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Paper2GIS: Going postal in the midst of a pandemic

Denwood, T.*¹; Huck, J.J.¹; and Lindley, S.¹

¹MCGIS, Department of Geography, University of Manchester

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Summary

It is widely agreed that using local knowledge and opinions can prove beneficial in the decision-making process, with various forms of Participatory Mapping being used to capture responses to spatial questions. However, remote participatory research is increasingly carried out using digital methods which can limit the involvement of those affected by digital divides. This research uses a novel, automatic self-digitising paper-based Participatory Mapping method to explore whether the accessibility needs of participants can be met whilst maintaining the potential for effective spatial analysis on the part of the researcher. As a paper-based, geographically specific approach this research could be conducted during the pandemic by post, with residents of the Outer Hebrides, UK.

KEYWORDS: Participatory Mapping, Sketch Mapping, PGIS, Accessibility, Digital Divides

1. Introduction

Participatory Mapping is an umbrella term for a range of methods used to collect and compile often complex and nuanced views, in response to spatial questions from a range of stakeholders (Brown & Kyttä, 2018). Such methods include Participatory GIS (digital mapping surveys), sketch mapping (drawing on a printed base map or satellite image) and mental mapping (freehand mapping without a base map). Whilst it is accepted across the literature as beneficial to include different parties in the decision-making process (for example in including local opinions in the siting of new energy infrastructure) balancing the needs of participants with the needs of decision-makers can pose a significant challenge (Huck et al., 2016). The objective of this research is to assess whether the capacity for spatial analysis of participatory data can be maintained whilst simultaneously prioritising accessibility for participants.

1.1 Accessibility in Participatory Mapping

Whilst there are a number of advantages to increasingly popular digital Participatory GIS (PGIS) approaches, such as the removal of temporal and geographical limits, it is not necessarily feasible (or

desirable) to approach spatial questions with highly technical solutions (Huck et al., 2014). Purely digital approaches may exclude those without a certain level of technical skill or access to computer technologies, or without high speed internet (Gottwald et al., 2016). These ‘digital divides’ are not only caused by differing access to digital technologies, but are inherently connected to wider social systems (van Dijk, 2020). For example a number of studies have found that those who tend to participate in participatory research fall into older age brackets (Gottwald et al., 2016), yet digital methods still dominate. This can prove challenging for some older adults due to physical difficulties such as reduced fine motor skills or visual impairments (White & Selwyn, 2013). It could be argued therefore that the use of a digital interface may not in fact be as effective as more low-tech alternatives in some situations.

Techniques like mental mapping can make an attractive alternative for gathering participant views. The emphasis on expression over precision places fewer demands on those who struggle to engage with digital Participatory GIS. However, this creates an important trade-off, namely the difficulty in carrying out subsequent quantitative spatial analysis on a dataset with no limitations on scale or notation (i.e. a formalised mode of presenting ideas as opposed to freeform ‘indication’). A system is therefore required which maintains the capacity for analysis whilst simultaneously being accessible for the participants. Gottwald et al. (2016) state that the use of more specialised, less traditional forms of Participatory Mapping will only improve public participation if all members of society are able to participate. This paper describes some initial reflections on a case study in which a novel, auto-extraction sketch mapping method is used to simultaneously maximise both accessibility and utility in the context of local environmental planning.

1.2 Case Study

The isles of Barra and Vatersay (Figure 1) are approximately 70 km² with a population of approximately 1,300 (CNE Siar, 2011).

