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Drones in Everyday Life: A SWOT Analysis of Social Perception in Hungary

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II. Abstract

As Unmanned Aerial Systems (UAS) or drones become more and more integrated into our everyday life, understanding social perception is crucial for the technological introduction, adoption and development of drones. In this thesis we researched ways to analyse the social perceptions of drones in Hungary. The focus of the literature review was to identify frequently measured or discussed questions for the base for our questionnaire and hypotheses. We found that utilizing the SWOT analysis method, which is usually used for strategic planning, we can average positive and negative attitudes and create 2 new metrics: SO_attitude (positive) from the strengths (S) and opportunities (O), WT_attitude (negative) from the weaknesses (W) and threats (T). To measure the attitude, a quantitative questionnaire is made which contains 16 questions (4 questions for each of the 4 SWOT quadrants, from which 8 is positive attitude and 8 negative attitude) to measure attitude on a 5 level Likert scale. The quantitative analysis of the participants responses of the questionnaire rejected three of the four null hypotheses. The results confirmed a statistically significant positive relation between knowledge and attitude (H1, $p = 0.031$). No significant correlation was found between gender and privacy concerns (H2, $p = 0.158$). Surprisingly, the urban population has a statistically significantly higher negative attitude (WT_attitude) towards drones (H3, $p = 0.002$) than their rural counterparts. Finally, we were able to confirm the statistically significant inverse correlation between the positive attitude and noise (H4, $p < 0.001$, $r = -0.208$) of a drone. The findings of this survey are expected to facilitate the development of strategies to increase the positive perception of Hungarian society for drones and drone technologies.

Keywords

1. Drone
2. Unmanned aerial system
3. Social perception
4. Hungary

License

III. Introduction

Mea culpa maxima

I often receive feedback from colleagues in the field of drone technologies, from hobbyists to operators, that the proper terminology is "Unmanned Aerial System" or "Unmanned Aircraft System" (UAS[3]). However, even journalists admit face to face, that the terminology "drone" is used by them as this is the accepted term by the general public.

Drone

"*drone - A land, sea, or air vehicle that is remotely or automatically controlled.*"[4]. The terminology, drone, requires some clarification regarding its scope in this thesis. Professionals in the industry have insights of the wide range and possibilities regarding drones and their capabilities (e.g.: on the Mars the Nasa drone helicopter Ingenuity[5], in the space the robotic spacecraft Boeing X-37[6]) thanks to the rapidly developing technology in this field. However, non-professionals mostly associate the terminology, drone, with noisy quad-copters above our heads. Having preliminary discussions with drone operators and laymen we faced a challenge: If we raise awareness in the questionnaire about the possibilities of drones we inadvertently would bias questionnaire participants towards a more positive view. Accepting that most people would associate the terminology with the "noisy quad copter" is just a pragmatic choice in order to have a non-biased base to start our research. Let me clarify with an example: If we would raise awareness in the questionnaire, that there are drones which were designed to operate in hazardous operating environments, not just military operational zones and taking wedding photos, we would instantly tip the balance of a previously negative attitude towards a positive direction. A person who just realised that drones can help monitor radiation levels without exposing personnel towards radiation in the Chornobyl Exclusion Zone[7] immediately would be biased towards a more positive attitude, even before having only negative experiences in real life.

Social perception

Construct validity[8] (Operationalization[9])
When the thesis was planned and the survey design started, we were curious
Horn bias (or the opposite Halo bias) because of the noise pollution which comes with operating drones.
Fundamental attribution error when we do not directly benefit from drone operation results.

