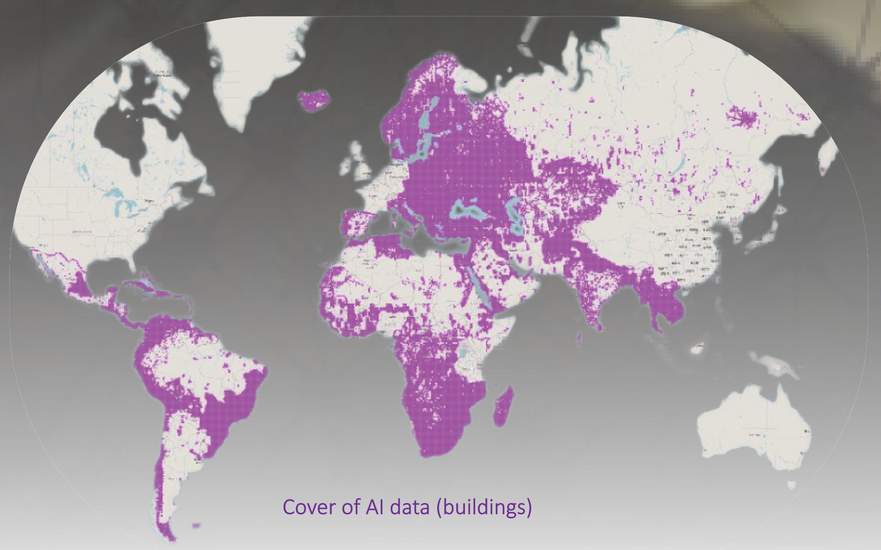
THE USE OF ARTIFICIAL INTELLIGENCE FOR HUMANITARIAN MAPPING



Cover of AI data (buildings)

Introduction

There are several crisis areas in the world. These crisis can be caused by natural disasters, epidemics of various diseases, water and food shortages, armed conflicts, changes in political regimes and other causes, to a greater or lesser extent. However, a large part of the sites is not mapped. For quick intervention and timely assistance, areas need to be mapped as accurately and quickly as possible (mostly roads and buildings). Volunteers (mappers) from all over the world, who map over satellite images (Bing, Maxar Premium) under the auspices of the HOT (Humanitarian OpenStreetMap Team) and participate in the mapping. Microsoft is working to streamline and simplify mapping with artificial intelligence (AI), which automatically generates data for buildings (so far tested in several countries), and Facebook, which automatically generates data for travelling around the world. Volunteer mapping cannot be completely replaced by AI data, but it could be facilitated. Our **research question** is: **Could be humanitarian mapping with the mapping tool using AI (RapiD editor) faster while maintaining the same quality?** This finding on the usability of data from AI can bring us several user testings in various editors (iD editor, RapiD editor, JOSM with AI).

Gill, Steadman, Peach [1]; CHEN et al. [2]; HERFORT et al. [3]; MENDES et al. [4]; HAO, HERFORT, ZIPF [5]

iD editor and mapwith.ai project (RapiD editor)

iD is an editor for OSM editing. “Map With AI” is a service designed for helping the OpenStreetMap (OSM) community. By facilitating mappers with AI-generated features through the RapiD Editor, it helps achieve faster mapping speed and higher data quality. *[6]*

RapiD is a version of iD improved within the mapwith.ai project to offer ready-made AI elements of buildings and roads for OSM editing. The building floor plans prepared in RapiD, which we used in the experiment, are generated by Microsoft as part of the Building Footprints project. *[6]*

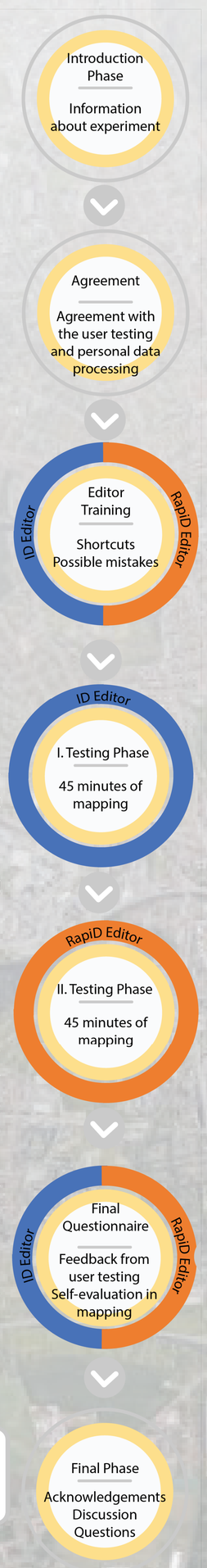
Microsoft has made significant investments in deep learning, computer vision and AI that have been applied to mapping. Over the past few years, Bing Maps has generated high-quality building footprints leveraging AI and harnessing the power of computer vision to identify map features at scale. *[7]*

