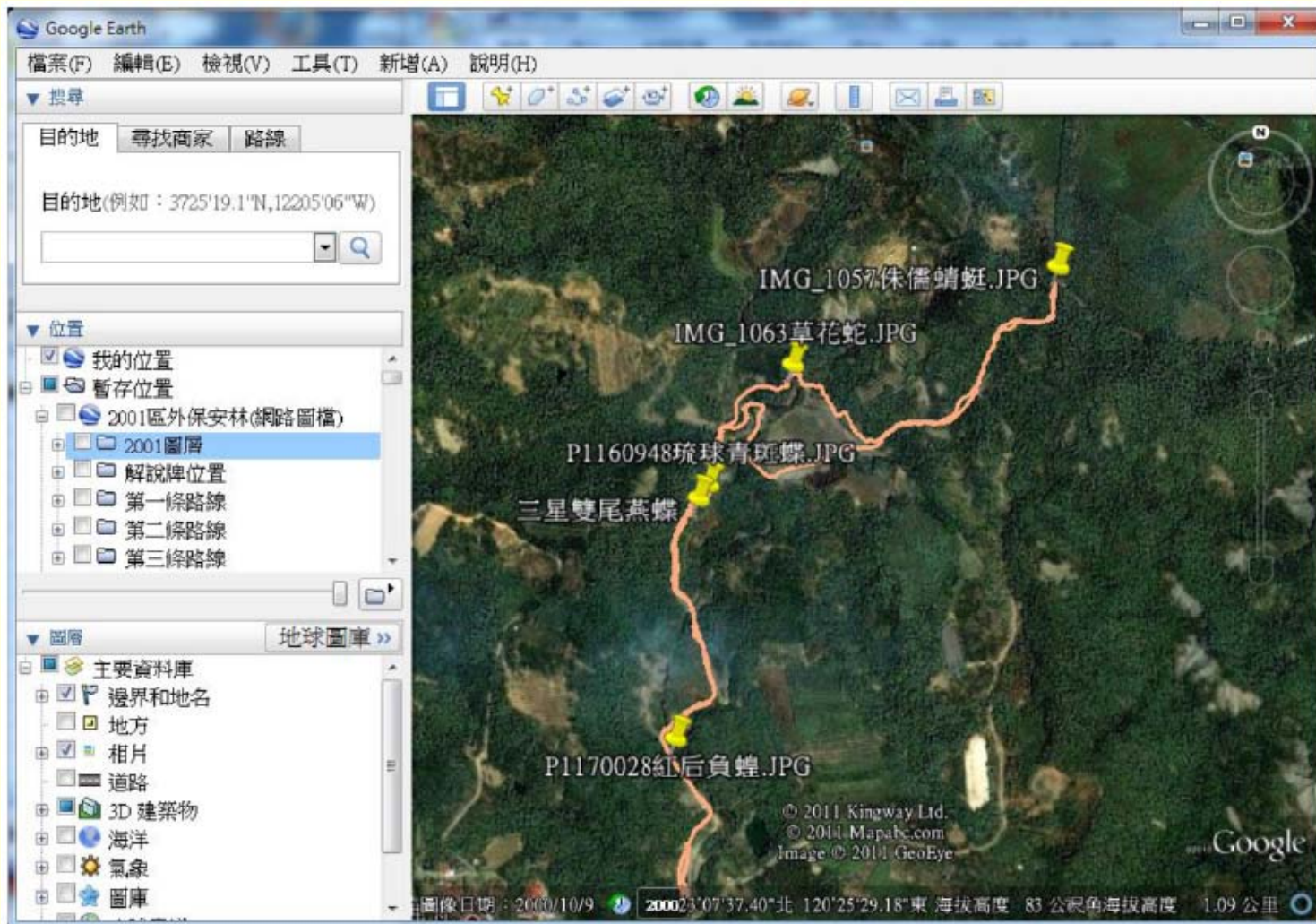
At the bottom right, there is a detailed metadata window for the selected photo (DSCF1111.JPG):

照片名稱	DSCF1111.JPG
日期/時間	2011年8月23日 下午 03:13:02
廠商	FUJIFILM
型號	FinePix J10
閃光燈	否
焦距	6 mm
曝光時間	1/320 sec
光圈	f/2.8
對應ISO值	64
曝光修正	0.0



# Research Tools and Data

- Using Google Earth for field data annotation





# Research Tools and Data

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## ■ **Software tools used for building a web-based GIS system for database management**

- Python: a very popular and powerful general-purpose programming language
- QGIS: a cross-platform open source desktop GIS that supports numerous vector and raster data formats
- OpenLayers: an open source JavaScript library designed for web mapping
- PostgreSQL: an open source object-relational database management system (ORDBMS) that runs on multiple platforms
- PostGIS: an open source software that extends the PostgreSQL, it enables PostgreSQL to store geographic objects into geospatial database
- Django: written in Python, it is a web framework designed to facilitate rapid development of web applications

# Research Tools and Data

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## ■ **Arches: the Heritage Inventory and Management System**

- Jointly developed by Getty Conservation Institute and World Monuments Fund
- Firstly released in October 2013, Arches is an open source software in the heritage conservation field providing a suite of powerful tools for compiling and managing inventories of immovable heritages of various scales (national, regional, city or site).
- Arches is supported by two CIDOC standards: (1) the revised International Core Data Standard for Archaeological and Architectural Heritage (CDS) and (2) the CIDOC Conceptual Reference Model (CRM). The former has been used as a basis to define the data fields in the generic version of the system while the latter has been used to provide the semantic framework.