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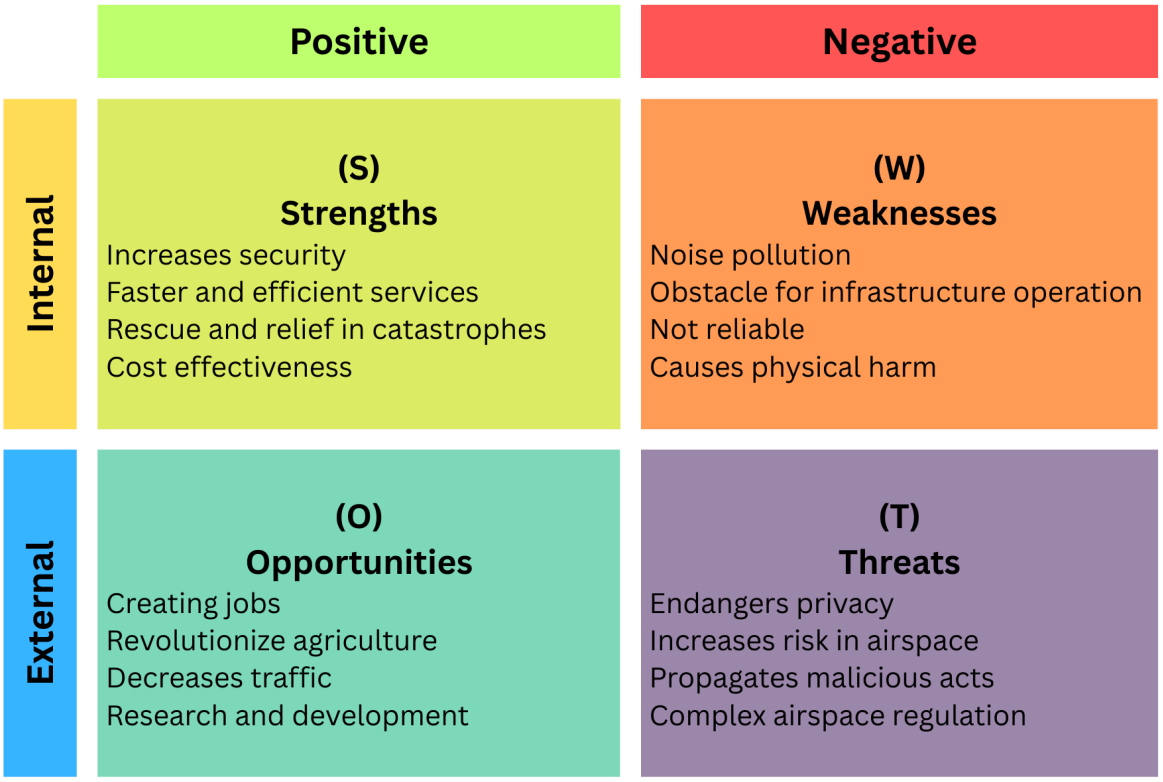
[3] https://en.wikipedia.org/wiki/Unmanned_aerial_vehicle 2025-11-26
[4] U.S. Joint Chiefs of Staff. Department of Defense Dictionary of Military and Associated Terms. Joint Publication 1-02. Washington, DC: Joint Chiefs of Staff, 2010. Incorporating changes through September 15, 2011.
[5] https://en.wikipedia.org/wiki/Ingenuity_(helicopter) 2026-01-25
[6] https://en.wikipedia.org/wiki/Boeing_X-37 2026-01-25
[7] Connor, Dean T., Kieran Wood, Peter G. Martin, Sevda Goren, David Megson-Smith, Yannick Verbelen, Igor Chyzhevskyi et al. "Radiological mapping of post-disaster nuclear environments using fixed-wing unmanned aerial systems: A study from chornobyl." Frontiers in Robotics and AI 6 (2020): 149.
[8] https://en.wikipedia.org/wiki/Construct_validity 2026-01-25
[9] https://en.wikipedia.org/wiki/Operationalization 2026-01-25

SWOT analysis



Image[10]: The SWOT quadrants or matrix.

