

Wanzi Su GIS assignment 2

by Wanzi Su

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1. Introduction

This essay introduces a Geographical Information System, which collects information of some hospitals and universities to create points on the immunisation rates map, and a Location Based Services System, which uses Leaflet and HTMLImageMap to generate some HTML files providing services for the users.

Before building a location based services system, it is very necessary to develop a GIS (Geographical Information System) because the services are able to construct only based on the collected spatial data. According to Labrador, Miguel A. and Perez, Alfredo J., GIS is one of the reasons that lead to the creation of location based systems:

The availability and pervasiveness of powerful mobile phones along with advances in software development platforms, databases, positioning technology, Geographic Information Systems (GIS), and communication networks have led to the creation of Location-Based Information Systems (LBIS), which promise to change the way we live. [1]

GIS is also very helpful for the medical system since it can be used to prevent the epidemic by showing the location of the source, the potential source, or the vulnerable points on the map. In addition to that, it can also help the treatment to get to the patients as soon as possible because the patients would know where is the closest hospital and the hospital would know where to send an ambulance. This view is supported by Hoseini, B. et al who wrote in their article that: *Geographic information systems (GISs) enable researchers in the healthcare field to apply combined spatial accessibility measures for the inspection of the equitability of resource allocation. [2]*

In the study of Danielle et al., they presented how GIS and spatial analysis can be used in the HIV-related research in Africa, which gave us some examples:

Notably, GIS and spatial analysis can be powerful tools to understand, prevent, and help treat diseases. For example, as a visualization aid, GIS software can be used to map the geographic distribution of disease, associated risk factors, and services available for prevention and treatment. Furthermore, spatial analysis of this data can analyze risks for disease, epidemic trends over space and time, and disease hotspots. Taken together, these tools can contribute to the design, planning, and allocation of global health resources for prevention and treatment services, as well as help to assess intervention impact. [3]

In previous studies, Ryschka, S. et al mentioned the legislative beginning of location based services: *From a legislative point of view, the advent of LBS was predominantly determined by the E911 mandate issued by the Federal Communications Commission in the United States in 1996. Originally, the purpose of this mandate was to improve emergency responses to wireless calls by enhancing the location accuracy of the caller's position. [4]*

While on the other hand, Arribas-Bel, D. and Bakens, J. explained the technological driving force of location based services: *In addition to the increase in computing power, location technology such as the global positioning system (GPS) has also undergone dramatic improvements and sharp drops in cost. The combination of these two trends is producing a vast amount of geo-referenced data, presenting many opportunities for research in the social and urban realms (Arribas-Bel, 2014). Powered by these technological advances (Goodchild, 2007) is the phenomenon called 'location-based services' (LBSs). [5]*

To understand what is location based services (LBS), we must know that there are three main features of location based services. The first one is that LBS requires a mobile device to provide its positional information. This view is supported by Ryschka, S. et al., who wrote: *Location-based services (LBS) evolved from mobile service... Consequently, as a starting point, LBSs can be defined as services that depend on and are enhanced by the positional information of the mobile device (Dhar and Varshney 2011). [4]* The second feature is that LBS is based on other location information. The third one is that LBS incorporates all the information and provides some useful services for the users.

Labrador, Miguel A. and Perez, Alfredo J. gave a description of what is a location based system and compared LBS systems with other systems: *A location-based service is an application that provides*

users with information based on the geographical position of the mobile device. This is one of the main differentiating features of LBS systems with regard to other systems, such as well-known enterprise systems, i.e., the system knows the physical location of the mobile device (user).[1]

In summary, when the user uses a mobile device to call LBS, LBS can locate the mobile device and incorporate massive geographical information around this location. As a result, LBS can provide various services according to the location for the users and even dynamically change the services as the users move.

2. Geographical Information System

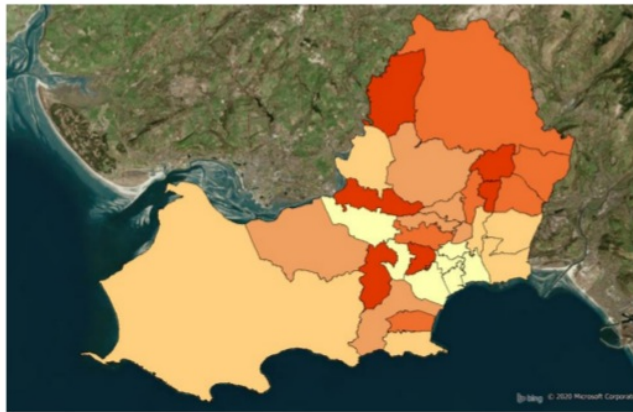


Figure 1: 1st dose MMR immunisation rates from 2012 to 2013

Based on the workspace for course work 1, the map of the immunisation rates is available to us, which can be used as a warning of those low immunisation rates areas for the government. As is shown in figure 1, this is the 1st dose MMR immunisation rates from 2012 to 2013, which is the latest data. The darker colour means the higher immunisation rates so we can see from figure 1 that the low immunisation uptake areas are mainly distributed around the city centre area.