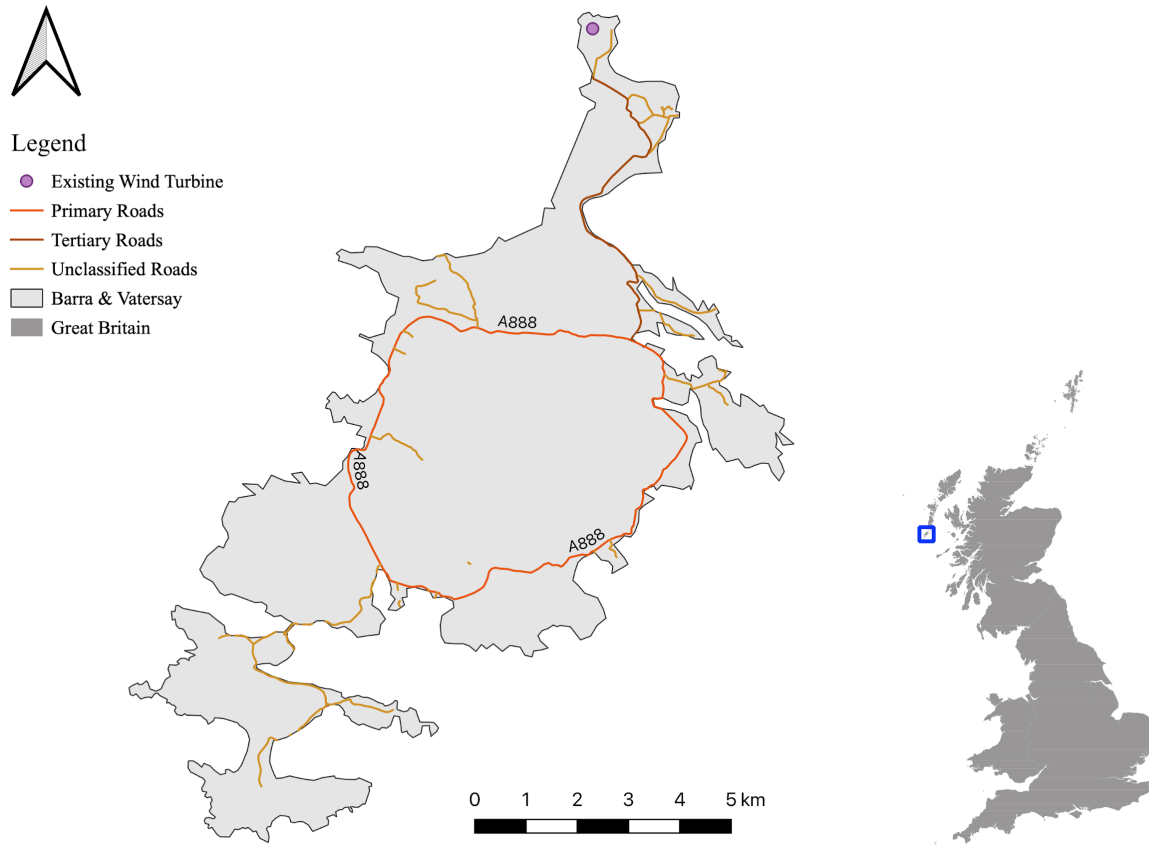


Figure 1 The isles of Barra and Vatersay, Outer Hebrides.

The isles provide a good opportunity to explore local environmental planning issues as there is pre-existing interest as indicated in the community produced energy plan, raising issues around energy consumption and production (Local Energy Scotland, 2018). Additionally, although this research is not focussing specifically on improving accessibility for older adults, the age demographic of the isles is that of an older population when compared to the rest of the UK (Gov.uk, 2011). This may therefore increase the potential impact that a paper-based method may have on participation by accommodating the needs of older residents, whilst also supporting subsequent digital analysis. Previous research for the same study area (Denwood et al., 2020), focussed on the challenge of representation in Participatory Mapping. This paper now focuses on accessibility.

2. Methods

Paper2GIS (<https://github.com/jonnyhuck/Paper2GIS>) is used for collecting and extracting geospatial data through the use of computer vision algorithms for the automated extraction, georeferencing and digitisation of markup from specifically designed paper maps. This is key, as the automated extraction of

participants' markup removes the potential for researcher bias and human error that are present in manual digitisation processes. Each step in the automated extraction of markup from paper maps using Paper2GIS is outlined in Figure 2.