"*SWOT Analysis is an analysis method used to evaluate the 'strengths', 'weaknesses', 'opportunities' and 'threats' involved in an organization, a plan, a project, a person or a business activity*"[11]. Borrowing the approach methodology from the SWOT analysis techniques, we can identify four categories for our questionnaire questions:

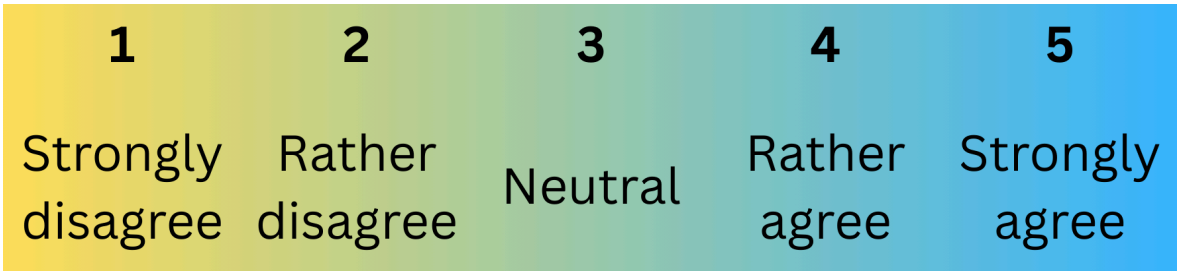
1. Internal positive (Strengths): The positive microeconomic effects of drones.
2. Internal negative (Weaknesses): The negative microeconomic effects of drones.
3. External positive (Opportunities): The positive macroeconomic effects of drones.
4. External negítive (Threats): The negative macroeconomic effects of drones.

We split the internal and external effects into microeconomic and macroeconomic effects in order to have a more clear split between external and internal effects. Implementing this approach will help us keep focus on the general and large scale view on the measurements.

This will help us categorise the result of the questionnaire into positive and negative attitudes.

[10] SWOT_matrix_drone_attributes.png
[11] Gurl, Emet. "SWOT analysis: A theoretical review." (2017).

Likert scale



Image[12]: The Likert scale.

1. 1 = Strongly disagree
2. 2 = Rather disagree
3. 3 = Neutral
4. 4 = Rather agree
5. 5 = Strongly agree

[12] Likert scale - DroneSociety.png

IV. Literature review

1. Strawser, Bradley Jay. "Moral predators: The duty to employ uninhabited aerial vehicles." Journal of Military Ethics 9, no. 4 (2010): 342-368.
    1.1. https://etica.uazuay.edu.ec/sites/etica.uazuay.edu.ec/files/public/Moral%20Reasoning%20A%20Text%20and%20Reader%20on%20Ethics%20and%20Contemporary%20Moral%20Issues%20%28%20PDFDrive%20%29.pdf#page=462
    1.2. “There is a worry that UAVs could lead to autonomous weapons that make lethal decisions on their own.”
    1.3. “I argue that remotely controlled weapons systems are merely an extension of a long historical trajectory of removing a warrior ever farther from his foe for the warrior’s better protection.”
    1.4. “My argument rests on the premise that if an agent is pursuing a morally justified yet inherently risky action, then there is a moral imperative to protect this agent if it possible to do so”
    1.5. “For any just action taken by a given military, if it is possible for the military to use UAV platforms in place of inhabited aerial vehicles without a significant loss of capability, then that military has an ethical obligation to do so.”
2. Wiesner, Ina. "A Sociology of the Drone." Journal of Military and Strategic Studies 18, no. 1 (2017).
    2.1. https://jmss.org/article/download/58280/43836
    2.2. “According to an interpretation in favour of combat drones, states are ethically obligated to use drones as the means of choice to spare the lives of their soldiers.”
    2.3. “In contrast to these technology-deterministic and microeconomic perspectives on technology development, sociologists interested in technology since the 1960s have regarded innovation and the diffusion of technologies as a social process, as innumerable decisions are made and negotiations are conducted in the course of technology development”
    2.4. “The sociology of technology not only asks about the conditions for the development of technology but also about the consequences of the introduction for societies, organisations and people. Remaining at first at the microsociological level, the questions arise, whether and how the existence of combat drones influences individuals in their behaviour.”
    2.5. “Drones are currently the highest developmental form of a military strategy orientation of armed services who wish to minimise their footprint in the operational theatre.”
    2.6. “By contrast, sociology studies the reasons for the development of technology and their long-term effects on social action, considering a longer background of time.”
3. Emimi, Mohamed, Mohamed Khaleel, and Abobakr Alkrash. "The current opportunities and challenges in drone technology." Int. J. Electr. Eng. and Sustain. (2023): 74-89.
    3.1. https://ijees.org/index.php/ijees/article/download/47/23
    3.2. “The process of globalization is being significantly influenced by the integration of technology, and among the technological advancements, drone technology stands out as a prominent example. Drones have witnessed a remarkable increase in their usage across various disciplines, including agriculture, healthcare, and military domains.”