The reason why to choose the 1st dose of MMR is that according to the CDC: "One dose of MMR vaccine is 93% effective against measles, 78% effective against mumps, and 97% effective against rubella. Two doses of MMR vaccine are 97% effective against measles and 88% effective against mumps." [6] Therefore, the 1st dose of MMR can already prevent the majority of the mumps and we should look for those who did not even take one dose of MMR since they are much more likely to be infected by mumps. On the other hand, the reason why to choose 2012 to 2013 is that this is the latest data so far and it indicates what will happen in the future. Even though those 2-year-old kids

are 10 years old right now, they will go to college several years later and the government can prepare for it before they go to college.

The first thing to develop a GIS is to specify the target. The first target is, of course, the hospitals because they have the ability to provide the MMR vaccine and deal with the patients with mumps. After finding the target, the next step is to specify the hospitals in Swansea. This is not difficult because those hospitals can be searched on the NHS website.

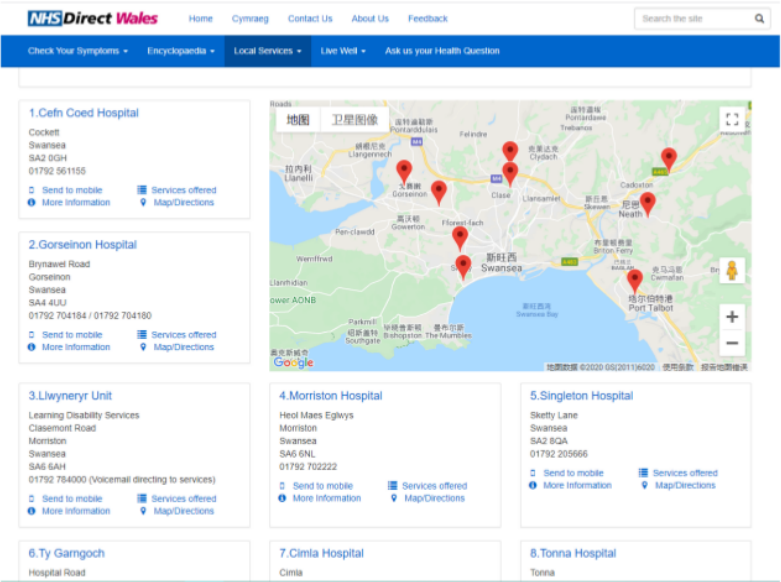


Figure 2: Hospitals on the NHS website

As we can see in figure 2, if you search “Hospital” with “Swansea” in the Local Services menu bar, it will return 9 matches. Six of them are the hospitals in Swansea and three of them are not in Swansea but near Swansea. In other words, they are the hospitals that people in Swansea can go to. Moreover, this page provides their postcodes, which can be used as one of their information.

There are two ways to show the location of these hospitals using Mapinfo. The first way is to download the digit map of the surrounding area on Digimap website, which provides detailed information about this area, and then select the buildings of each hospital. After saving the selection as a new table and a new map, we are able to highlight those buildings on the map. Then the interactive map can be made using Leaflet application, which allows users to click the buildings and get the information.

The second way is to create points for each hospital. This requires the accurate location of the hospitals. You can either put all the information in an excel file and open it in Mapinfo or create a new blank table

in Mapinfo and put the information in. Then after changing the style of those points, they would be shown as a red cross in the map. In the interactive map made by Leaflet, those points become blue arrows pointing at the hospitals and clicking them also make the information bubble pop out.

On the one hand, the digit map from Digimap website shows many things like the road, the buildings, or the sea. You can order all kinds of map elements on the Digimap website. On the other hand, this digit map can only cover a small area as an exchange of the detailed contents. Therefore, to select all the hospitals, you must download many digit maps, which is a tedious process. In addition to that, the Mapinfo has some bugs that when it is importing the digit map file, the Mapinfo would shut down, which is very annoying that. Another thing to mention is that the users usually would not care about the buildings. In most cases, they require the location and the information as well as access to the hospitals, which can all be provided by creating the points way. Considering all these together, the second way is the best choice and the final choice.

To create points for each hospital in Mapinfo, the postcode is not enough while the latitude and the longitude are required. Good news is that there is a website called Free Map Tools providing the service of converting the postcode to the latitude and longitude as figure 3 has shown to us.

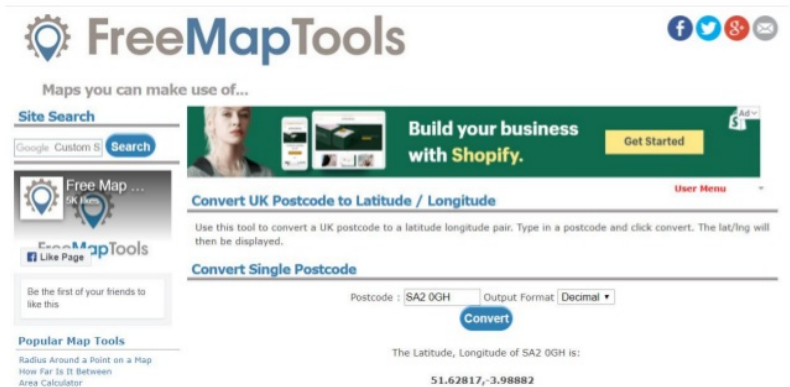


Figure 3: Free Map Tools

University Browser					Hospitals Browser					Hospitals, Universi				
Name	Address	Postcode	Lat	Lon	Name	Address	Postcode	Lat	Lon	Name	Address	Postcode	Lat	Lon
Cefn Coed Hospital	Cockett	SA2 0GH	51.62817	-3.98882	Gorseinon Hospital	Brynawel Road, Gorseinon	SA4 4UU	51.67212	-4.04800	Llwyneryn Unit	Learning Disability Service	SA6 6AH	51.67101	-3.93525
Morrison Hospital	Heol Maes Eglwys, Morriston	SA6 6NL	51.68465	-3.93525	Singleton Hospital	Sketty Lane	SA2 8QA	51.60903	-3.98478	Ty Garngoch	Hospital Road, Gorseinon	SA4 4LH	51.65870	-4.01111
Cimla Hospital	Cimla, Neath	SA11 3SU	51.65075	-3.78801	Tonna Hospital	Tonna, Neath	SA11 3LX	51.68004	-3.76547	Neath Port Talbot Hospital	Baglan Way, Port Talbot	SA12 7BX	51.59921	-3.80035