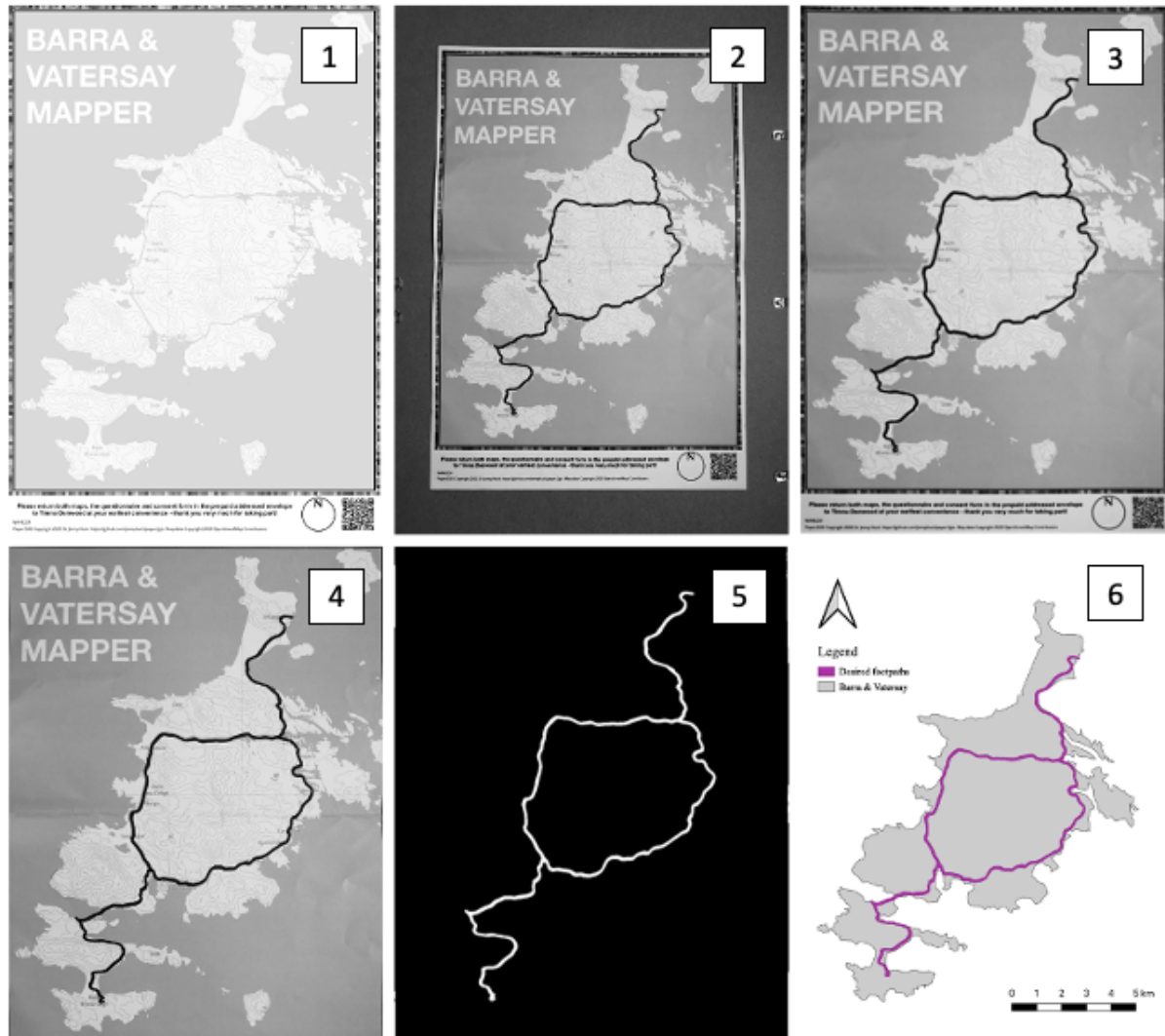


Figure 2 The input and extraction stages of Paper2GIS: 1) Reference map; 2) Photograph of participant map; 3) Extract page from (2) and transform to correct perspective distortion; 4) Extract map from (3); 5) Extract markup from (4); 6) Georeference and clean (5), then output to Shapefile or GeoTiff for Analysis