# Research Tools and Data

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- **The Arches-HIP (Heritage Inventory Package) is an officially developed application of Arches. This application is designed to let users manage many types of heritage data and these types are mainly divided into six different resources:**
  - Heritage Resources: culturally significant objects such as buildings and monuments.
  - Heritage Resource Groups: collections of heritage resources.
  - Activity: resources that occur over a period of time.
  - Historic Event: culturally significant occurrences.
  - Actor: persons, groups of people, or organizations.
  - Information Objects: objects that encode information such as an image, documents, signs, and inscriptions.
- **The Arches system is also designed to ensure the compliance with Open Geospatial Consortium (OGC) standards and therefore is compatible with other desktop GIS applications such as ESRI ArcGIS, Google Earth, Quantum GIS, and online satellite imagery and map services.**

# Research Tools and Data

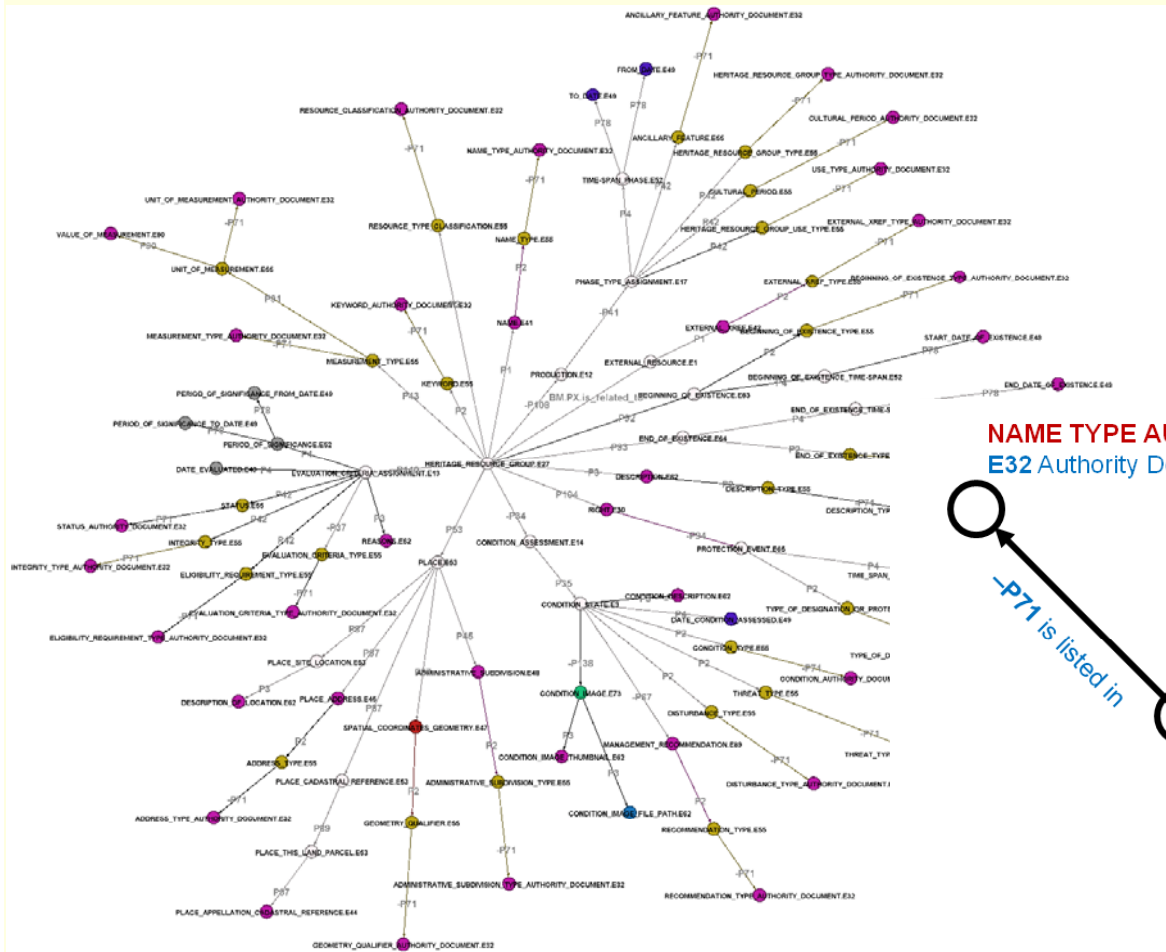
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## ■ HIP graphs

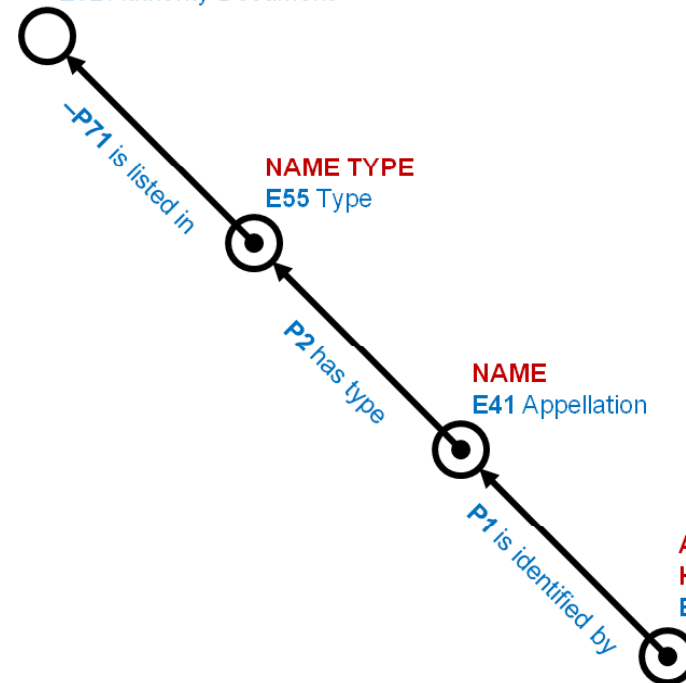
- In the HIP, the nodes that make up each graph correspond to an item of required information as specified in the International Core Data Standard for Archaeological and Architectural Heritage.
- Nodes correspond to a CRM class, while edges correspond to a CRM property.