Figure 4: Hospitals Table

Figure 4 is the Hospitals Table after converting all the postcodes of the hospitals to latitudes and longitudes. The next step is to create the points in Mapinfo. As figure 5 has shown, there is a tool named “Create Points” on the top right corner, which is the one to be used.

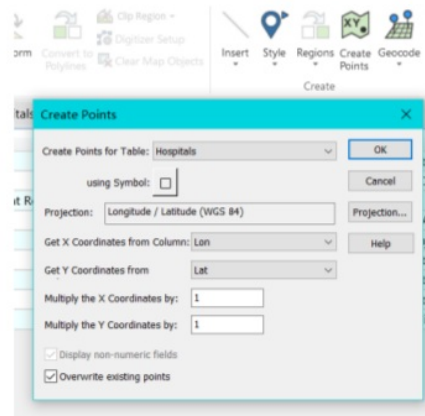


Figure 5: create points

A few settings should be changed here. First, select the Hospitals Table. Second, change the symbol to a red cross. Its Background is “Halo” and the Effects is “Drop Shadow” to make those red crosses distinguish from the background. Third, the Projection should be “Longitude/ Latitude” so that the Mapinfo can recognize two columns in the table and use them as the longitude or the latitude. After creating the points, we can put them onto the immunisation rates map and display their names in the same way as to display the red cross. Then the map would look like figure 6.

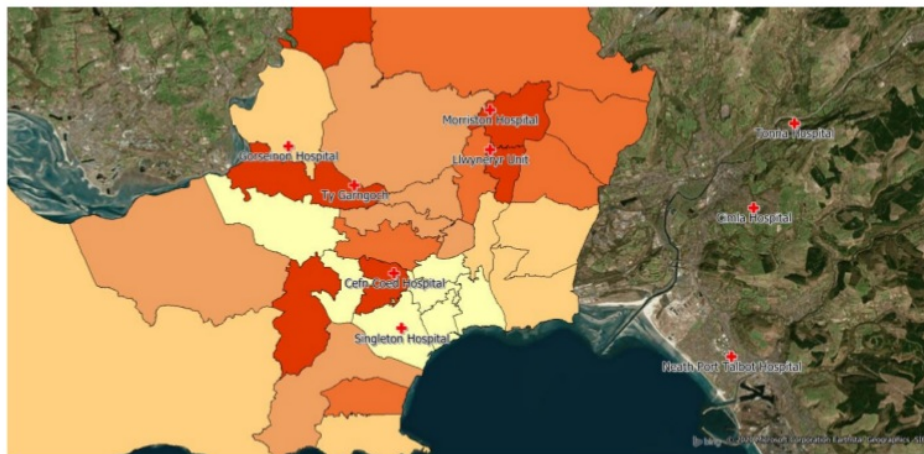


Figure 6: map with hospitals points

As is shown in figure 6, there are three hospitals located near the low immunisation rates areas and Singleton Hospital is just in a low immunisation rates area. Therefore, these four hospitals, especially Singleton Hospital, should be informed to pay more attention to the mumps cases. In addition to that,

there is no hospital in the western part of Swansea so mumps patients from this area would go to these four hospitals in the middle part, which gives these hospitals more pressure.

On the other hand, Morriston Hospital and Llwyneryr Unit would not have as many mumps cases as those hospitals so they are responsible to share more burdens. Morriston Hospital and Llwyneryr Unit should cover more areas and maybe take some mumps patients from other hospitals when those four hospitals are short of hands or equipment. By the way, the immunisation rates of the areas around the three hospitals outside Swansea are unknown but they can still keep in touch with Morriston Hospital and Llwyneryr Unit since the distance is not very far.

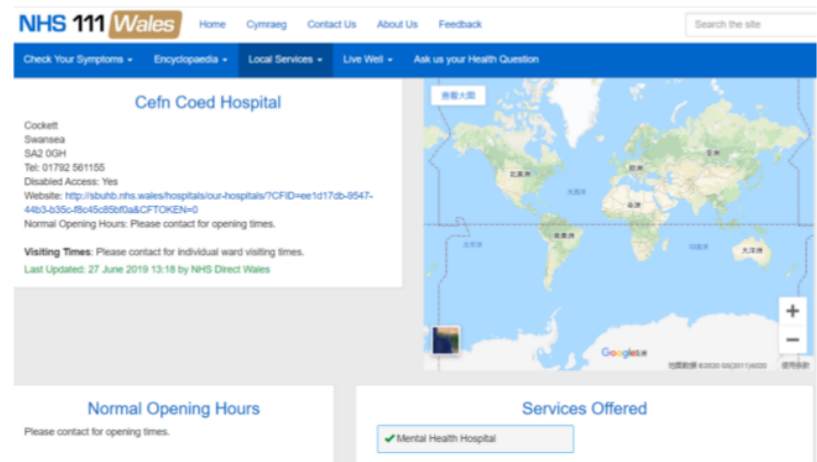


Figure 7: More Information about Hospitals

As we can see in figure 7, the NHS website provides more information about those hospitals like the telephone number, the website, the opening hours, and the services offered, which allows the patients to know where is the hospital as well as whether this hospital can handle the mumps or contact with the hospital in time. This information can be added to the Hospitals Table as figure 8 has shown.