Paper-based data collection methods can be conducted remotely or in a facilitated situation. Therefore the research could still be conducted by post during the national COVID-19 lockdowns. Mapping materials along with explicit instructions regarding the notation required (lines or shading), consent forms and prepaid return envelopes were sent to 525 households on the isles (the number of addresses freely

available online) in November 2020. The research was advertised on a local Facebook group, but no incentive was offered for taking part. Residents on the isles were asked for their opinions on two questions raised by the Local Energy Plan, the answers to which were to be drawn on two separate A3 paper maps:

1. From which locations would you not wish to be able to see a wind turbine on the isles?
2. Where would you like new footpaths or pavements to be developed on the isles?

A questionnaire covering the reasons for choices made when drawing on the maps, feedback on the method itself and demographic information was sent alongside the mapping survey.

3. Results

At the time of writing 29 responses have been received, of which 28 provided demographic information (Figure 3). An initial assessment of the results and suitability of the method are presented below (to be expanded upon at the conference).

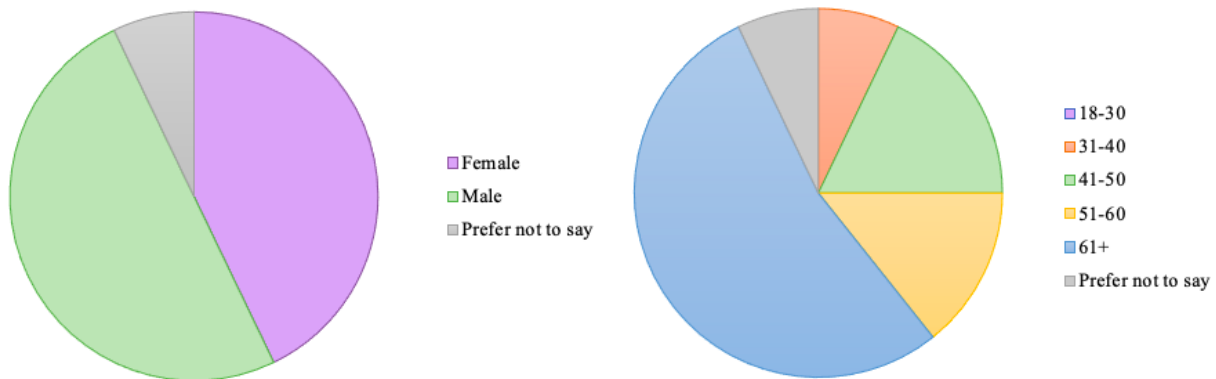


Figure 3 Demographic information for the 28 participants that provided questionnaire responses in addition to maps

The distinguishing factor between Paper2GIS and other sketch mapping methods is the automatic digitisation process, which is not only advantageous in terms of efficiency, but also negates the need for intermediate classification or interpretation, removing inherent bias that may be caused by the positionality of the researcher. Figure 4 gives one participants' responses to the two questions asked as an example of the data extracted.