3.3. “However, it is crucial to acknowledge that despite their numerous benefits, drones can pose risks, such as potential injuries to individuals and damage to property, especially when operated by untrained personnel or in the event of component failures during flight. Moreover, extremist elements can be hijacking drones to further their agendas and redirect the payload accordingly”

3.4. “The integration of Global Positioning System (GPS) technology and the availability of customizable applications for smartphones and tablets have significantly enhanced flight durations, reliability, and ease of operation.”

3.5. “Moreover, drones can facilitate automated inspections to ensure compliance with social distancing protocols in public spaces, thus aiding in the management of the pandemic.”

3.6. “The utilization of drones for the swift delivery of critical and life-saving medications to all members of society can contribute significantly to the realization of the goal of achieving universal health coverage. Furthermore, the logistics and transportation sectors stand to benefit from the integration of drones, offering opportunities for improved efficiency in the movement of goods and passengers.”

3.7. “The transition of drones from their origins in military applications to their integration within civilian contexts has introduced regulatory challenges that must be addressed to fully harness the potential of this technology.”

3.8. “One significant contribution of the multifaceted applicability of drones in the military, medical, and agricultural domains is the ability to enhance efficiency, effectiveness, and safety in various operations and activities.”

3.9. “In agriculture, drones offer numerous benefits in improving farm management and optimizing agricultural practices. They provide real-time imagery, sensor data, and mapping capabilities, allowing farmers to monitor crop health, detect diseases, and assess the overall condition of their fields.”

3.10. “The delegation of life-and-death decisions to automated systems or remote operators raises questions regarding accountability, transparency, and adherence to international laws of armed conflict.”

3.11. “Drones also play a significant role in precision agriculture, where they facilitate the precise application of inputs, such as fertilizers, pesticides, and herbicides. By utilizing GPS and onboard sensors, agricultural drones can precisely and accurately target specific areas of a field, minimizing waste and ensuring optimal use of resources.”

3.12. “Drone technology has emerged as a disruptive force, transforming industries and revolutionizing data collection, analysis, and decision-making processes. At the heart of this transformative capability lies drone sensor technology, a crucial aspect that empowers unmanned aerial vehicles (UAVs) to perceive their surroundings and gather essential data.”

3.13. “Drone-to-Drone communication is currently not standardized, and its development is an area of active research. Machine Learning techniques can be employed to design and optimize an intelligent Unmanned Aerial Vehicle (UAV)-based wireless communication system, as suggested in reference. In many instances, Drone-to-Drone (D2D) communications can be conceptualized as Peer-to-Peer (P2P) communication. However, this P2P model renders communication vulnerable to various types of attacks, including jamming, such as Distributed Denial of Service (D-DoS) attacks, and Sybil attacks.”

3.14. “Emergency Medical Services: Drones have the potential to play a vital role in emergency medical services. For instance, drones equipped with automated external defibrillators (AEDs) can be rapidly dispatched to the scene of cardiac arrests, allowing for immediate intervention before medical professionals arrive.”