Name	Address	Postcode	Lat	Lon	Services	Tel	Website	Opening Hours
Cefn Coed Hospital	Cockett	SA2 0GH	51.62817	-3.98882	Mental Health Hospital	01792 561155	http://sbuhb.nhs.wales/h	Please contact for opening times.
Gorseinon Hospital	Brynawel Road, Gorseinon	SA4 4UU	51.67212	-4.04800	Audiology Services, Com	01792 704184 / 01792 704180	https://sbuhb.nhs.wales	9am-5pm
Llwyneryr Unit	Learning Disability Serv	SA6 6AH	51.67101	-3.93525	24 Hour Availability	01792 784000 (Voicemail direc	https://sbuhb.nhs.wales	24hr
Morriston Hospital	Heol Maes Eglwys, Morri	SA6 6NL	51.68465	-3.93525	24 Hour Availability, A&E	01792 702222	https://sbuhb.nhs.wales/f	Please check with the hospital or visi
Singleton Hospital	Sketty Lane	SA2 8QA	51.60903	-3.98478	Assessment Of Eye Injury	01792 205666	https://sbuhb.nhs.wales	Closed until further notice
Ty Garmoch	Hospital Road, Gorseinon	SA4 4LH	51.65870	-4.01111	Mental Health Hospital	01792 531200	https://sbuhb.nhs.wales	9am-5pm only weekday
Cimla Hospital	Cimla, Neath	SA11 3SU	51.65075	-3.78801	Mental Health Hospital	01639 862000	https://sbuhb.nhs.wales	The teams generally operate within 1
Tonna Hospital	Tonna, Neath	SA11 3LX	51.68004	-3.76547	Mental Health Hospital	01639 862921	https://sbuhb.nhs.wales	Contact the hospital for opening hos
Neath Port Talbot H	Baglan Way, Port Talbot	SA12 7BX	51.59921	-3.80035	Access To Fracture Clinic	01639 862000	http://sbuhb.nhs.wales/f	7.30am-11pm

Figure 8: more information in Hospitals Table

After completing the Hospitals Table, the information is enough to move on to the next target: universities, schools, and 6th form colleges. There are three universities in Swansea: Gower College Swansea, University of Wales Trinity Saint David, and Swansea University. Besides, there is a six form

college in Swansea. Each university has several campuses so it is better to create a point for each campus instead of creating a point for each university.

On the home page of each university or college, the postcodes of the campuses are provided so we can use the Free Map Tools website again to convert the postcode to latitude and longitude. Create a new table in Mapinfo and add the name, the postcode, the latitude, and the longitude in the table. The next step is to search these campuses on Google Map, where the address, the telephone number, and the website of them are provided.

To find more information, the university website is browsed over and over again. However, there is hardly some useful information like the student number of each campus or the average age of the students so here the population is just a ballpark figure. The only helpful information is the courses of each campus. As figure 9 has shown to us, UWTSO provides the detailed course information in the “Book An Open Day” page. Nevertheless, some university only gives a very vague description like “a wide variety of vocational courses”.