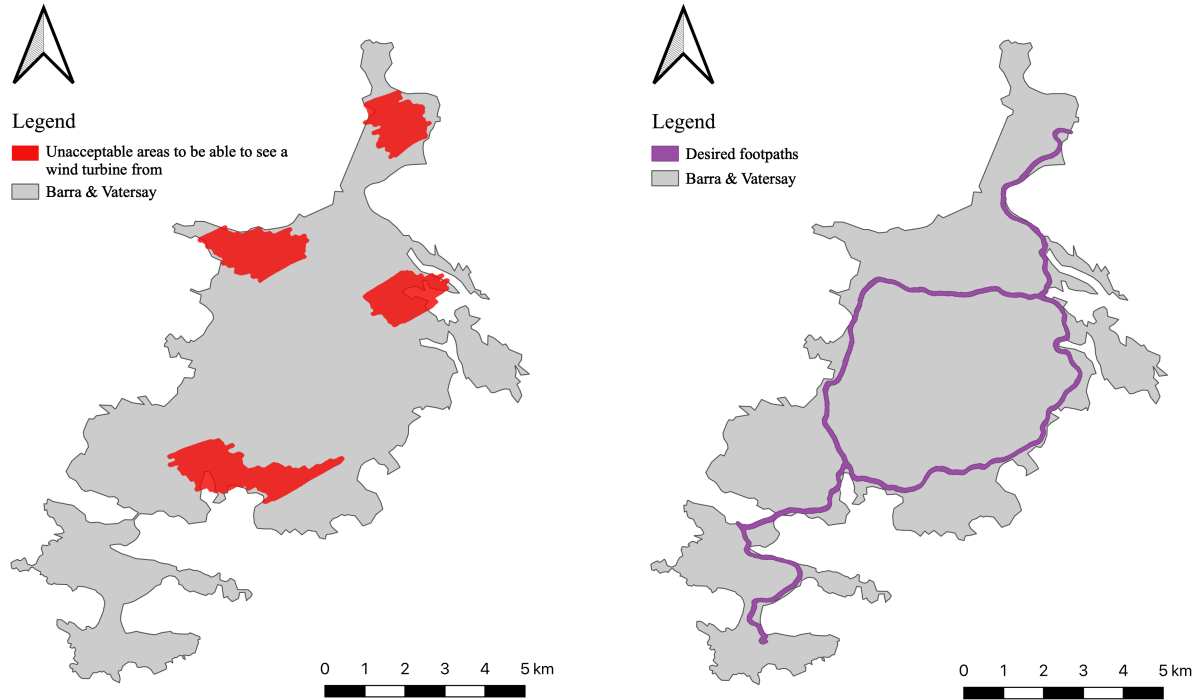


Figure 4 Two maps produced by one participant from the isles of Barra and Vatersay, indicating where they would like new footpaths and from where they would not want to be able to see a wind turbine

The maps in Figure 4 are indicative of the responses received thus far, with this participant not wanting to see a wind turbine from the residential areas of the isles or picturesque beaches; and exhibiting a desire for paths to follow alongside the existing roads for improved pedestrian safety. Feedback provided in the questionnaire was positive, with the participant stating the method was, *"accessible by all who wish to participate whether they have internet access or not and whether mobile or not"*. Conducting the research by post did add challenges, such as the increased time taken to collect data and the removal of interaction between researcher and participants. Nevertheless, this approach meant that research could be continued in a safe and geographically specific manner that enabled older participants to take part without leaving their homes as is clearly indicated in the age demographics of Figure 3.

4. Conclusion

Paper2GIS provides an accessible method for collecting hand-drawn participatory spatial data, which analysts can easily extract without bias or deviation from the views of the participant. Whilst not without difficulties, the preliminary findings suggest that paper-based methods of Participatory Mapping still have an important place in an increasingly digital world.

5. Acknowledgements

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Biographies

Timna Denwood is currently a third year PhD student in the School of Environment, Education and Development at the University of Manchester. She is part of the Power Networks CDT and interested in developing tools to improve representation and value in Participatory Mapping.

Jonny Huck is a Senior Lecturer in Geographical Information Science at the University of Manchester, with research interests in the representation of vague geographical entities in GIS and the application of geospatial technologies for the provision of humanitarian aid in the global south.

Sarah Lindley is a Professor of Geography at the University of Manchester, with research interests in environmental processes and geographical information science.