

GIS_LBS_Final

by Shannon Boulting

FILE	16808_SHANNON_BOULTING_GIS_LBS_FINAL_254212_1251830318.DOCX (4.41M)		
TIME SUBMITTED	08-MAY-2020 10:29PM (UTC+0100)	WORD COUNT	3719
SUBMISSION ID	126804255	CHARACTER COUNT	19795



[32]

Investigating Location Based Services

Shannon Boulting
1903281

8th May 2020

Geographical Information Systems
BSc Computing Portfolio

Contents

Contents.....	0
1. Introduction	3
1.1 Location Based Services (LBS)	3
1.1.1 Overview	3
1.1.2 Hardware & Software Requirements.....	3
1.1.3 Real-world Application.....	3
1.1.4 LBS and Health	3
1.1.5 Case Study: Mumps.....	4
2. Methodology.....	5
2.1 Overview	5
2.2 Software	5
2.3 Creation of Point Data.....	5
2.4 Creation of LBS.....	6
2.4.1 Creation of University location buffer zones	6
2.4.2 Boundary Selection	9
2.4.3 Creation of Web Pages.....	11
2.4.4 Creation of HTML Web Pages	14
2.4.5 Creation of Front Web Page	18
3. Data analysis & results discussion	20
3.1 MapInfo2Leaflet Vs MapBasic Approach.....	24
4. Recommendations	25
5. Conclusion.....	25
6. References	26

List of Figures

Figure 1: LBS Convergence Diagram [1]	4
Figure 2: Creation of risk buffers	7
Figure 3: Creation of buffer table structure.....	7
Figure 4: Creation of buffer objects	8
Figure 5: Overview of Buffer Zones around Universities	8
Figure 6: Boundary Selection Tool	9
Figure 7: Boundary Selected Tool (Existing dataset covering Wales).....	9

Figure 8: Export table.....	10
Figure 9: Tab file for the table.....	10
Figure 10: Table selection to export	11
Figure 11: MapInfo2Leaflet Layer Settings	12
Figure 12: Final confirmation prior to exporting	13
Figure 13: Creation of Web Page	14
Figure 14: Creating new database	15
Figure 15: Naming the database	16
Figure 16: Modifying the Table	16
Figure 17: Creating the web page	17
Figure 18: Selecting web page options	17
Figure 19: Web Page for Morriston Hospital	18
Figure 20: Main Directory Web Page	18
Figure 21: Code for Main Directory Web Page	19
Figure 22: Buffer zones and MSOA Ranges by Student Population.....	20
Figure 23: Buffering Zones and 1 st dose MMR data.....	21
Figure 24: Heat Map of Immunisation	21
Figure 25: Buffering Zones and 2 nd dose MMR.....	22
Figure 26: Buffering Zones and Townsend Index.....	23
Figure 27: LBS Prototype.....	25

List of Tables

Table 1: Datasets for the LBS system	6
--	---

1. Introduction

1.1 Location Based Services (LBS)

1.1.1 Overview

Due to the growth in the development and distribution of smart mobile devices, accessing locational information on the go has become commonplace. This has created demands for Location Based Services (LBS). An LBS is “any service or application that extends spatial information processing or GIS capabilities, to end users via the Internet and/or wireless network”. The priority of these applications is to deliver mobile users with personalised services whereby their location determines what information they access or receive [1].

1.1.2 Hardware & Software Requirements

LBS provides to its users personalised services which is based on the users current location through GNSS (Global Navigation Satellite System), GIS and Wireless Communication technologies (WC). LBS utilises real-time positioning allowing the users to connect to points of interest, as well as advising them on current weather and/or traffic conditions, as well as tracking and routing information [2].

LBS is required to be integrated with GIS and mobile computer technology. [2]. Mobile-networked environments are used to provide geographic information services via the internet to smart phones [1]. The technology is utilised for collating, storing, analysing and editing various data relating to earth [3].

LBS technology allows users to access real-time data and services worldwide, allowing the user to display their actual information, location and chosen preferences [3]. GIS and telecommunication technology are used to support LBS services to provide and deliver the information in accordance of the user's needs. LBS services can respond to general questions regarding a specific place with geographical information and advising on the most convenient route to get there. [3]. Therefore, GIS is an inseparable and central part within LBS.

1.1.3 Real-world Application

LBS is used today by individuals to undertake and plan journeys, for the monitoring of traffic within a given city, find out where the nearest shop is etc. The public sector utilises it to provide services to its citizens such as transport timetables. Within businesses, LBS can support the management of stock, truck fleets providing a fresh element to marketing (geo-marketing) through the utilisation of a customer's locational data [4].

1.1.4 LBS and Health

LBS and GIS can be utilised in medical research and health-based services. It can collect and deliver environmental information to assess the impact of environmental factors on health through various spatial and temporal scales; from short term epidemic outbreak to long term [4]. In terms of health services, it allows for the deployment of emergency services to easily obtain the position of users and customise the information received resulting in a safe and reliable tool for decision making in all areas [5].

In the current worldwide Coronavirus pandemic, GIS industry leader Esri has utilised LBS to track key assets (such as ventilators, hospital beds, equipment) as well as create databases of vulnerable people and volunteers alongside local councils. This has helped source crucial resources for tackling

the virus and also provide residents with important safety information to slow the spread of the virus. Co-ordination and collaboration between the stakeholders in this project has been key; including councils, local government, health boards and the general public [6]. It is crucial that users have access to timely and accurate data in order to control the spread of Coronavirus and protect those most at-risk. This also applies to other viruses, including mumps.

1.1.5 Case Study: Mumps

A GIS project was previously created to demonstrate which areas and populations in the City and County of Swansea are most at-risk of contracting and spreading mumps. The conclusion of this was that student populations and densely populated city centre areas were most at-risk.

As demonstrated through the Coronavirus example, GIS and geospatial data is key in tackling the outbreak of viruses. Therefore, this paper will build upon the previous Swansea Mumps Case Study, by assessing the capabilities of a combined LBS and GIS application in providing crucial information to those most at-risk during an outbreak.

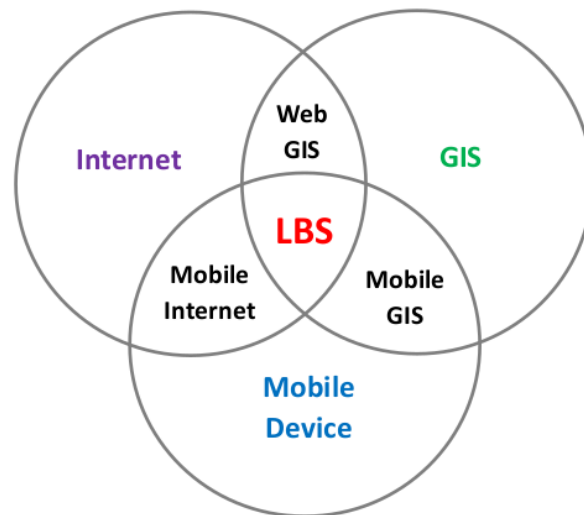


Figure 1: LBS Convergence Diagram [1]

2. Methodology

2.1 Overview

This section will document the creation of a combined LBS and GIS application which aims to provide users with valuable information during a mumps outbreak to reduce their risk of contracting and spreading mumps.