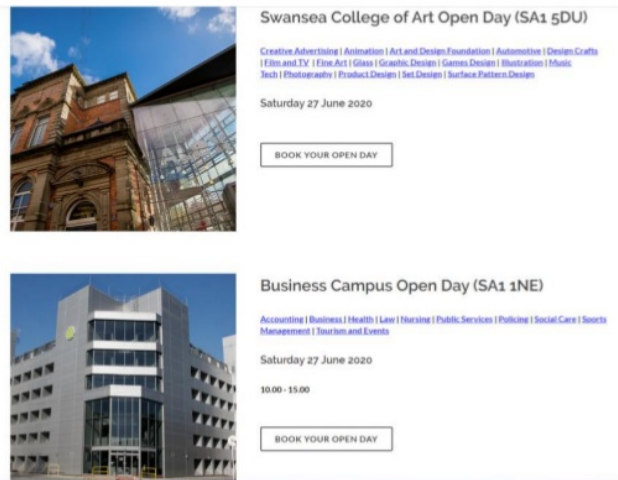


Figure 9: courses of each campus

Name	Address	Postcode	Lat	Lon	Open	Tel	Website	Course	Population
UWTSO Business Campus	UWTSO, High St	SA1 1NE	51.62096	-3.94116	Closed	01792 481025	https://www.uwtsd.ac.uk/swansea	Accounting, Business, Health, Law, Nursing, Public Services, 2000	
UWTSO AntiDesign Campus	College of Art, Campus, Dyer	SA1 3BU	51.62170	-3.94630	Closed	01792 481025	https://uwtsd.ac.uk/art-design/	Creative Advertising, Animation, Art and Design Foundation, 2000	
UWTSO Waterfront Campus	University of Wales Trinity St	SA1 8BW	51.61736	-3.92550	Closed	01792 481000	https://www.uwtsd.ac.uk/ta/	Architecture, Computing, Construction, Counselling, Childho	2000
Swansea University	Singleton Park, Sketty	SA2 8PP	51.60962	-3.98060	Closed	01792 205670	https://www.swansea.ac.uk/	Arts and Humanities, Human and Health Sciences, Hilary Ro	12000
Swansea University Bay Campus	Fabian Way, Crymlyn Burrow	SA1 8EN	51.61081	-3.87941	Closed	01792 205670	https://www.swansea.ac.uk/accon	College of Engineering, the School of Management, and the	3000
Six Team College	18 Mansel St	SA1 5SG	51.62080	-3.94890	Closed	01792 535000	http://www.sswales.com/	English language, English literature, Mathematics, Biology	300
Gower College Swansea Llyn y Bryn Cj	77 Walter Rd, Uplands	SA1 4QA	51.61034	-3.96055	Closed	01792 284021	https://www.gcs.ac.uk/lynn-y-br	art and design, fashion, fine art, graphics, media, photograph	500
Gower College Swansea Tycoch Campus	Tycoch Rd, Sketty	SA2 9EB	51.62238	-3.98376	Closed	01792 284000	https://www.gcs.ac.uk/tycoch	a wide variety of vocational courses	500
Gower College Swansea Gorseinon Carr	Belgrave Rd, Gorseinon	SA4 6RD	51.66399	-4.05033	Closed	01792 890700	https://www.gcs.ac.uk/gorseinon	nearly 40 A Level subjects and a wide range of vocational co	500
Gower College Swansea Jubilee Court	Jubilee Court, Unit 1-2 Jubli	SA5 4HB	51.64346	-3.98956	Closed	01792 284400	https://www.gcs.ac.uk/jubilee-co	customer service, health and safety, IT and assessing qualific	500

Figure 10: University Table

Figure 10 is the University Table after putting all the information in. Then we can create the points of the campuses with their latitude and longitude. The different thing is that the University Table is selected and the symbol is a blue square academic cap, which is very suitable for college students. Other settings are the same as creating the hospital points. Then we can put those points onto the map in figure 11.

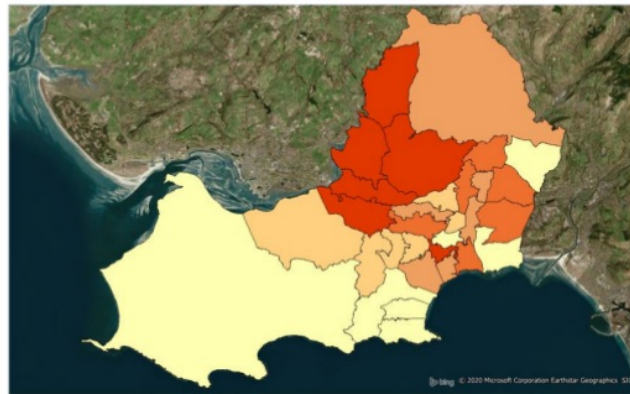


Figure 11: 1st dose MMR immunisation rates from 2003 to 2005

Figure 11 is the 1st dose MMR immunisation rates from 2003 to 2005. The reason to use this map is that we are talking about students in universities at this point and the immunisation rates from 2012 to 2013 has no relation to them. Since the 1st dose MMR immunisation rates are by the age of 2, those who are counted in the 1st dose MMR immunisation rates from 2003 to 2005 are 19 to 21 years old now, which is exactly the age of the college students. Even if the students in the university are not all from Swansea, the local young people in the same age group are from Swansea and students cannot avoid meeting them. Therefore, this map would indicate the immunisation rates among the college students in Swansea and it is better to use this map to discuss the mumps threat to college students.

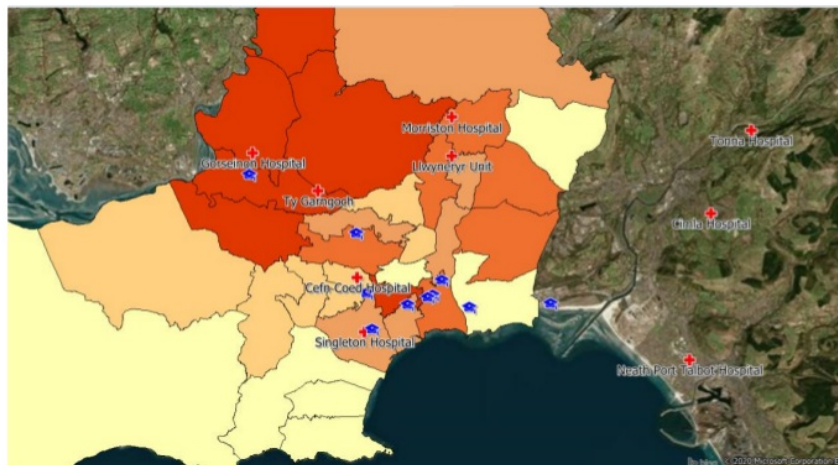


Figure 12: map with university points

As we can see in figure 12, except Gower College Swansea Gorseinon Campus, the universities or schools are basically not far from the low immunisation areas, which means the university students would have more possibility to get infected when they are around the campus. This alerts the universities and schools to take the precaution and make more preparation for the mumps. For example, they can always send an email to all students about what the symptoms of mumps are and how to prevent mumps or relieve symptoms. Another good way is to immediately warn all the students when the first mumps case occurs before it spreads or at least to reduce the losses as much as possible.