3.15. “Disaster Response and Relief: Drones are invaluable in disaster response and relief efforts. They can assess damage, identify survivors, and facilitate search and rescue operations in hazardous or hard-to-reach areas.”

4. Purahong, Boonchana, Thanavit Anuwongpinit, Aniwat Juhong, Isoon Kanjanasurat, and Chuchart Pintaviooj. "Medical drone managing system for automated external defibrillator delivery service." Drones 6, no. 4 (2022): 93.

4.1. https://www.mdpi.com/2504-446x/6/4/93

4.2. “CPR can only keep blood flowing to the heart and brain for a time. To restore the heart’s normal rhythm, a device called an automatic external defibrillator (AED) must be used.”

4.3. “When a person experiences a heart attack, their survival rate depends on the time elapsed between the onset of the heart attack and the time they are treated with an AED. The aim of our medical drone managing system is to deliver an automated external defibrillator to a patient in less time. The system can respond to the AED request within 5 min for a maximum distance of 5 km.”

4.4. “The distance between the patient with the drone mobile app and the drone sever can be as far as 5 km. Local Wi-Fi hot spots cannot be applied, and 4G/5G mobile broadband must be used in our autonomous medical drone system for communicating with the PubNub cloud server.”

4.5. “The drone ground station is designed to be mobile and can even operate the drones from a van equipped with 4G or 5G signals.”

4.6. “The mission was successful. The weather conditions for the test fight date were as follows: temperature 29.4 °C, humidity 65%, and wind speed 12 km per hour. We also asked the drone administrator and volunteer for their opinions about the drone server application and the mobile application. The feedback was quite positive, especially regarding the ease of use, reliability, and accuracy of the application. The total elapsed time from the emergency call to the delivery of the AED was about 2 min, divided into ascending time of 6 s (30-m altitude), descending time of 12 s, and flight time of 2 min. The maximum flight time of the drone is 24 min for a payload of 800 g.”

4.7. “One of the missing features of our medical drone managing system for automated external defibrillator delivery is obstacle avoidance. The medical drone managing system is hence not suitable to be operated in a city, where many obstacles can be found, including electrical wires and tall buildings. To be used in a city, an obstacle avoidance feature should be added.”

4.8. “A drone propeller guard must be used to prevent any injury, especially when the drone flies near living humans or animals.”

5. Tan, Lynn Kai Lin, Beng Chong Lim, Guihyun Park, Kin Huat Low, and Victor Chuan Seng Yeo. "Public acceptance of drone applications in a highly urbanized environment." Technology in Society 64 (2021): 101462.

5.1. https://dr.ntu.edu.sg/bitstreams/b73dd305-45fe-467e-8172-a13d23990c18/download

5.2. "First, using two knowledge tests, we were able to confirm that the majority of the public seems to have a good understanding of what a drone is. Second, acceptance levels towards drones did significantly differ depending on the context of use. Industrial areas had the highest acceptance level, followed by recreational areas and business districts while residential areas had the lowest acceptance level."

5.3. "We provided preliminary evidence that two factors – fears and concerns, and perceived potential benefits – affected the public acceptance levels differently depending on the contexts of drone applications."

5.4. "While drone technologies are not new, it has not permeated our daily lives until a few years ago. These days, news of emerging applications of drone technologies are ubiquitous. Be it for routine building inspection, constant security surveillance, or last mile commercial delivery, drone technologies have been touted as a cost-effective solution."

5.5. "To ensure successful implementation, social and psychological dimensions of drone operations in urban environment must be fully understood in order to enhance public acceptance of the technology."

5.6. "For instance, people may be more accepting of using drones for building inspection in industrial areas compared to residential areas. Similarly, people may be more receptive toward security surveillance in commercial and industrial areas compared to residential and recreational areas."

5.7. "Participants were asked single-itemed demographic questions pertaining to their gender, age, level of residence, occupation, annual income, industry, nature of work, and their highest educational qualification based on the Singapore education system."