2.2 Software

The software which will be utilised to build the LBS:

1. MapInfo Professional – Desktop based GIS application
2. Microsoft Excel – Spreadsheet software used to create datasets as csv's before they are converted to MapInfo .tab files
3. MapBasic – Programming language for customising the geographic functionality of MapInfo Professional
4. Mapinfo2leaflet – Tool which allows users to setup a web map application through exporting tables in MapInfo Professional.

2.3 Creation of Point Data

Data is the foundation of the GIS; if the datasets are flawed then any findings based on the GIS and LBS are also flawed. Therefore, it is crucial that datasets are accurate, up-to-date and complete. The key datasets included in the LBS are below, each of these cover the study area in Swansea. Those created from scratch (Universities, 3xbuffers and Townsend index) are produced in excel as a csv then exported as MapInfo tab files. Others (health services) were downloaded from Lle; a dataset portal for Wales.

Dataset	Description	Attributes	Rationale
Universities	Location of all universities in study area.	Name Campus name Mumps status X and Y location	Students are thought to be a high-risk population so knowing where they are studying, and also likely living close to, is crucial
College & Sixth forms	Location of college & sixth forms in study area	Name X and Y location	
Schools	Location of schools in study area	Name X and Y location	
Hospitals	Location of hospitals in study area	Name X and Y location A&E Present	If users' symptoms become severe and life-threatening, they may need to refer themselves to hospital
GP Surgeries	Location of GP surgeries in study area	Name X and Y location	If users require a doctor's appointment for diagnosis or advice

Red zone buffer – within 500m of University	Areas where there is a high risk of contracting mumps	Buffer distance Buffer category	High risk areas where users should strictly avoid to reduce their risk of catching mumps
Orange zone buffer: between 500m and 1000m	Areas where there is a medium risk of contracting mumps	Buffer distance Buffer category	Medium risk areas where users should try to avoid to reduce their risk of catching mumps
Green zone buffer: between 100m and 1500m	Areas where there is a low risk of contracting mumps	Buffer distance Buffer category	Low risk areas where users do not need to avoid
Townsend Index	Index of material deprivation	Combines four census-based variables (households with a car, overcrowded households, households which are not owner-occupied and unemployment)	To assess higher risks areas due to deprivation factors

Table 1: Datasets for the LBS system

2.4 Creation of LBS

2.4.1 Creation of University location buffer zones

In the previous project, students were identified as an at-risk population, capable of easily contracting and spreading mumps. Therefore universities, where students spend much of their time and often live, are locations where a person would be more likely to contract mumps. The university location buffer zones were created through the buffer layer tool. This allows for a buffer to be created around features in a table (Figure 2). The table selected is “uni stats” which is the universities point dataset (Table 1).

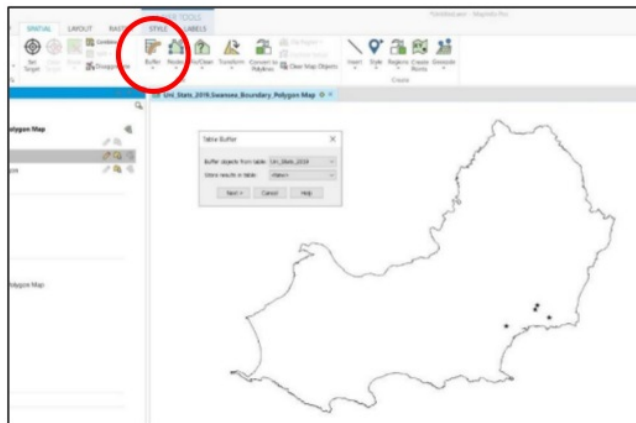


Figure 2: Creation of risk buffers

The option to create a new table structure is selected and the existing fields; Buffer_Name, Distance and Description were added (Figure 3) to the new table.

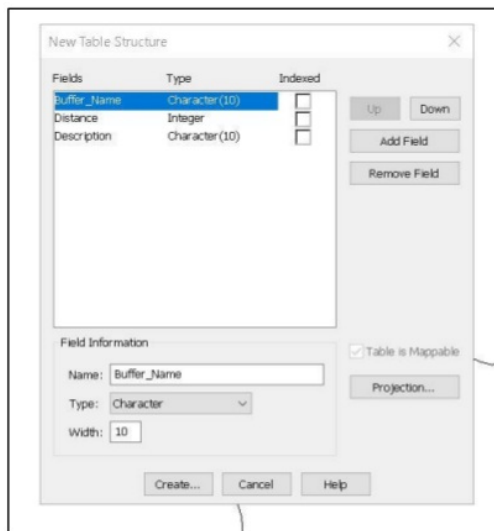


Figure 3: Creation of buffer table structure

The 'value' sets the buffer distance in metres around the university point locations. This was gradually increased to clearly communicate the risk level to users, with the red zone starting at 500m around universities.

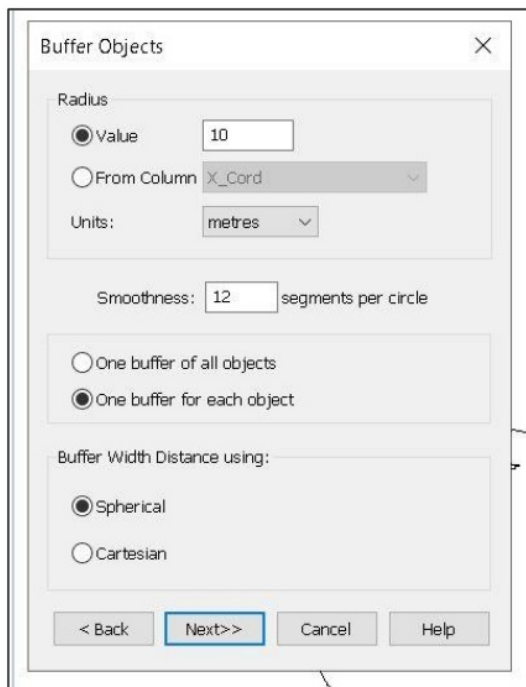


Figure 4: Creation of buffer objects

The risk buffer zones can be seen below (Figure 5); these quickly and clearly show users areas they should avoid to reduce their risk of contracting mumps.