# HIP Graphs



**NAME TYPE AUTHORITY DOCUMENT**  
E32 Authority Document



**ARCHITECTURAL HERITAGE**  
E18 Physical Thing

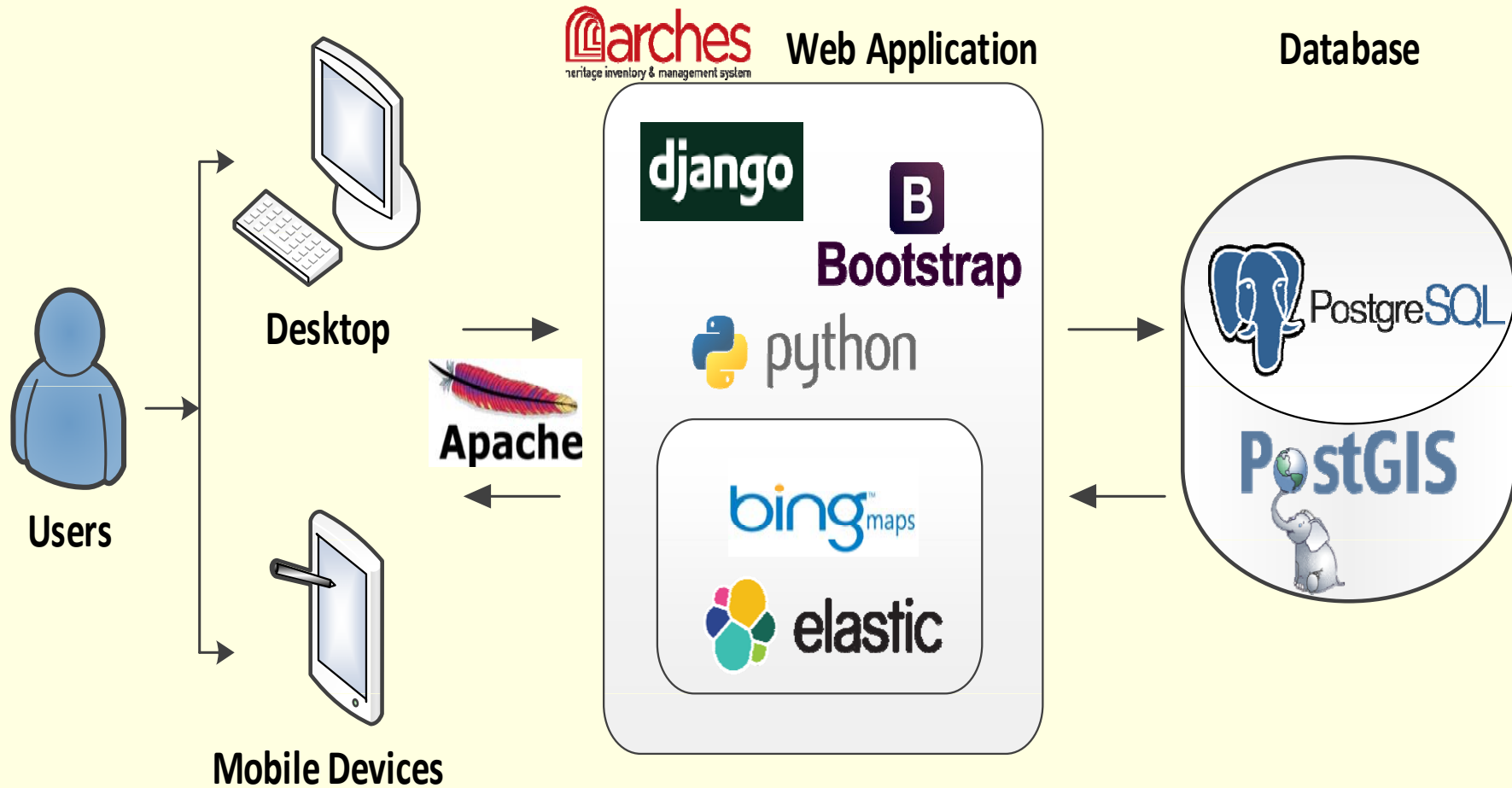
# Research Tools and Data

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- **Arches is comprised of four basic components:**
  - A Django based server tier written in Python
  - A Bootstrap based user interface using JavaScript and CSS
  - A PostgreSQL relational database and PostGIS which is the spatial database extender for PostgreSQL
  - An Elasticsearch search engine
- **The development environment of this project:**

