Modelling Access with GIS in Urban Systems
The project aims were to develop, test and apply a Geographical Information System (GIS) for modelling access for wheelchair users in urban areas.

The system has been designed to:

• provide planners and other users (e.g. other disabled groups) with a tool for evaluating the effects of urban planning and development

• help local authorities and disabled groups to produce up-to-date maps on access for the disabled to urban areas;

• provide a basis for a fully interactive route-finding system that will allow wheelchair users to assess, compare and select routes through urban areas, which best meets their individual circumstances and needs.
Northampton Town Centre
Qualitative data

For use by both wheelchair users and urban planners, although clearly the knowledge of the subject lies predominately with one user group

- 400 wheelchair users were contacted from across the county and invited to complete a postal questionnaire.
- Emergent themes and issues were explored in focus groups, of 6-8 participants.

Route assessment and modelling package should be usable by both computer experts and non-experts

- A goal for the user interface was to create a simple, and straightforward structure
Percentage of questionnaire respondents who found urban barriers to be severe and prohibitive

- Steps: 31%
- High kerbs: 76%
- Deep gutters: 2%
- Gravel surfaces: 35%
- Lack of dropped kerbs: 3%
- Narrow pavements: 50%
- Steep gradients: 19%
- Difficult cambers: 75%
- Cobbled surfaces: 31%
- Congested pavements: 76%
- Raised manhole covers: 56%
- Uneven paving slabs: 56%
- Street furniture: 43%
- Handrails not on ramps: 42%

% of respondents who found the barriers either prohibitive or severe
Quantifying findings

Urban barrier

- Surface Type
- Surface Quality
- Supervised crossings
- Steps
- Deep gutters
- Raised manhole covers
- Cambers
- Street furniture that obstructs
- Ramps
- Dropped kerbs
- Slopes

Quantification

- Categorised by measures of rolling resistance
- Categorised features mapped by location
- Classed using a matrix
- Line in DEM grid overlay
The rolling resistance of six surface types was measured.

Where lower force readings represented easier passage (mobility)

<table>
<thead>
<tr>
<th>Surface type</th>
<th>Quality</th>
<th>Avg.</th>
<th>Range</th>
<th>Avg.</th>
<th>Range</th>
<th>Avg.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>Good</td>
<td>3.5</td>
<td>3-4</td>
<td>6.54</td>
<td>5.24-8.50</td>
<td>7.27</td>
<td>5.44-10.08</td>
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<tr>
<td>Paving</td>
<td>Good</td>
<td>4.5</td>
<td>4-5</td>
<td>7.53</td>
<td>3.85-11.82</td>
<td>9.70</td>
<td>6.55-13.51</td>
</tr>
<tr>
<td>Brickwork</td>
<td>Good</td>
<td>7</td>
<td>5-8</td>
<td>9.59</td>
<td>5.25-13.93</td>
<td>10.52</td>
<td>7.02-14.02</td>
</tr>
<tr>
<td>Tarmac</td>
<td>Good</td>
<td>7</td>
<td>5-10</td>
<td>11.97</td>
<td>8.43-19.48</td>
<td>16.72</td>
<td>7.36-14.43</td>
</tr>
<tr>
<td>Grass</td>
<td>Poor</td>
<td>15</td>
<td>10-20</td>
<td>26.62</td>
<td>18.51-32.61</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Gravel</td>
<td>Poor</td>
<td>20</td>
<td>10-30</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Drop kerbs - aspects of the matrix

1. Height
2. Surface
3. Slope
4. Camber
5. Width
6. Orientation
7. Curvature
8. With Bullnose
9. With Brickrunners
10. Qualitative Findings
Digital data

Ordnance Survey data:

• Land-line data (at 1:12 50) resolution
• Digital Elevation Data
The data storage

The database was constructed within ARC/INFO using dynamic segmentation.

Each pavement is stored as a route, along which the features or ‘attributes’ are linked.

These attributes can be either the linear measures along the route, or point events associated with the route at measure locations.