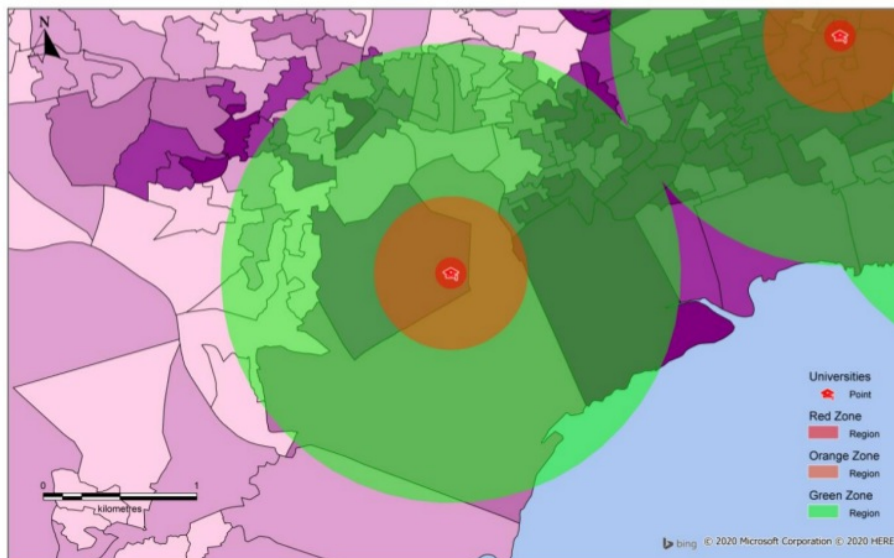


Figure 5: Overview of Buffer Zones around Universities

2.4.2 Boundary Selection

The Boundary Selection tool (Figure 6) restricts the view of datasets to only show data within the study area; in this case clipped to the Swansea boundary. This can ensure that users are only seeing relevant data and not overwhelmed with unnecessary information.

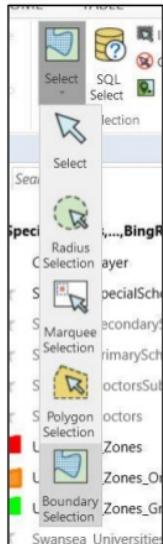


Figure 6: Boundary Selection Tool

The dataset illustrated in Figure 7 is Swansea hospitals, this has been clipped to solely display hospitals in Swansea area.

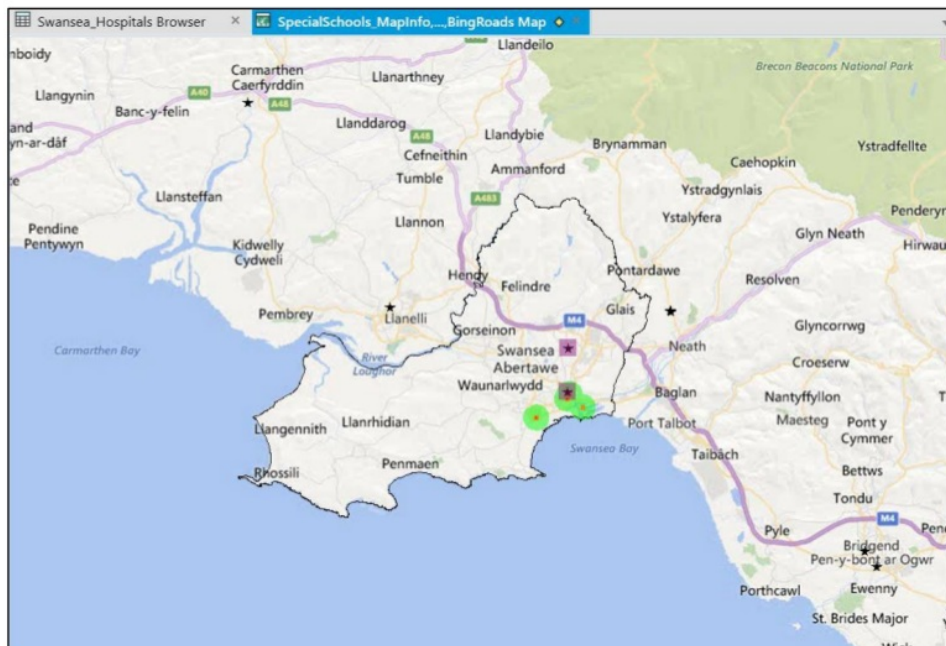


Figure 7: Boundary Selected Tool (Existing dataset covering Wales)

The table is exported in a mif file format to export only relevant data (Figure 8).

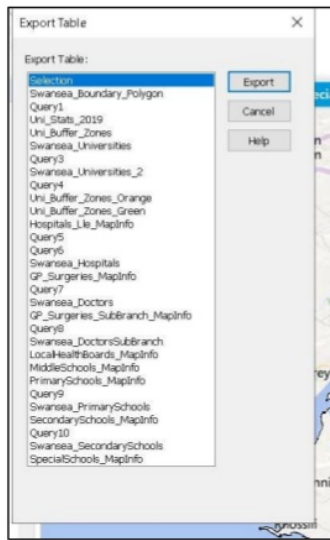


Figure 8: Export table

The table is then opened and imported into the current workspace and saved as a tab file (Figure 9).

gid	school_cod	sch_name	lea_name_e	lea_name_c	school_typ	school_ty0	gender_mix	school_lan
873	6707000	Ysgol Pen-y-Bryn	Swansea	Abertawe	Special (with post-16 provision)	Arbennig gyda darpariaeth A'1-16	Mixed	Not applicable
874	6707008	Ysgol Crug Glas	Swansea	Abertawe	Special (with post-16 provision)	Arbennig gyda darpariaeth A'1-16	Mixed	Not applicable

Figure 9: Tab file for the table

2.4.3 Creation of Web Pages

MapInfo2Leaflet was installed as an add-on to export tables to a web map application, which is the platform which hosts the LBS and where users can access it. Mapinfo2Leaflet creates interactive maps which are mobile friendly using the JavaScript library. It allows for MapInfo tables to be exported to a web map application (Figure 10). The output is formed of 3 elements; html file, json file containing the features and css file for styling [7].

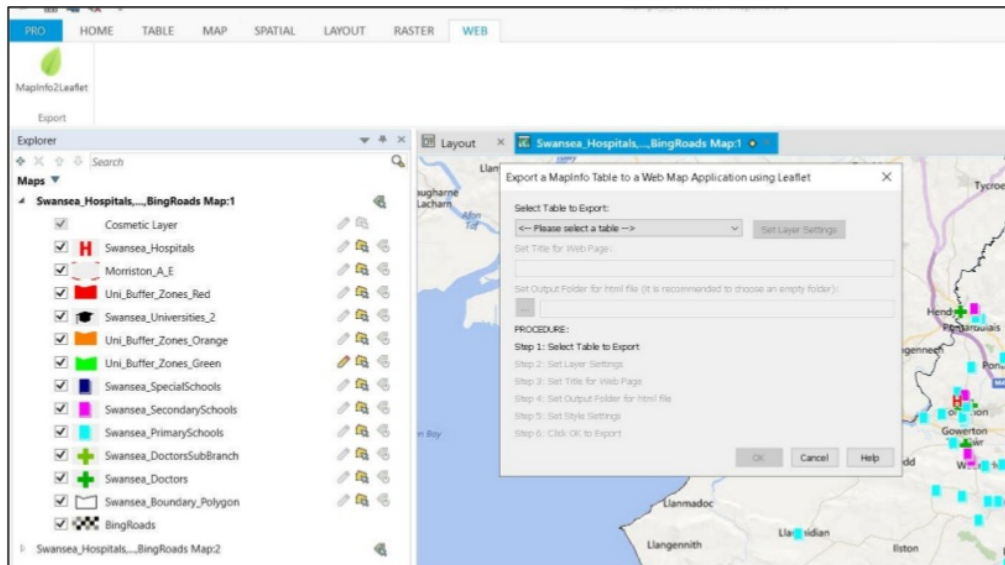


Figure 10: Table selection to export

Once the relevant table has been selected, the following elements are completed in the 'Layer Settings' window (Figure 11) in order to customise the webmap application:

- Map Title
- LayerGroup Name
- Columns to be added to popup
- First column in popup to be shown in bold
- Tooltip selection

The example (Figure 11) is based on the Swansea doctors data set.