5.8. "An independent t-test between males and females revealed that the gender effect on the picture-based test ($t(1042) = 3.51$, $p < .001$) where males were found to perform significantly better than females (male: $M = 4.87/ 6.00$, $SD = .76$, female: $M = 4.68/ 6.00$, $SD = .92$). However, there was no significant difference between males and females on the word-based test ($t(1043) = 1.27$, $p = .20$)."

5.9. "Based on a one-way ANOVA, there are no significant age effects on both test scores (picture-based: $F(6, 1043) = 0.54$, $p = .77$; word-based: $F(6, 1043) = .54$, $p = .39$)."

5.10. "There are significant differences between the various education levels of respondents on their scores on the picture-based test ($F(6, 977) = 3.51$, $p < .01$). There are also significant differences between the various education levels of respondents on the word-based test ($F(6, 977) = 6.33$, $p < .000$). For both tests, those who received a higher education were more likely to score high on the tests."

5.11. "A one-way ANOVA test revealed non-significant effects of occupation (3 categorical options of student, working adult, or non-working adult) (picture: $F(2, 1047) = 0.25$, $p = .78$; word: $F(2, 1047) = 1.44$, $p = .24$)."

5.12. "Considering those who responded that they have active drone experience, those with

5.13. active experience scored significantly lower on the picture-based test than those without active experience with drones (active: $M = 4.67$, $SD = .86$; non-active: $M = 4.85$, $SD = .82$). There was no significant difference."

5.14. "The top 4 fears and concerns indicated by the Singaporean public is misuse of drones by unauthorized personnel, inability to identify whether drones are filming

or not, drones being a threat to one's physical safety if parts of it falls, and loss of privacy."

5.15. "A repeated measures ANOVA was conducted to analyse whether the acceptance levels towards drones differed significantly based on the location of drone operation. The results revealed that the mean difference between acceptance levels did indeed differ significantly from each other ($F(1, 1049) = 21840.82$, $p < .000$; Residential: $M = 3.87$, $SD = 1.24$, Recreational: $M = 4.40$, $SD = 1.12$, Business district: $M = 4.30$, $SD = 1.12$, Industrial: $M = 4.58$, $SD = 1.16$)."

5.16. "While we did not make specific hypotheses regarding their relationships, we do believe that the two factors, fears and concerns, and perceived potential benefits, would affect the acceptance level differently depending on the specific context."

5.17. "Fears and concerns were the main factor that affected one's level of acceptance for drone use in residential area while it has no effect on drone use in industrial areas."

5.18. "Is the public ready for extensive drone applications to be an integral part of their daily lives? As mentioned earlier, public acceptance of any technology is necessary for realizing their benefits fully."

5.19. "Generally, a majority of the public seem to have a good understanding of what a drone is. However, the study also revealed two features of drones that the public seemed unsure about, namely whether drones have an on-board pilot or not, and whether drones can be as large as commercial planes. Further analysis also reveals that those who are male, working in engineering industry, or more educated were more knowledgeable about drone than females, working in nonengineering industry, or less educated."

5.20. "the public generally support the applications of drone for search and rescue purposes; where they were more conservative toward photography or videography that impose a more serious concern of privacy"

5.21. "The top 4 fears and concerns were misuse of drones by unauthorised personnel, inability to identify whether drones are filming or not, drones being a threat to one's physical safety, and loss of privacy."

5.22. "Not surprisingly, the media industry appears to have a huge impact on public perceptions and their understanding of drones."

5.23. "The psychology behind the public acceptance towards drones likely will differ for residents of rural areas – rural residents feel less positively about autonomous vehicles (like cars or buses) than urban residents (Hilgarter & Granig, 2020)."

5.24. "Thus, future work could also further investigate whether and how various physical dimensions of drones can affect public acceptance towards drones."

6. Clothier, Reece A., Dominique A. Greer, Duncan G. Greer, and Amisha M. Mehta. "Risk perception and the public acceptance of drones." Risk analysis 35, no. 6 (2015): 1167-1183.