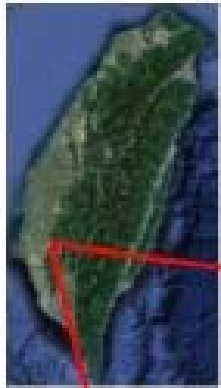
Name of software	Version
Ubuntu Server	14.04 LTS
Python	2.7.6
Apache	2.4.7
Elasticsearch	1.4.1
PostgreSQL / PostGIS	9.3 / 2.2.0
GEOS	3.4.2

# System Architecture



# The Study Site (Tainan City)

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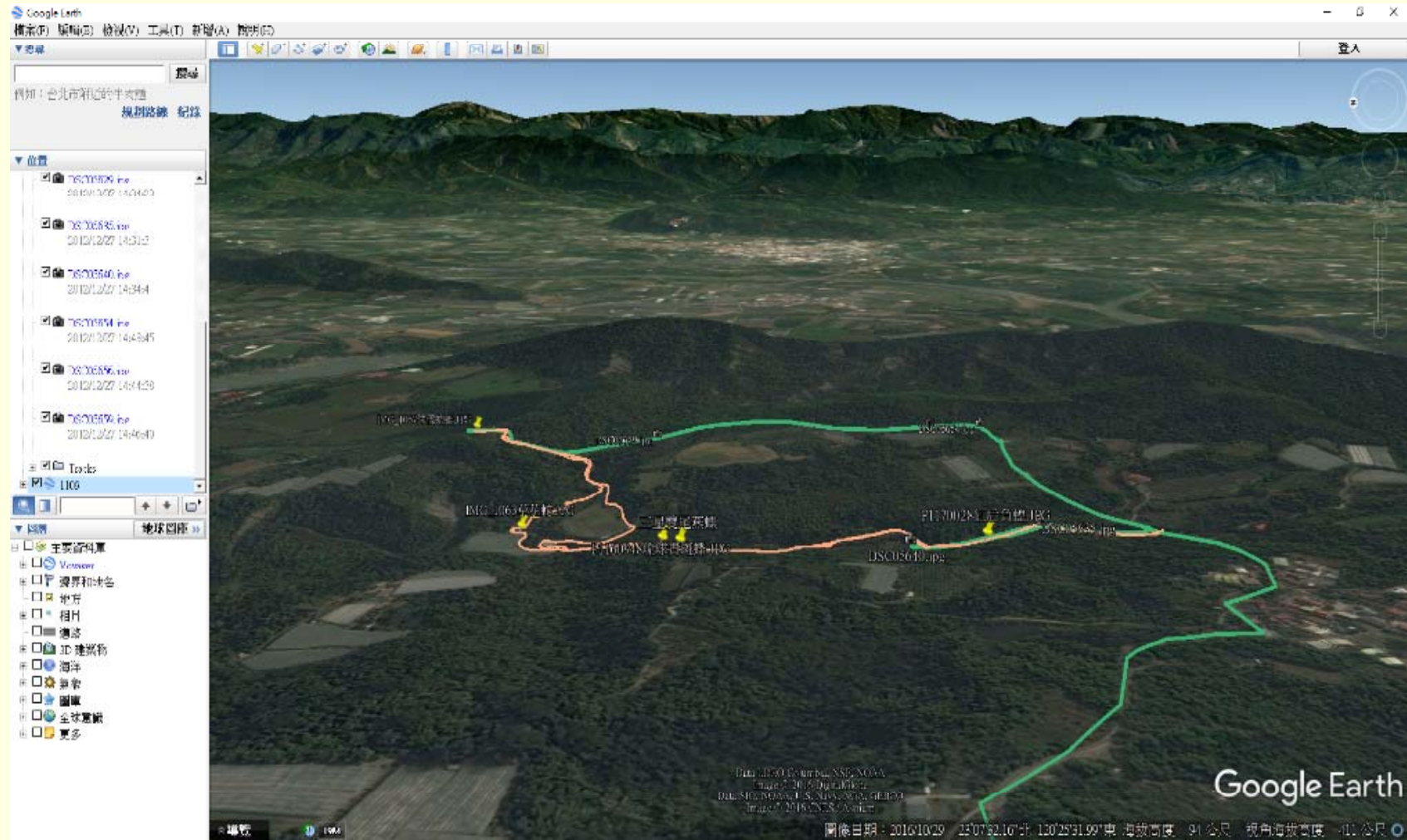