Layer Settings

☒ Map Title: Doctors

LayerGroup Name (in Leaflet Layers Control): Swansea Doctors

Columns Not to be Added to Popup:

ogrfid
easting
northing
doctor
valid

Add >

Add All >>

< Remove

<< Remove All

Columns to be Added to Popup:

Name
Address
Address1
Address2
Address3
Postcode
Telephone
Telephone1

Hyperlink:

Column:

Alias:

Remove Hyperlink

☐ Same Window

☒ New Window or Tab

☐ Zoom in to marker/feature on click

Popup:

☐ Add Column Names

☒ First Column Bold

Thematic Legend:

Title:

Sub Title:

Tooltip: Name

OK Cancel Help

Figure 11: MapInfo2Leaflet Layer Settings

The overview window confirms the tools 6-step procedure before proceeding to create the webpage (Figure 12).

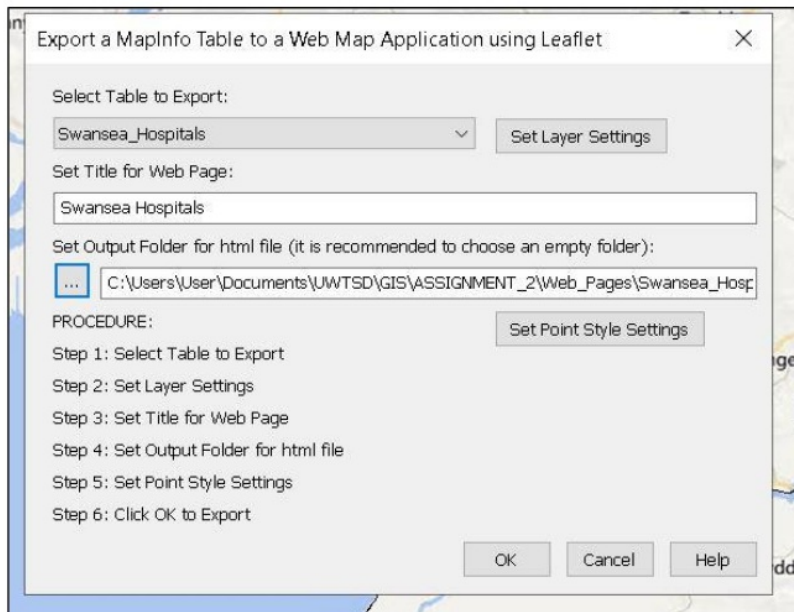


Figure 12: Final confirmation prior to exporting

Figure 13 displays the finished Web Page layout; this one shows doctors in Swansea and their details based on the dataset table with GIS. This allows users to quickly access the location and contact details of doctors who they may need to reach out to if they suspect they have contracting mumps or if they need to enquire about their vaccination records. However, appropriate advice should be included regarding contacting doctors during an outbreak (i.e. phoning first to see if you should visit in person).



Figure 13: Creation of Web Page

2.4.4 Creation of HTML Web Pages

An alternative method was trialed for creating Webpages. Some HTML Web Pages were created using HTML Image Map which uses MapBasic to create customised applications for MapInfo [8]. To create HTML web pages, topography maps from Digimap through the Ordnance Survey are first downloaded to provide detailed background imagery. Morriston Hospital was the focus of this WebPage in order to provide users with details of the main A&E Hospital in Swansea (Figure 14).

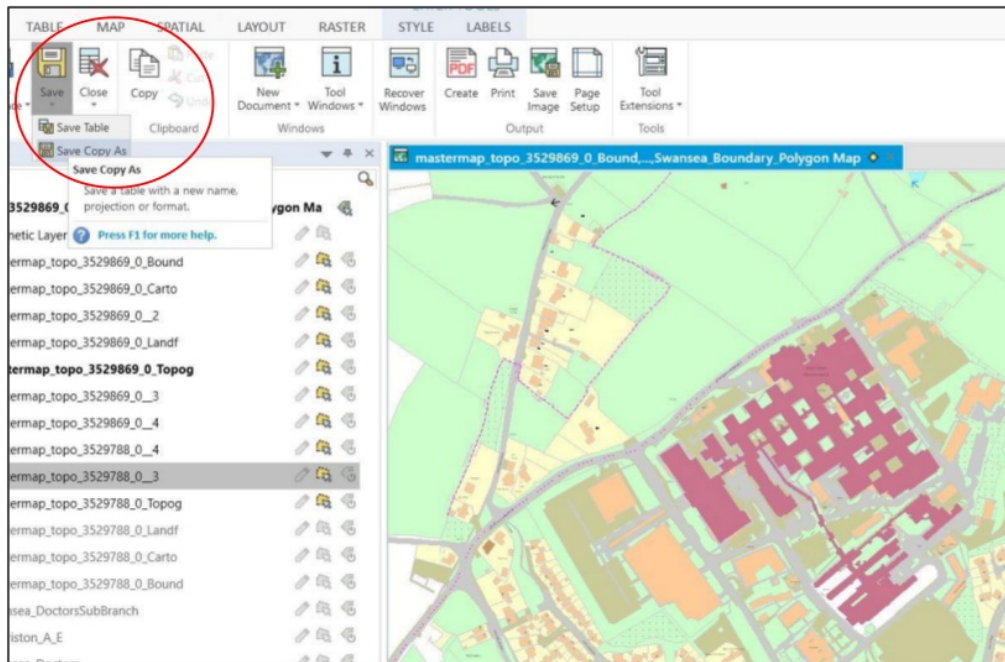


Figure 14: Creating new database

When exporting the table containing Morriston Hospital, changes were made to ensure the data is content specific and user relevant (Figure 15).