3. Location Based Services System

After completing all the GIS work, the final work is to build a location based services system. Here, the mobile device is not available because the LBS system is a web application. However, the alternative way is to allow the users to select the service according to the map, which means the users do not provide their location but they need to interact with the map. At this point, the first step is to use Leaflet to make the interactive maps. Leaflet is an application in Mapinfo that can be used to export a Mapinfo table to an interactive map. As we can see in figure 13, the green leaf on the top left corner is the icon of Leaflet after opening the Leaflet program file.

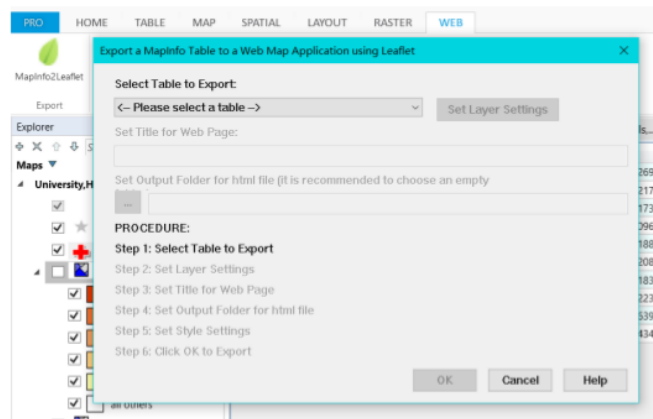


Figure 13: Leaflet

There are two tables as is mentioned above, which are the Hospitals Table and the University Table. Therefore, we can select them separately and make an interactive map for each of them. After selecting the table, it is to click the “Set Layer Settings” button beside.

Figure 14: Set Layer Settings

The Layer Settings is shown in figure 14. It is unnecessary to keep the latitude and the longitude so they can be removed. Users do not need to know the latitude and the longitude and they are just used for creating points. The hyperlink is the Website column so the URL can link to the website of the hospital or the university. Tick “Add Column Names” to show the users the name of the information and tick “Zoom in to marker/feature on click” to allow the users to see the specific location. Then we can complete the settings and export the interactive map which is shown in figure 15.

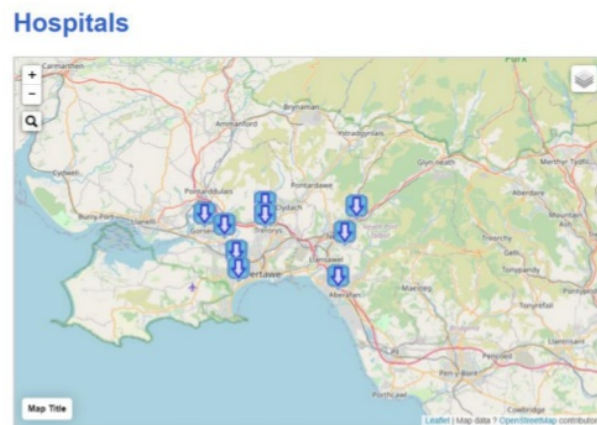


Figure 15: interactive map of Hospitals Table

As we can see in figure 15, there are many blue arrows pointing at the hospital locations so the users can click those arrows to interact with them. For example, if you click a blue arrow, it would be like figure 16.

Hospitals

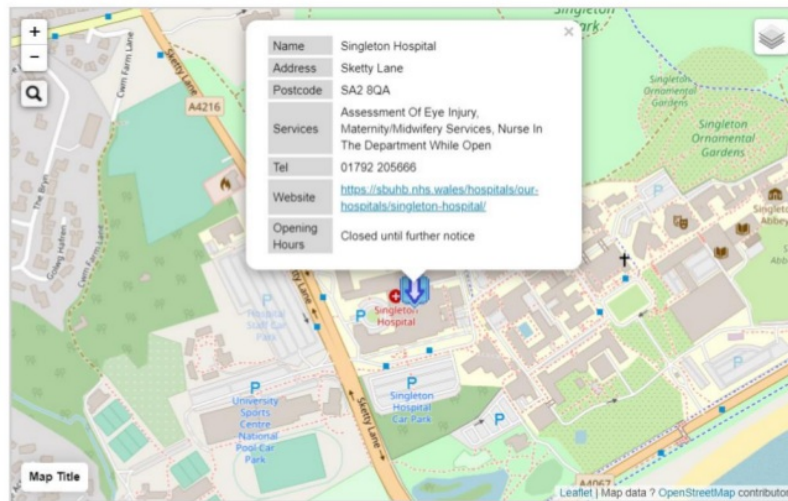


Figure 16: zoom in and information bubble pops out

As figure 16 shows, the map would zoom in to the location and the bubble containing all the information would pop out. In this case, the users would know the location and the information of this hospital. In addition to that, they can contact the hospital if they are inconvenient as the telephone number is provided.