# A field trip shown on Google Earth

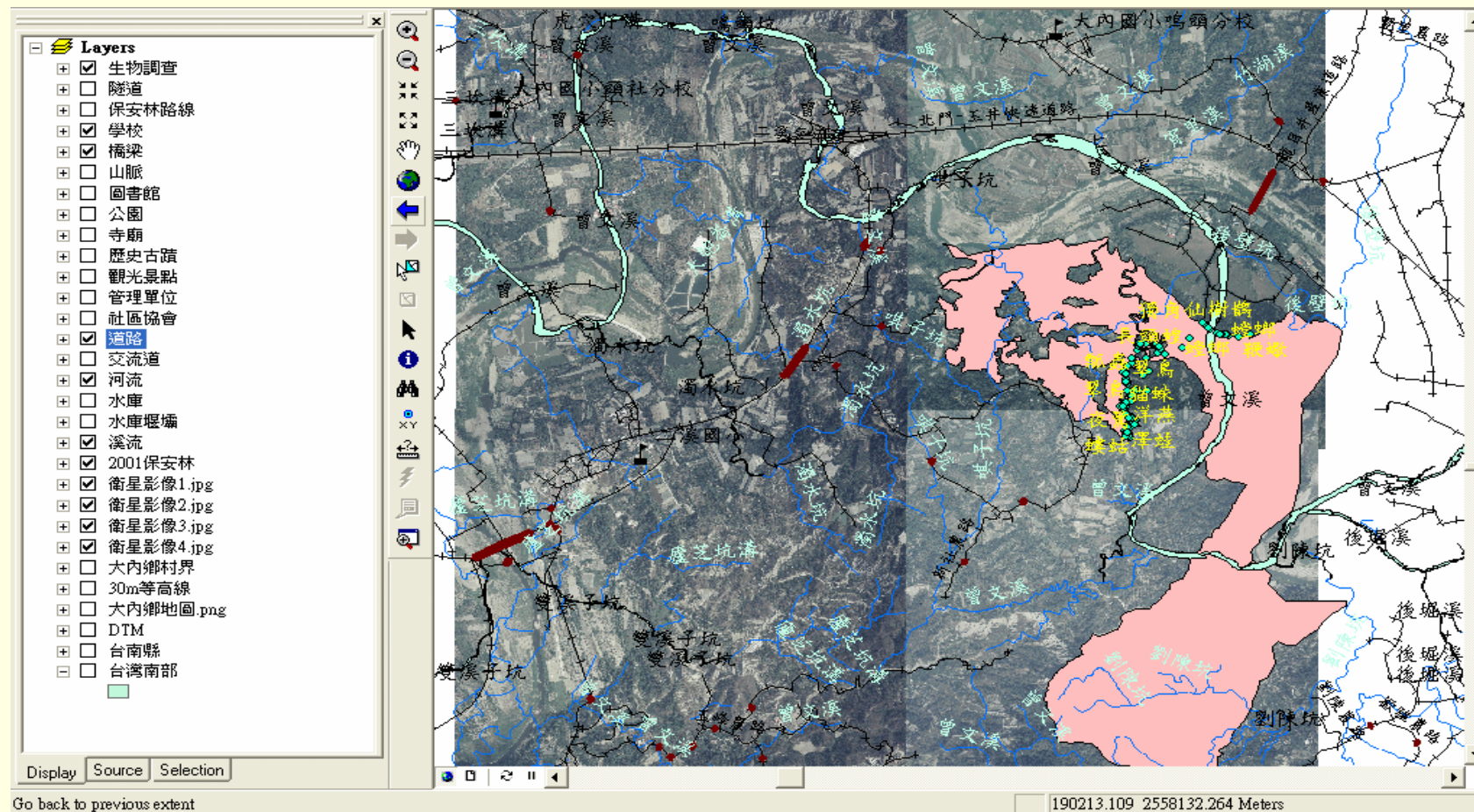
The screenshot displays the Google Earth interface with a field trip route overlaid on a satellite map of a forested area. The route is marked with a purple line and several photo thumbnails labeled with filenames like DSCF4806.JPG, DSCF4800.JPG, DSCF4849.JPG, DSCF4838.JPG, DSCF4835.JPG, DSCF4825.JPG, DSCF4822.JPG, DSCF4829.JPG, DSCF4870.JPG, DSCF4815.JPG, DSCF4813.JPG, and DSCF4845.JPG. A red pin is placed at the start of the route with the text '0813, Ele:601.064148'. On the left, the '目的地' (Destination) and '位置' (Location) panels are visible. The '位置' panel lists several photos with their timestamps: DSCF4835.JPG (2011/8/27 16:26:13), DSCF4838.JPG (2011/8/27 16:28:44), 蜂窩 (2011/8/27 16:32:39, 可能有危險), DSCF4845.JPG (2011/8/27 16:35:41), DSCF4849.JPG (2011/8/27 16:40:46), and DSCF4870.JPG (2011/8/27 17:11:35). On the right, a photo gallery for 'DSCF4838.JPG' (2011/8/27 16:28:44) shows three sequential photos of a tree canopy. At the bottom right, a legend indicates '路線: 到這裡 - 從這裡' (Route: to here - from here).