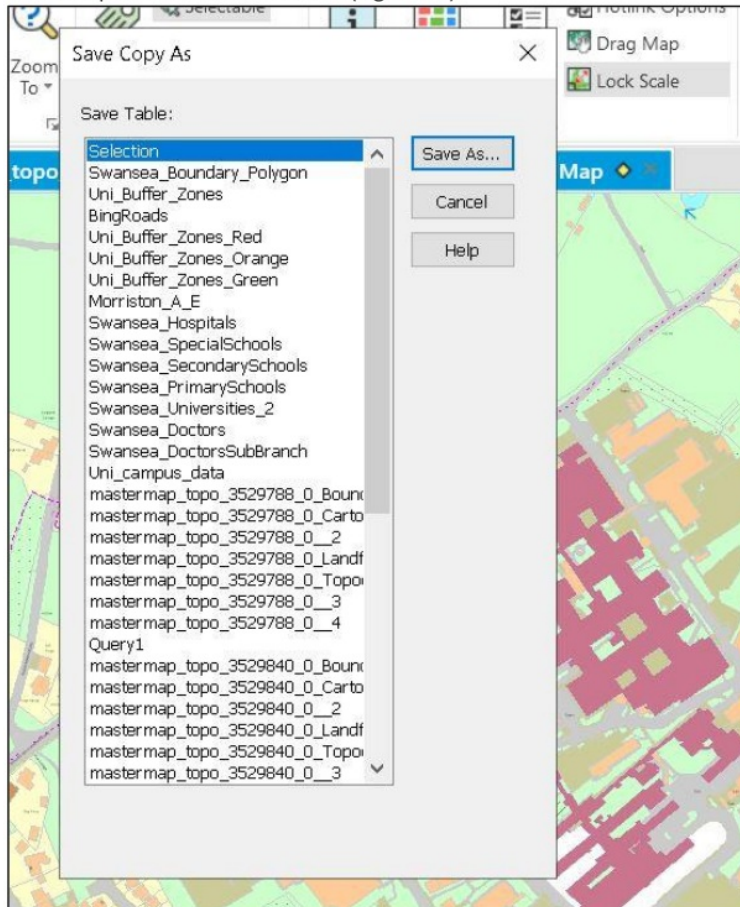


Figure 15: Naming the database

The Hospital table was modified to replace the existing columns names with a clear naming strategy, which would be useful for users utilising the LBS. The columns advise the user on the hospitals address, postcode, number, service hours and a link to their website (Figure 16).

ID	Name	Address	Postcode	Number	Type	Service	24Hr	Link
1000020650276	Morriston Hospital	Swansea, Heol Mae	SA6 6NL	01792 702222	A&E	Major A&E	24hour	https://sbuhs.nhs.wales/hospitals/our-hospitals/morriston-hospital/

Figure 16: Modifying the Table

To create the HTML web pages the HTML Image Map tool was utilised (Figure 17).

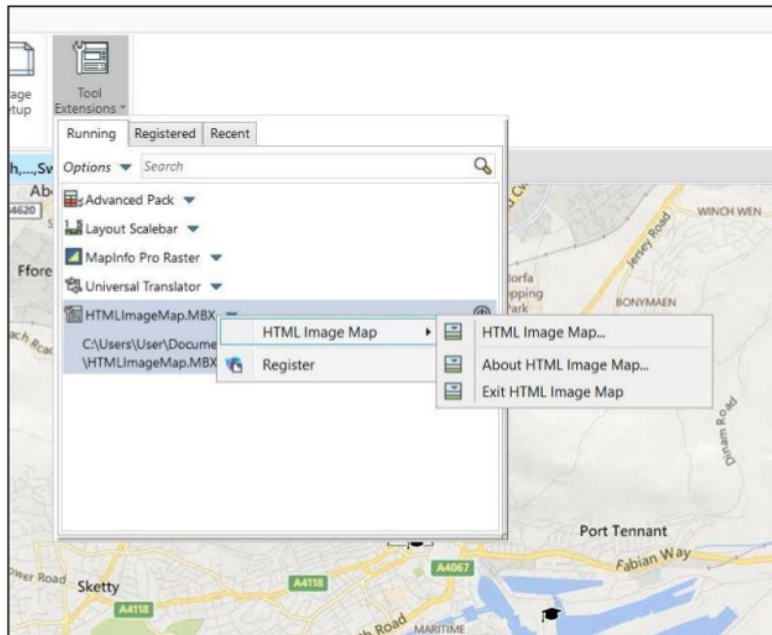


Figure 17: Creating the web page

The hospital table was selected and the following options implemented (Figure 18).

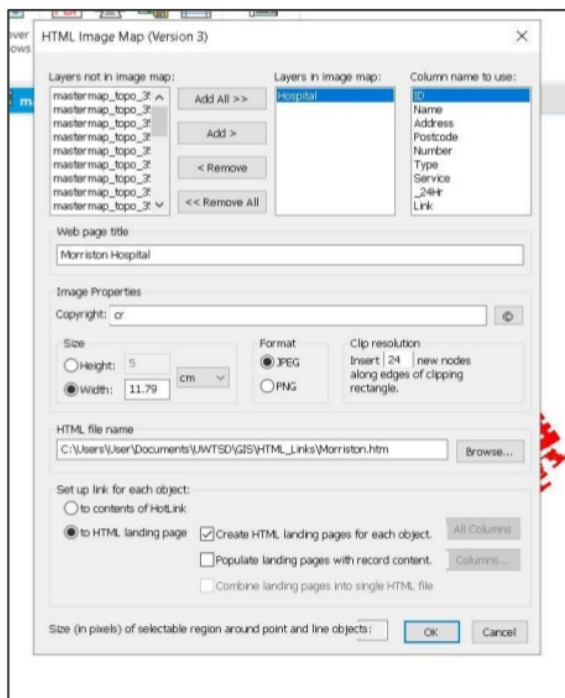


Figure 18: Selecting web page options

The Web Page is developed (Figure 19) and the outline of the Morriston Hospital site is shown. Upon clicking on the outline, the user will be directed to another Web Page containing useful hospital information such as address, telephone number, services available, opening times and a link to their website to access anything further (as seen in Figure 13).