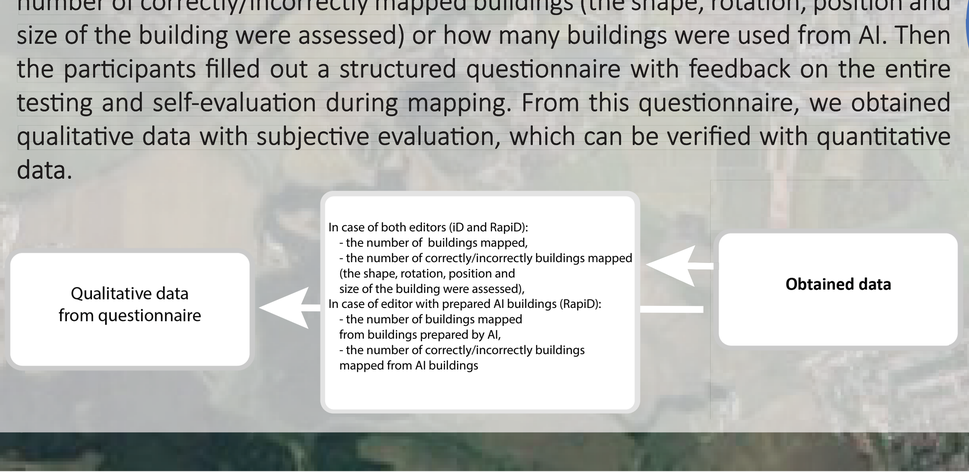
Materials and Methods

We focused on user testing of two mapping editors – iD editor (manual mapping) and RapiD editor (possibility of using pre-processed data from artificial intelligence). We performed user testing on June 22, 2022 using the within-subject method with 83 participants from the Dutch mapathon (iD editor – 38 participants, RapiD editor – 45 participants). Participants mapped in each of the editors for approximately one hour and were trained with the editors before the actual testing (they already knew the iD editor from earlier mapping).

Testing Phases

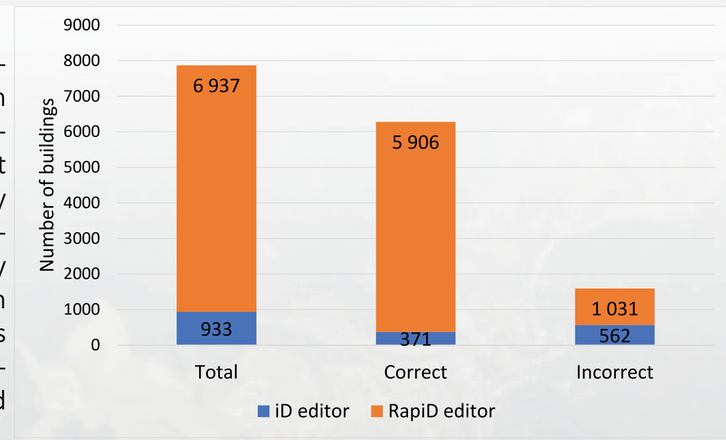
First, we familiarized all participants with the individual phases of testing. After a short introduction, in which we introduced the participants to the issue, they filled out a form with confirmation of anonymization and processing of personal data. This was followed by a short tutorial designed for beginners. During the training, we explained different cases that can occur during mapping, for example, different types of errors and ways to solve them or shortcuts that can greatly simplify and speed up mapping. After the training, the mapping took place in the given editor (iD editor, RapiD editor). From the data created by the participants, we found several quantitative indicators – the number buildings mapped, after validation (two validators) the number of correctly/incorrectly mapped buildings (the shape, rotation, position and size of the building were assessed) or how many buildings were used from AI. Then the participants filled out a structured questionnaire with feedback on the entire testing and self-evaluation during mapping. From this questionnaire, we obtained qualitative data with subjective evaluation, which can be verified with quantitative data.