# 3D view of field environment



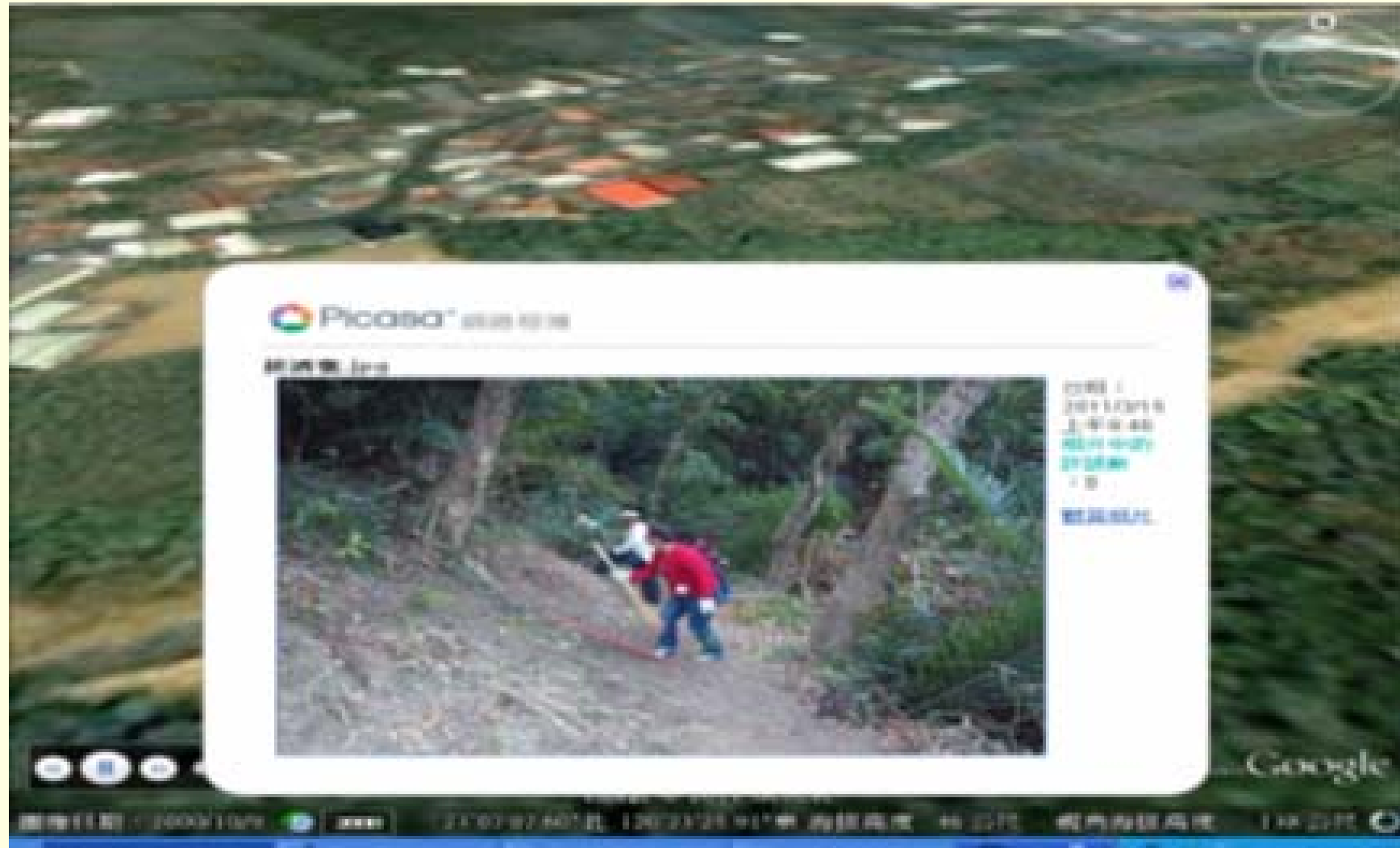


# Thematic layers and orthoimages of the study site shown on QGIS



# Video recording of virtual tour using Google Earth

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# Website of the community





# Information of cultural heritage



**大廬的起源和沿革**

由於「大廬頂」座落於丘陵地上（此竹坑），為了防止竹叢掩埋造成的人為崩塌，早在傳統時期居民即合力築置成圓形砂石（磚和瓦），彼此緊打成圓形石坑，中間置一圓形石頂的基座，圓形石頂和圓形石坑中間可見這些民間所製的瓦片碎瓦，是當地竹叢叢生且常有雷暴的象徵。在軍事勢力增加的時候，竹坑是則曾文、溪墘砂石堆運至當地，作為一打一掃的打泥石頂的基礎的基礎。留著一項執事權力，獨自當時的任務。這說明了大廬頂乃為整個地區發展，大廬頂頂力是地，家用的努力可見圖一切的問題，而這種精神也是一種精神，至今仍深植人心，為其是從事物發展最大的貢獻。



# The Study Site (Hua-Lien County)

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arches\_app x


arches.nccu.edu.tw

社區法人花蓮縣牛犁社區交流協會

語言 | HELP | 歡迎 - 登出

花蓮縣牛犁社區

首頁 客庄文化普查 搜尋 地圖



花蓮牛犁

蘊藏多元族群文化

照片: 豐田文史館 社區法人花蓮縣牛犁社區 提供

arches.nccu.edu.tw/#



arches\_app x

arches.nccu.edu.tw/map

社團法人花蓮縣牛犁社區交流協會

語言 | HELP | 歡迎 - 登出

花蓮縣牛犁社區

首頁 客庄文化普查 搜尋 地圖

以地址尋找

The map displays the Niuli Community area in Hualien County, Taiwan. It features a grid of roads and several survey points marked with numbered pins. The pins are color-coded: orange (1, 2, 3, 4, 5, 7, 9, 10) and purple (6, 8). The central area is labeled '壽豐鄉' (Shoufeng Township). Major roads shown include '中山路' (Zhongshan Road) and '豐田路' (Fengtian Road). A search bar on the left contains the text '以地址尋找' (Search by address).