6.1. https://eprints.qut.edu.au/80007/1/Authors%20Version%20-%20Manuscript%20Final.pdf

6.2. "The neutral response is likely due to a lack of knowledge about the technology, which was also identified as the most prevalent public concern as opposed to the risks associated with its use. Privacy, military use and misuse (e.g., terrorism) were also significant public concerns. The results suggest that society is yet to form an opinion of drones."

7. Gurl, Emet. "SWOT analysis: A theoretical review." (2017).

7.1. https://www.academia.edu/download/109539676/jisr.2017.pdf
7.2. "SWOT Analysis is an analysis method used to evaluate the 'strengths', 'weaknesses', 'opportunities' and 'threats' involved in an organization, a plan, a project, a person or a business activity"
7.3. "Based on SWOT Analysis, organizations can choose the appropriate strategy."
7.4. "Strategic choice is associated with vision, mission, objectives and the external and internal analysis of the organization; an organization is willing to make strategic choices. This is to say that an organization is able to choose its 'theory of how to obtain a competitive advantage'."
7.5. (Image) "Vision -> Mission -> Objectives -> ExternalInternal analysis" -> Strategic choice -> Strategy implementation -> Competitive advantage"
7.6. "SWOT Analysis is therefore a significant tool for situation analysis that helps the managers to identify organizational and environmental factors."
7.7. "Strength is the characteristic that adds value to something and makes it more special than others."
7.8. "Weakness refers to not having the form and competency necessary for something."
7.9. "Opportunity means a situation or condition suitable for an activity. Opportunity is an advantage and the driving force for an activity to take place."
7.10. "Threat is a situation or condition that jeopardizes the actualization of an activity."
7.11. "The historical background of SWOT Analysis is as old as the concept of strategic planning. For this reason, it has been identified with strategic planning and accepted as the primary element of the strategic planning process."
7.12. "SWOT Analysis can be applied at different analytical levels -individual level, organizational level, national level, international level-. It can be used by educational institutes, non-profit organizations, countries, governments, projects on multiculturalism etc."
7.13. "Listing strengths on paper is prone to bias and is very different from testing the organization and experiencing the strengths at work."
7.14. "Categorization of variables into one of the four SWOT quadrants is challenging. The same factor can be fitted in two categories. A factor can be a strength and a weakness at the same time. In addition, strengths that are not maintained may become weaknesses. Opportunities not taken, but adopted by competitors, may become threats. The classification of a variable also depends on the purpose of the practice."

8. Niedenthal, Paula M., Lawrence W. Barsalou, Piotr Winkielman, Silvia Krauth-Gruber, and François Ric. "Embodiment in attitudes, social perception, and emotion." Personality and social psychology review 9, no. 3 (2005): 184-211.
8.1. https://barsaloulab.org/Online_Articles/2005-Niedenthal_et_al-PSPR-social_embodiment.pdf
9. Swann, William B. "Quest for accuracy in person perception: A matter of pragmatics." Psychological review 91, no. 4 (1984): 457.
9.1. https://www.researchgate.net/profile/William-Swann-2/publication/16691423_Quest_for_accuracy_in_person_perception_A_matter_of_pragmatics/links/0912f50e4d69d9302f000000/Quest-for-accuracy-in-person-perception-A-matter-of-pragmatics.pdf