Descriptive statistics

Quantitative data were first evaluated through descriptive statistics. The first bar graph expresses the total number of mapped buildings in the given editor (before validation). It also expresses the total number of correctly and incorrectly mapped buildings (after validation). The graph shows that approximately seven times more buildings were mapped in RapiD editor (6,937 buildings), sixteen times more correctly mapped buildings (5,906 buildings), but twice as many incorrectly mapped buildings as in iD editor.



The next two graphs are focused on the correctness of the mapping of specific participants. It can be stated that the participants mapping in the iD editor had a significantly higher percentage of errors. On the other hand, participants mapping in the RapiD editor had a relatively high percentage of correctness.

Results

When we statistically investigated the significance between iD editor and RapiD editor in mapping accuracy, data normality was first verified using the Shapiro-Wilk test. This did not show a normal distribution of data as the p-value (0.02655) was lower than the chosen significance level (0.05). For this reason, a non-parametric version of the test was chosen – the MannWhitney U Test. This demonstrated a statistically significant difference in mapping accuracy/error between iD editor and RapiD editor at the chosen significance level (0.05).

Variable	Mann-Whitney U Test									
	iD	RapiD	U	Z	p-value	Z	p-value	N – iD	N – RapiD	2*1 p
Correct	790	2696	49	-7,36238	0,00000	-7,36544	0,00000	38	45	0,00000
Inncorrect	1831	1655	620	2,14336	0,03209	2,17460	0,02966	38	45	0,03157

Conclusion

The above results suggest that AI-generated data helped participants map more effectively. Thus, in the same period of time, a participant using data from AI can correctly map a higher number of buildings than a participant who maps all buildings manually. The results are rather indicative, because the testing had several shortcomings that need to be eliminated in the next testing (the same and higher number of participants for a given editor, filling out all the questionnaires, dividing into groups according to experience with mapping, testing more editors), and thus creating a more controlled testing.

MUNI FACULTY OF SCIENCE

Milan Fila, M.Sc., fila.milan@mail.muni.cz
Radim Štampach, Ph.D., stampach@mail.muni.cz
Department of Geography, Faculty of Science,
Masaryk University
Kotlarska 2, 61137 Brno, Czechia

References:

[1] Gill, I., Steadman, I., & Peach, K. (2021). Collective intelligence authors Issy Gill grants programme Ian Steadman ... Retrieved May 9, 2022, from https://media.nesta.org.uk/documents/Collective_Intelligence_Grants_Programme-Experiments_in_collective_intelligence_design_2.0_1.pdf

[2] Chen, J., Zhou, Y., Zipf, A., & Fan, H. (2019). Deep learning from multiple crowds: A case study of humanitarian mapping. IEEE Transactions on Geoscience and Remote Sensing, 57(3), 1713–1722. https://doi.org/10.1109/tgrs.2018.2868748

[3] Herfort, B., Li, H., Fendrich, S., Lautenbach, S., & Zipf, A. (2019). Mapping human settlements with higher accuracy and less volunteer efforts by combining crowdsourcing and Deep Learning. Remote Sensing, 11(15), 1799. https://doi.org/10.3390/rs11151799

[4] Mendes, A., Palmer, T., Berens, A., Espey, J., Price, R., Mallya, A., Brown, S., Martinez, M., Farag, N., & Kaplan, B. (2021). Mapathons versus Automated Feature Extraction: A Comparative Analysis for strengthening immunization microplanning. International Journal of Health Geographics, 20(1). https://doi.org/10.1186/s12942-021-00277-x

[5] Hao, L., Herfort, B., & Zipf, A. (2019, June 17). Estimating OpenStreetMap missing built-up areas ...- heidelberg university. Retrieved May 9, 2022, from https://www.geog.uni-heidelberg.de/md/chemgeo/geog/gis/agile_final_version.pdf

[6] General Questions about Map With AI, 2021. GitHub [online]. [cit. 2022-08-16]. Dostupné z: https://github.com/facebookmicrosites/Open-Mapping-At-Facebook/wiki/FAQ

[7] Building Footprints: AI Assisted Mapping, 2022. Microsoft [online]. [cit. 2022-08-16]. Dostupné z: https://www.microsoft.com/en-us/maps/building-footprints