University

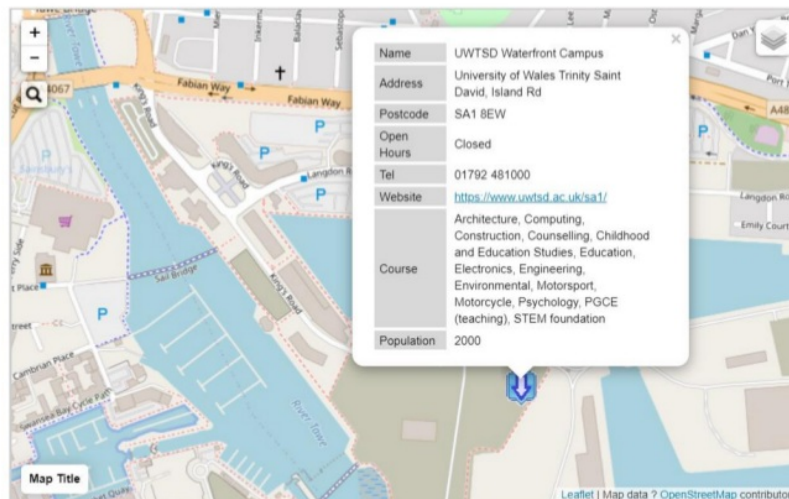


Figure 17: University interactive map

As we can see in figure 17, the case is the same for the University Table. It provides some information and the telephone number for the government so that the government can make policy according to the location and the population or inform the university about the mumps situation.

The next step is to use HTMLImageMap to build a static map with the immunisation rates map as the background. Here, two immunisation rates maps are used so we can build twice.

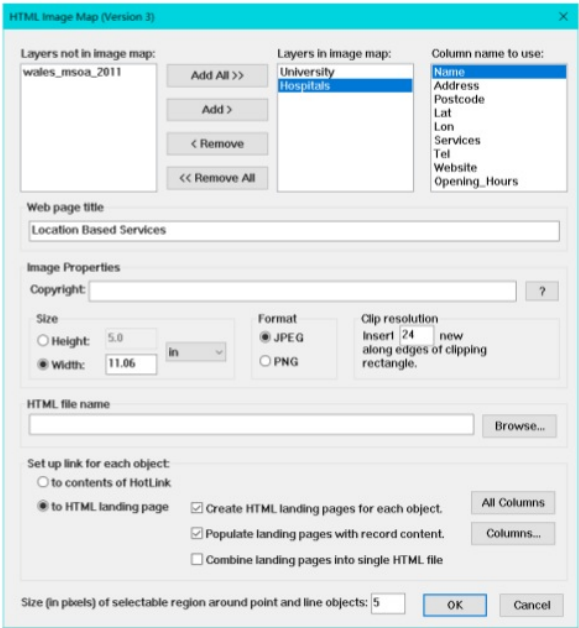


Figure 18: HTML Image Map

As is shown in figure 18, the Hospitals Table and the University Table are added in image map. Type in a web page title and HTML file name. Set the height as 5 inches and tick first two options in “to HTML landing page”.

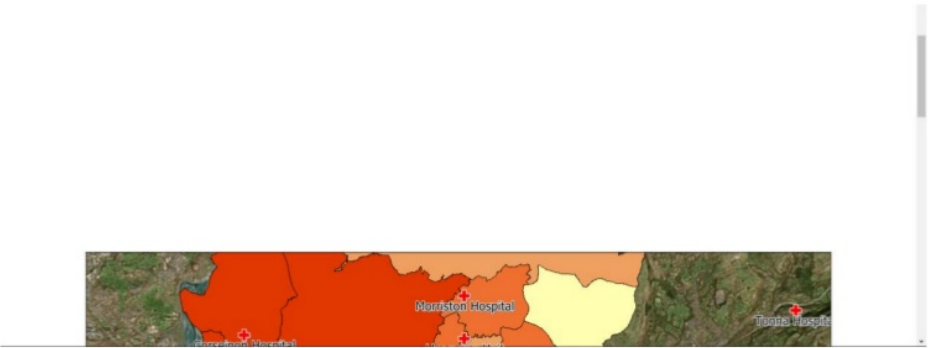


Figure 19: wrong image map

As figure 19 shows, after exporting, we would find that the image map is wrong. The fix is to delete the “ISMAP VSPACE=100%” in the image map file and recreate the clicking areas in a website called Free Online Image Map Generator as figure 20 has shown.

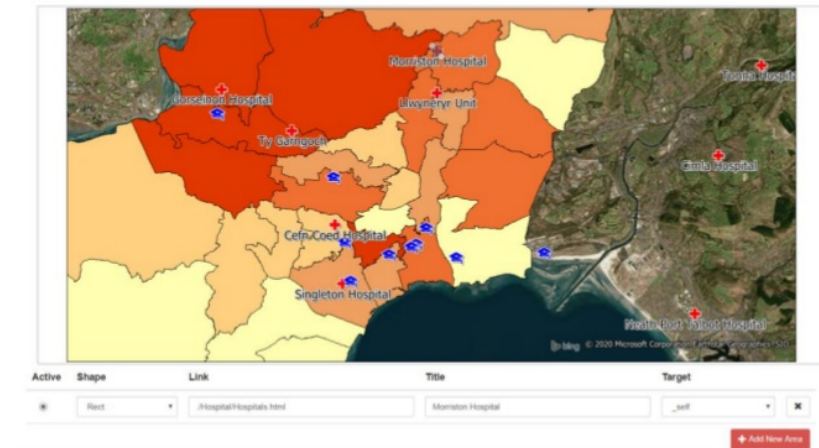


Figure 20: Free Online Image Map Generator

After recreating each clicking areas, we can copy the code and replace the previous code in the image map file. One thing to mention is that the link is replaced by the path of the interactive map so if those hospital or university points are clicked, the browser would respectively go the interactive map of the hospitals or the university.