<table>
<thead>
<tr>
<th>Record</th>
<th>STREET</th>
<th>SURFACE-TYPE</th>
<th>SURFACE-QUALITY</th>
<th>FROM-MEAS</th>
<th>TO-MEAS</th>
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<tbody>
<tr>
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<td>3</td>
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<td>3</td>
<td>3</td>
<td>48.183</td>
<td>51.022</td>
</tr>
</tbody>
</table>
Quantifying findings

Urban barrier
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Digital Storage
- Linear event table
- Point event table
- Fixed topology
The GIS System - using ArcView

- Built entirely within ESRI™ ArcView® GIS, using AVENUE™ programming language and Dialog Designer

- Users are led through the system by these menus so no knowledge of ArcView® or GIS is required

- All choices are made using well-spaced ‘buttons’ with each displaying a simple textual description of the option

- The Microsoft® accessible tools were used to enable users to navigate using the mousekeys if preferred to a mouse
Wheelchair Types

Three categories of wheelchair are recognised:

- Manual
- Powered
- Manual Assisted

• A self-assessed classification is made to refine user characteristics
The user may select a route in either of two modes; an optimal ‘from-to route’, or ‘all wheelchair accessible routes outwards’ from a specified location.
Route Finding: The Interface
Welcome to MAGUS

The MAGUS system is a fully interactive route-finding system that can be used to:
- evaluate the effects of urban planning and development (e.g. road building, construction, changes in traffic management, urban geometry etc) on access for wheelchair users;
- produce up-to-date maps on access for the disabled to urban areas;
- assess, compare and select wheelchair accessible routes through Northampton town, which best meets individual circumstances and needs.

Are you new to Northampton? Have a look at the town map... You can return to this page once you have looked at the map [click the button that will appear top left].

How do I use the MAGUS system? It's simple. All you need to know is where you want to go and the type of wheelchair being used. Remember there is always help at hand. Just hover the cursor over any button you want to learn about and text will appear along the bottom of the screen. You can also print out the page [click print].

To START <click start> or READ-ON if you want to learn more. (If you have returned to this page from the main menu <click cancel> to return).

How do I get started? First you must give some brief details. <Click on the User Details> A wheelchair type and fitness level must be entered.

I want to visit several destinations? <Click on the To or From box>
A "From to Route" will determine the most accessible route between two or more destinations. You will be prompted to add the destinations either by entering them on the map or by entering the address.
Starting from Stop 0
- Travel on Gold Street R for 105.01 m
- Turn left onto Bridge Street C1
- Travel on Bridge Street C1 for 17.33 m
- Turn right onto Bridge Street L
- Travel on Bridge Street L for 64.22 m
- Turn right into Stop 1

Starting from Stop 1
- Turn left onto Bridge Street L
- Travel on Bridge Street L for 64.22 m
- Turn right onto George Row R
- Travel on George Row R for 129.86 m
- Turn left onto St Giles Square C1
- Travel on St Giles Square C1 for 1.74 m
- Continue straight onto St Giles Street C1
- Travel on St Giles Street C1 for 4.72 m
- Continue straight onto St Giles Square C1
- Travel on St Giles Square C1 for 3.75 m
The image shows a software interface for route planning. The user interface includes a menu with options such as 'Main Menu', 'Introduction', 'From-To Route', and 'Outward Route'. The main area of the interface displays a map with a route highlighted, showing a total journey length of 1242.43m. The 'Route Statistics' window indicates the following:

- Total journey length: 1242.43m
- Pavement Quality:
  - 697.61 m is good quality
  - 306.48 m is reasonable quality
  - 338.34 m is poor quality
- 0.8 m of ramps
- 12.2 m of cambers
- 2.3 degrees max. slope
- 7 raised manhole covers
- 14 areas of bad surface (< 1m)
Conclusions

To date a total of 20 wheelchair users and 5 planners have assisted with trialing MAGUS

- Twenty of these volunteers regularly used PCs
- The majority knew what a GIS was, although none had previously used any GIS software

Planners and wheelchair users gave very different feedback

- No one required assistance with navigation, although a number of the volunteers used the mousekeys
- All the volunteers felt that MAGUS was provided a useful tool, and a number of users enjoyed using MAGUS
- All volunteers said that having used MAGUS, they would be confident using GIS in the future
Acknowledgements

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