arches\_app x

arches.nccu.edu.tw/map

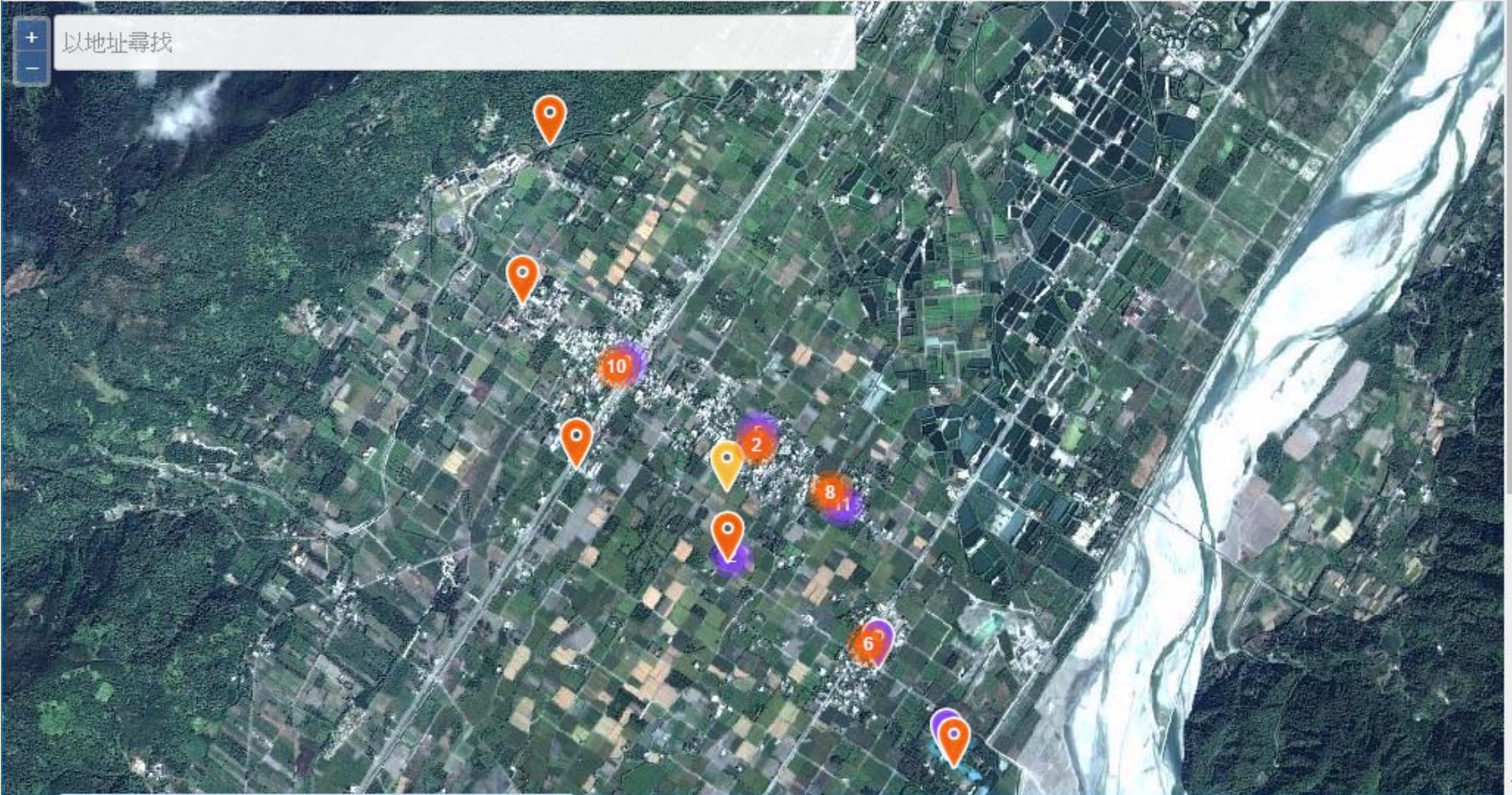
社團法人花蓮縣牛犁社區交流協會

語言 | HELP | 歡迎 - 登出

花蓮縣牛犁社區

首頁 客庄文化普查 搜尋 地圖

+ 以地址尋找





arches\_app x

arches.nccu.edu.tw/map

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語言 | HELP | 歡迎 - 登出

花蓮縣牛犁社區

首頁 客庄文化普查 搜尋 地圖

以地址尋找

圖層 + 增加圖層 x

- Historic Resource (100)
- Historic District (100)
- Activity (100)
- Historic Event (100)
- Person/Organization (100)

arches\_app arches\_app

arches.nccu.edu.tw/reports/05c8627b-4791-4a43-adbc-ea6087f640fc

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首頁 客庄文化普查 搜尋 地圖

壽豐文史館(壽豐客家文化館)

縣立壽豐國小

壽豐文史館

7E38

Racemane

arches\_app x arches\_app x

arches.nccu.edu.tw/reports/05c8627b-4791-4a43-adbc-ea6087f640fc

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語言 | HELP | 歡迎 - 登出

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首頁 客庄文化普查 搜尋 地圖

### 壽豐文史館(壽豐客家文化館)

Related People/Organizations 日本 (殖民者, is related to)