Welcome, please select the map



Figure 21: Homepage

Figure 21 is the homepage of the location based services system. It is a very simple HTML file with only two buttons respectively linking to the image map in figure 22 and the image map 2 in figure 23.

Location Based Services

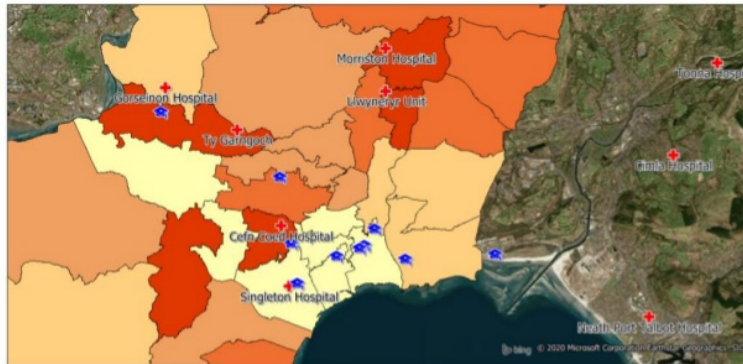


Figure 22: image map

Location Based Services 2



Figure 23: image map 2

As we can see in figure 22 and figure 23, the only difference is that the background is the immunisation rates map either from 2012 to 2013 or from 2003 to 2005. The users can select the map they want according to their requirement. In the future, the government can add more immunisation rates map if they want. If there are mumps cases in the university, Singleton Hospital would have so much pressure because most of the universities are near it and Cefn Coed Hospital is a Mental Health Hospital. The suggestion is that Morriston Hospital and Llywneryr Unit should prepare the transfer of the patients to take some burdens off Singleton Hospital.

4. Conclusion

In chapter 1, I gave a brief introduction of what is Geographical Information System and why to develop a GIS. Then I explained what is Location Based Services and what can LBS system do.

In chapter 2, I described something in the GIS like why to use immunisation rates map, why to create points, how to collect the information, and how to create points. I also provided some analysis of the hospital location, the university location, and the low immunisation rates areas.

In chapter 3, I discussed how to use Leaflet to make interactive maps, what can interactive maps do, how to use HTMLImageMap to build image maps, how to fix the bug of the image map, and why to have two image maps. Then I gave a suggestion to the hospitals for the case if mumps occurs in the university.

5. Reference

- [1]. Labrador, Miguel A. and Perez, Alfredo J. (2010) "Location-Based Information Systems : Developing Real-Time Tracking Applications", [library.oapen.org: handle/20.500.12657/25165](https://library.oapen.org/handle/20.500.12657/25165)
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Wanzi Su GIS assignment 2

GRADEMARK REPORT

FINAL GRADE

72/100

GENERAL COMMENTS

Instructor

Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills		
<i>Discussion and present a brief report on LBS in relation to the provision of health care related information.</i> A suitable introduction to LBS. You have presented relevant and clear research on LBS and you have reflected on location data as required for this type of study. You have research many relevant articles and provided a suitable structure to your referencing but try to summarise your reading and not put in too many direct quotes.	20	12
2. Knowledge and Understanding Skills		

<i>Demonstrate how you have collected and cleansed the data. Provide evidence and discuss how new data has been used in the system. What have you included in your data that will enhance that users experience with the GIS/LBS. Your report should discuss the data that you used to build this application and should reflect on the concept of LBS.</i> You have collected suitable layers of additional data to support the creation of your website LBS solution. This has been presented well on our report and demonstrated within the MapInfo software. Two important layers have been added to show location of University sites and hospital location. You have also described the relationship between the MMR vaccination uptake and possible outbreaks due to location very well.	20	14
3. Cognitive and Intellectual Skills		

<i>Describe in detail all the of the spatial data sets that you have included. Why were they necessary and what added detail have they given to the dataset.</i> You have evaluated the data and discussed the methods of analysis as required when building the workspace. You demonstrated a suitable understanding of several different processes for data collection. Your dataset has helped you with your study of the application of location based services and therefore map layers demonstrate suitable judgement of the data requirement for such a study.	20	15
4. Practical Application Skills		
<i>How you developed the layers within the system. Functionality of system GIS and Website. You must submit a working GIS/ LBS environment developed with MapInfo and any additional software add-ons that will enhance the build of a working website.</i> Very good use of the software. You have explored several methods of adding data. Your workspace works well although maybe you could have looked at the Townsend index of	35	27

depravation as an alternative way to visualise the LBS requirements. Some good uses of visualisation of the data through the various layers and searches. You have demonstrated a good understanding of the datasets and the ability to look for correlations within the data. You have developed a website and within the given time and difficult circumstances you have produced some good results using leaflet. You have used HTML build well and you have adapted the image map to link to alternative pages. If you had used this to generate landing pages via the database fields that you had already created in MapInfo you would have allowed for better information on the landing pages and added another layer of information. Generally, this section has been completed to a good standard.

5. Transferable Skills for Life and Professional Practice		
<i>All work suitably presented and referenced and concluded</i> Your work has been presented to a suitable standard. You have improved the way you reference your research and you have produced a suitable conclusion.	5	4

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