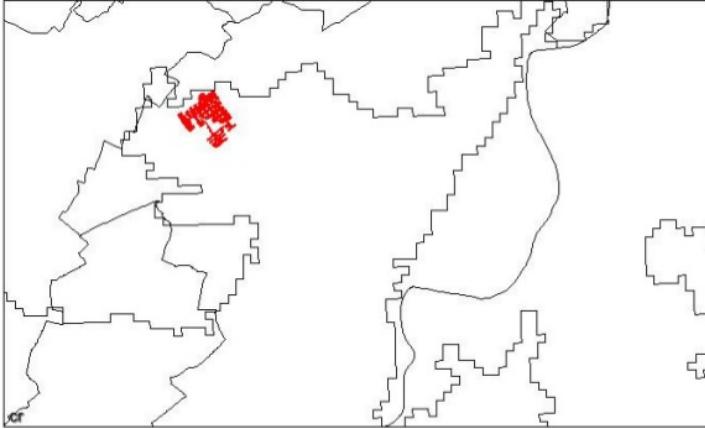


Figure 19: Web Page for Morriston Hospital

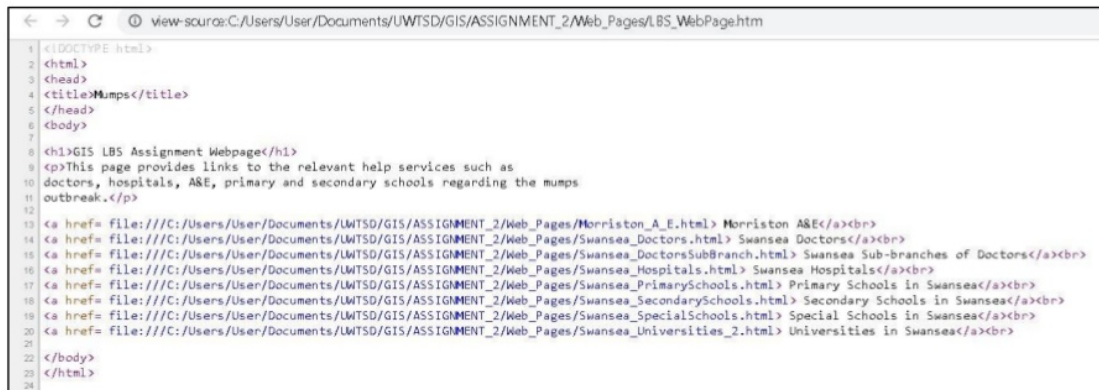
2.4.5 Creation of Front Web Page

The main directory webpage, which provides links to the range of web maps available within the LBS, was created using HTML programming language (Figure 20). These Web Pages are designed to provide users with information specific to tackling a mumps outbreak, such as Doctor Surgeries, Hospitals and the main A&E within Swansea. Moreover, information is provided for schools and universities; institutions which can provide students and their families with further information regarding any mumps outbreaks.



Figure 20: Main Directory Web Page

The code behind the web page is shown below (Figure 21).



```
1 <!DOCTYPE html>
2 <html>
3 <head>
4 <title>Mumps</title>
5 </head>
6 <body>
7
8 <h1>GIS LBS Assignment Webpage</h1>
9 <p>This page provides links to the relevant help services such as
10 doctors, hospitals, A&E, primary and secondary schools regarding the mumps
11 outbreak.</p>
12
13 <a href= file:///C:/Users/User/Documents/UWTSO/GIS/ASSIGNMENT_2/Web_Pages/Morriston_A_E.html> Morriston A&E</a><br>
14 <a href= file:///C:/Users/User/Documents/UWTSO/GIS/ASSIGNMENT_2/Web_Pages/Swansea_Doctors.html> Swansea Doctors</a><br>
15 <a href= file:///C:/Users/User/Documents/UWTSO/GIS/ASSIGNMENT_2/Web_Pages/Swansea_DoctorsSubBranch.html> Swansea Sub-branches of Doctors</a><br>
16 <a href= file:///C:/Users/User/Documents/UWTSO/GIS/ASSIGNMENT_2/Web_Pages/Swansea_Hospitals.html> Swansea Hospitals</a><br>
17 <a href= file:///C:/Users/User/Documents/UWTSO/GIS/ASSIGNMENT_2/Web_Pages/Swansea_PrimarySchools.html> Primary Schools in Swansea</a><br>
18 <a href= file:///C:/Users/User/Documents/UWTSO/GIS/ASSIGNMENT_2/Web_Pages/Swansea_SecondarySchools.html> Secondary Schools in Swansea</a><br>
19 <a href= file:///C:/Users/User/Documents/UWTSO/GIS/ASSIGNMENT_2/Web_Pages/Swansea_SpecialSchools.html> Special Schools in Swansea</a><br>
20 <a href= file:///C:/Users/User/Documents/UWTSO/GIS/ASSIGNMENT_2/Web_Pages/Swansea_Universities_2.html> Universities in Swansea</a><br>
21
22 </body>
23 </html>
```

Figure 21: Code for Main Directory Web Page

3. Data analysis & results discussion

One of the main findings from the Swansea Mumps GIS was that students are a vulnerable population in terms of contracting and also spreading mumps. They live in the most densely populated and deprived areas of Swansea City Centre, which is where University Campuses are also predominantly located. Therefore, one place where we can be certain Students spend a lot of their time is in University and these locations should be avoided as much as possible during a mumps outbreak.

The LBS communicates this risk to its users using RAG (Red-Amber/Orange-Green) categorised buffers (Figure 22). The red buffer indicates the areas which are most likely to contain large student populations and therefore where you are most at risk of contracting mumps, the amber/orange buffer indicates where you are at medium risk and the green buffer contains areas which are sufficiently far from the campuses that you are no longer at significant risk, so are deemed low risk. If someone is deemed vulnerable or is unvaccinated then they can use this system to avoid high or medium risk areas. Furthermore, health organisations can use these buffers to decide where to focus combating resources (such as a vaccination programme or advertisements).

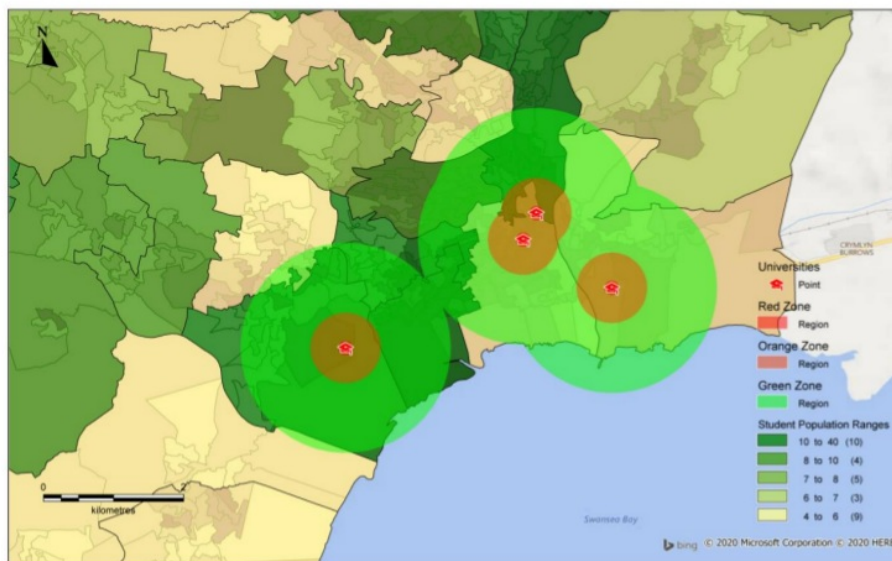


Figure 22: Buffer zones and MSOA Ranges by Student Population

Figure 23 shows the relationship between 1st doses of MMR and the university buffer zones. The map shows that the universities are located in low vaccination areas. This puts the students and others in these areas at high risk of contracting mumps and reinforces the accuracy of the risk buffers.