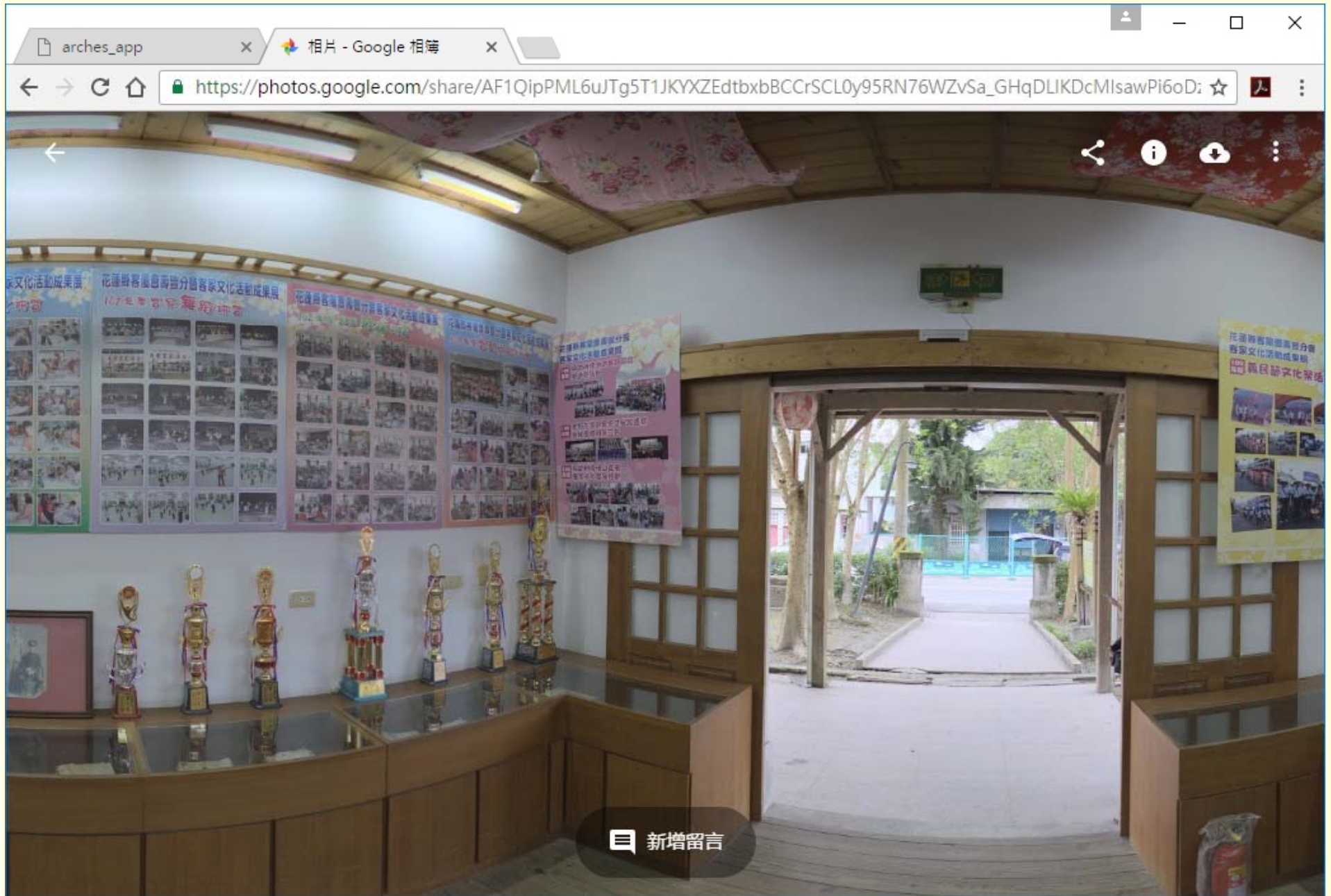
Related Information Resources

Images



Documents  
None





### 壽豐文史館(壽豐客家文化館) Historic Resource

[Related Resources](#) [Map](#)

原日本警察廳舍，隸屬移民指導所設置的管理機構，當時移民指導所於「中里」設置的機構尚有；醫療所（2005年遭龍王颱風吹毀）、花蓮港廳豐田小學校（今豐裡國小）、豐田神社（今碧蓮寺）。警察廳舍前院原有二道水泥門（目前只剩一道），因上班地點與宿舍同處一處，而為了有所區隔而設，一道門專供人員上下班及接洽業務使用，另一道門供住宿人員進出使用（住宿人員不得直接由宿舍進入辦公室或由辦公室直接進入宿舍），據稱這是日人重視禮節的規矩，民國89年由於警察廳舍屋瓦嚴重損壞，經行政院文化建設委員會補助整治為「壽豐文史館」，目前館內設有老照片回顧、社區營造、文化創意產業展示、兒童閱覽室及飲料簡餐服務，除擔任遊客接待、亦提供居民休憩、教育使用。2011年10月31日，原「壽豐文史館」，由於壽豐鄉公所將從新規畫成「壽豐客家文化館」，因而將「壽豐文史館」遷移至豐裡村街民族街23號，並於2011年11月6日定名為「豐田文史館」，承接起「壽豐文史館」原有之功能。2010年鄉公所接手管理正名「壽豐客家生活文化館」。





# Conclusions

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- **This study utilized open source software tools to develop a Web-based GIS (WebGIS) platform for rural communities in Taiwan. The WebGIS is an integrating system and analysis tool for managing community resources inventory data collected by volunteered residents of the community and tourists.**
- **It shows that VGI (volunteered geographic information) is a valuable source for data collection, however, it is recommended to employ validation measures to avoid erroneous data and insure data quality.**
- **The WebGIS is a useful tool for the community to draw more attentions from tourists. By providing convenient tools for query and mapping service through the Internet, the system encourages more people to participate in the process of data collection, thereby the geospatial database of the community resources can be established more thoroughly and efficiently.**

# Conclusions

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- **The Arches-HIP system implements internationally adopted standards for heritage data definition and management, which is essential for data sharing and international collaboration on heritage conservation.**
- **Arches-HIP supports geospatial technology standards, such as OGC (Open Geospatial Consortium) standards on spatial data and web services. This is very important to develop a system that can be interoperable both on retrieving images and maps from the other servers, and publishing heritage data as standard web service that may be consumed by the other GIS applications.**
- **The results show that, using open source geospatial software, we are able to build a community-oriented heritage resources inventory and management system with very low cost. This can be helpful to develop applications for local communities and indigenous people, and encourage public participation in heritage conservation.**

Thank you for your attention!