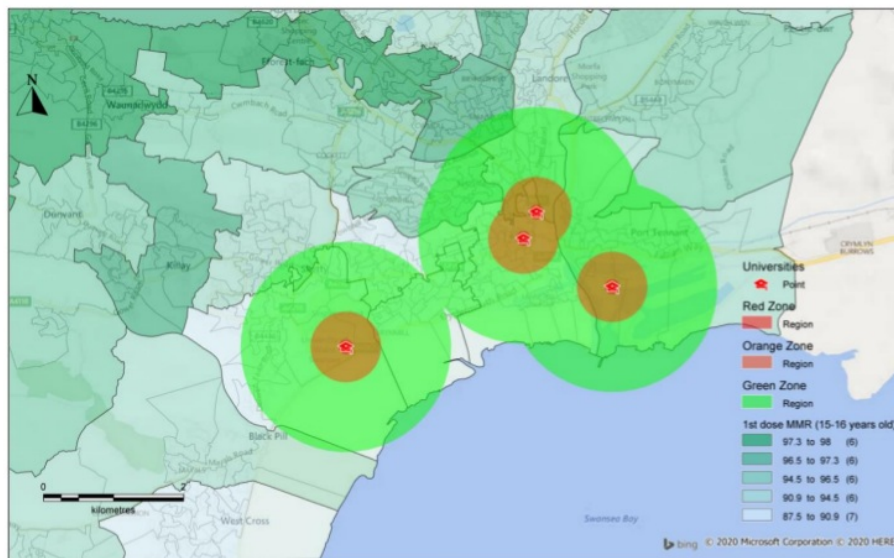


Figure 23: Buffering Zones and 1st dose MMR data

The risk buffers concept can also be expanded to cover the whole of Swansea using a heat map. This may be useful for health organisations, Swansea council etc. as a way to view an overview of the risk in Swansea.

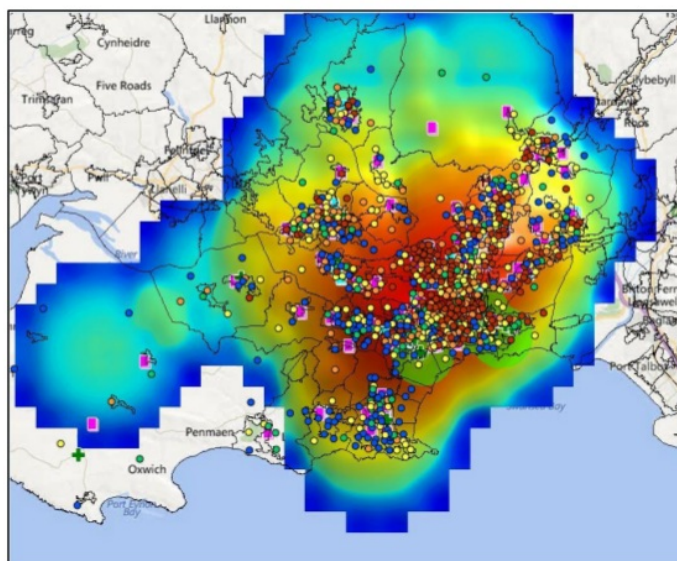


Figure 24: Heat Map of Immunisation

Figure 25 shows that the two of the university campuses are located within high immunisation rates for 2nd doses of MMR. However effective vaccination requires two doses of MMR, so these areas are still at risk. Further analysis is required to determine why the rates between the first and second doses are contradicting and establish an accurate vaccination rate for these areas. However it is always better to take a precautionary approach, so the LBS will assume these remain high-risk areas until reliable data is available.

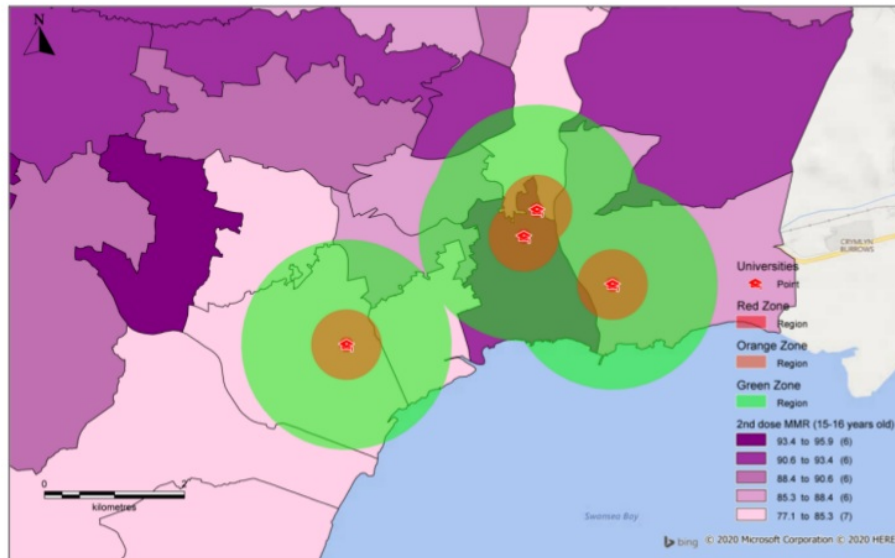


Figure 25: Buffering Zones and 2nd dose MMR

Figure 26 show the university locations in relation to levels of deprivation (Townsend Index). Deprived areas are more likely to be densely populated, overcrowded, impoverished and mix with student populations. The Swansea Mumps GIS previously found that these areas were also less likely to be vaccinated due to lower education levels and belief in the 'anti-vax movement'. Figure 26 shows that the universities are located within areas of high levels of deprivation which puts residents here at high risk, as researched in the original GIS Mumps Project.

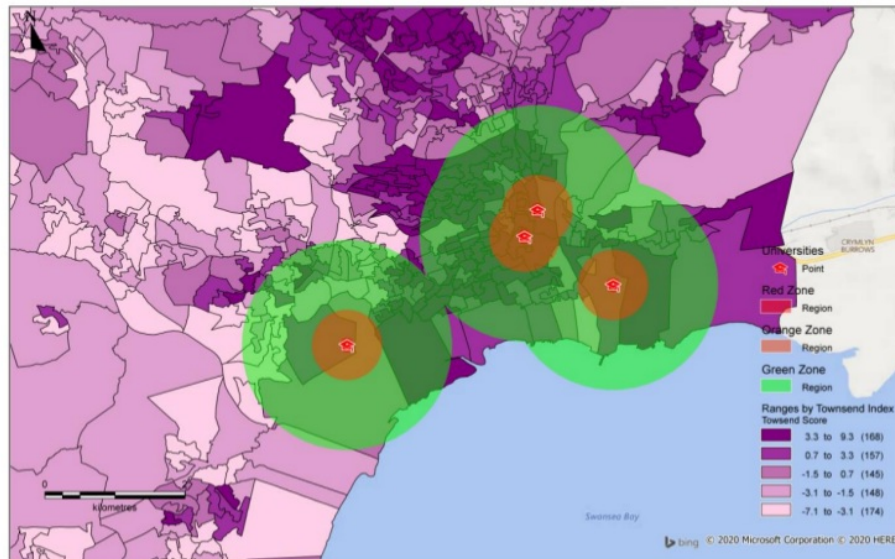


Figure 26: Buffering Zones and Townsend Index

3.1 MapInfo2Leaflet Vs MapBasic Approach

MapInfo2Leaflet provides users with an interactive map containing various points of interests and the ability to zoom in and out of the map and pan to areas local to them. If the user clicks on the blue arrow icon, they are provided with details of the point of interest easily and efficiently (Figure 13). The steps with this tool has further options for customisation, such as which table columns to include, heading etc.

On the other hand, the MapBasic webpage provides the user with an outline of the relevant site locations. The user then clicks within the outline and they are navigated to a separate webpage containing a table of information about the item. The site location webpage contains a static map that cannot be panned or zoomed to other locations. Therefore, it requires the creation of further separate maps to show other areas, which does not make this an efficient way to navigate the Swansea area (Figure 19). This could be improved by making use of the API (Application Programming Interface) interactions available, in particular a Geolocation API which will pan the map to the user's location.

Therefore, the MapInfo2Leaflet was deemed a more suitable tool in this case for efficiently creating an LBS system, as it is tailored for use with MapInfo and is an easy tool to operate. This in-turn provides users with a better performing LBS system.

4. Recommendations

There are several recommendations which could improve this LBS for users that were outside the scope of this project:

- It is suggested that the LBS implement appropriate icons to easily communicate and distinguish to users' locations which are high risk as well as locations which provide medical assistance (Figure 27). These could be incorporated through amending the HTML code.

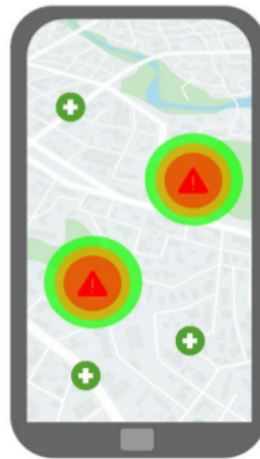


Figure 27: LBS Prototype

- The LBS could include additional capabilities for tracking Mumps in Swansea, similar to the NHS Tracing App currently implemented for the coronavirus outbreak to digitally contact/trace on a large scale. This will alert users if they have been within close contact with an individual who has contracted mumps and users can also declare cases of mumps to help others avoid these areas. [9].
- A 'go to my location' button (Geolocation API using a location data event) which pans and zooms the map to the user's current location so that they can view information relating to where they are there and then.

5. Conclusion

As demonstrated, utilising location intelligence is key in tackling the spread of viruses. This is because it allows users, whether these are ordinary citizens or health organisations, to retrieve useful location-based information efficiently which they can use to help slow the spread of mumps. Depending on the user, this could be by avoiding high-risk areas to reduce their risk of contracting and spreading mumps or, in terms of organisations, they can use the LBS to better focus resources to tackle areas of low immunisation.

Furthermore, the LBS provides its user with information on geographical location-based services such as GP'S and Hospitals, should they need them. Each of the features within the LBS aims to provide timely and accurate information to inform and help users act strategically in addressing a mumps outbreak. This makes it an invaluable tool which, if implemented correctly, can directly reduce the spread of a virus. As shown, the MapInfo2Leaflet tool proved useful in converting the Swansea Mumps GIS into a working LBS application.

6. References

- [1] B. Jiang and X. Yao, "Location Based Services and GIS in Perspective," *Computers Environment and Urban Systems*, pp. 712-725, 2016.
- [2] B. Sadoun and O. A. Al-Bayari, "LBS and GIS Technology Combination and Applications," *Computer Systems and Application*, 2007.
- [3] R. India, "Relation between GIS and LBS," Rose India, 2020. [Online]. Available: <https://www.roseindia.net/technology/LBS/relation-between-gis-lbs.shtml>. [Accessed March 2020].
- [4] Atos, "Towards 3D location-based services," White paper, 2011.
- [5] R. M. R. K, "Application of Mobile Mapping and Location Based Services for Dehradun Health Services," *Mobile Computing*, vol. 2, no. 2, 2013.
- [6] Esri, "Informing COVID-19 Response with Location Intelligence Webinar," in *Respond to COVID-19 with Location Intelligence Webinar*, 2020.
- [7] E.-J. Polle, "MapInfo2Leaflet," Pitney Bowes, 2020. [Online]. Available: <https://communitydownloads.pbinsight.com/code-exchange/download/mapinfo2leaflet/>. [Accessed 8 May 2020].
- [8] P. Bowes, "MapBasic v17.0.3 Download," Pitney Bowes, 21 June 2019. [Online]. Available: <https://www.pbinsight.com/support/product-downloads/item/mapbasic-v17.0.3-download>. [Accessed 8 May 2020].
- [9] H. Chowdhury, M. Field and M. Murphy, "NHS contact tracing app: how does it work and when can you download it?," *Telegraph*, 8 May 2020. [Online]. Available: <https://www.telegraph.co.uk/technology/2020/05/08/nhs-contact-tracing-app-coronavirus-how-download/>. [Accessed 8 May 2020].
- [10] G. Gartner, W. Cartwright and M. P. Peterson, *Location Based Services and TeleCartography*, Springer Science & Business Media, 2007.
- [11] N. Shah, "Location Based Services Part I: Technologies in Wireless Networks," *Technowizz*, 3 January 2010. [Online]. Available: <https://technowizz.wordpress.com/2010/01/03/lbs-technologies-part-1/>. [Accessed 14 April 2020].

FINAL GRADE

80/100

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>	20	16
An excellent and well-focused report. 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 gone beyond the remit and discussed location-based services in the context of our current situation. You demonstrate a sound understanding of the use of GIS software in epidemiology type studies.		

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> Again, you have researched many different areas to obtain differing datasets. You have justified your choice and discussed the relevance of each set when constructing an LBS using GIS software. Exploring the Lle dataset has added value to the overall analysis.	20	17
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 have used and demonstrated an understanding of several different processes for data collection. Your dataset and therefore map layers demonstrate sound judgement of the data requirement for such a study.	20	17
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> Excellent use of the software. You have explored many methods of adding data. Your workspace works well and is informative. Good use of visualisation of the data through the various layers and searches. This demonstrate a very good understanding of the datasets and the ability to look for correlations within the data. You have explore the build of a website and within the given time and difficult circumstances you have produced some good results using leaflet. Maybe a bit more exploration of the HTML build via the database fields would have allowed for better information on the landing pages. Generally, this section has been completed to a very high standard.	35	25
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 very high standard well throughout practical solutions and a well-documented report of you work	5	5
--	---	---

PAGE 1
PAGE 2
PAGE 3
PAGE 4
PAGE 5
PAGE 6
PAGE 7
PAGE 8
PAGE 9
PAGE 10
PAGE 11
PAGE 12
PAGE 13
PAGE 14

PAGE 15

PAGE 16

PAGE 17

PAGE 18

PAGE 19

PAGE 20

PAGE 21

PAGE 22

PAGE 23

PAGE 24

PAGE 25

PAGE 26

PAGE 27