10. Noor, Norzalina, Sukor Beram, Fanny Khoo Chee Yuet, Kumaran Gengatharan, and Mohamad Syafiq Mohamad Rasidi. "Bias, Halo Effect and Horn Effect: A Systematic Literature." International Journal of Academic Research in Business & Social Sciences 13, no. 3 (2023): 1116-1140.
    10.1. https://www.researchgate.net/profile/Sukor-Beram/publication/369600152_Bias_Halo_Effect_and_Horn_Effect_A_Systematic_Literature_Review/links/642a9bbf66f8522c38f29295/Bias-Halo-Effect-and-Horn-Effect-A-Systematic-Literature-Review.pdf
    10.2. "An initiative has been taken to minimise the raters' conflicting attitudes and biases that they might have brought to their assessment by giving them assessment criteria and performance samples and asking them to take part in the training program."
    10.3. "Thorndike initially noticed the halo effect when he discovered that supervisors could not judge their subordinates separately on various character personalities. The halo effect is a cognitive bias that causes people to see another person's qualities in a way that matches their past impressions of other characteristics. This phenomenon is known as the halo effect, meaning that positive qualities are more likely to be ascribed to individuals who display positive qualities in other domains (Thorndike, 1920)."
    10.4. "The halo effect is the perception of a company's success or failure based on its reputation. Companies can be the object of a 'halo effect' when their reputation is high. A brand's excellent reputation has a significant impact on the overall perception of product quality."
    10.5. "A 'reverse halo effect' is accountable for these stigmatising assessments. Halo effects are a cognitive bias that affects how people create impressions and decide (Thorndike, 1920)."
11. Thorndike, Edward L. "Intelligence examinations for college entrance." The Journal of Educational Research 1, no. 5 (1920): 329-337.
    11.1. https://scholar.archive.org/work/frwzdpukvvc7zbn3guol6lfbie/access/ia_file/crossref-pre-1923-scholarly-works/10.1080%252F00220671.1920.10879060.zip/10.1080%252F00220671.1920.10879060.pdf
12. Chamayou, GrŽgoire. A Theory of the Drone. New Press, The, 2015.
    12.1. https://www.manosparnai.lt/e107_files/public/1646669620_3181_FT64165_a_theory_of_the_drone_2015.pdf
    12.2. "Months of monotony and milliseconds of mayhem."
    12.3. "The drone family is not composed solely of flying objects. There may be as many different kinds as there are families of weapons: terrestrial drones, marine drones, submarine drones, even subterranean drones imagined in the form of fat mechanical moles. Provided there is no longer any human crew aboard, any kind of vehicle or piloted engine can be "dronized."
    12.4. "The best definition of drones is probably the following: "flying, high-resolution video cameras armed with missiles.""
    12.5. "But the central question would be this: How do drones affect the war situation? To what do they lead, not only in terms of their relation to the enemy but also in terms of the state's relation to its own subjects?"
    12.6. "Where did the drone come from? What is its technical and tactical genealogy? And what are its consequent fundamental characteristics? This weapon extends and

radicalizes the existing processes of remote warfare and ends up by doing away with combat. But in so doing, it is the very notion of "war" that enters into crisis. A central problem arises: if the "war of drones" is no longer quite warfare, what kind of "state of violence" does it amount to?"

12.7. "It is clear enough that by making it unnecessary to expose American lives to combat, the drone indeed spares them. However, it is less clear to see how it might at the same time "save" any lives other than those."

12.8. "Within what legal framework do drone strikes take place today?"

13. U.S. Joint Chiefs of Staff. Department of Defense Dictionary of Military and Associated Terms. Joint Publication 1-02. Washington, DC: Joint Chiefs of Staff, 2010. Incorporating changes through September 15, 2011.

13.1. https://edocs.nps.edu/dodpubs/topic/jointpubs/JP1/JP1_02_110915.pdf

13.2. "drone - A land, sea, or air vehicle that is remotely or automatically controlled."

14. Connor, Dean T., Kieran Wood, Peter G. Martin, Sevda Goren, David Megson-Smith, Yannick Verbelen, Igor Chyzhevskyi et al. "Radiological mapping of post-disaster nuclear environments using fixed-wing unmanned aerial systems: A study from chornobyl." Frontiers in Robotics and AI 6 (2020): 149.

14.1. https://www.frontiersin.org/journals/robotics-and-ai/articles/10.3389/frobt.2019.00149/pdf

14.2. "This study presents a new radiation mapping UAS based on a lightweight (8 kg) fixed-wing unmanned aircraft and tests its suitability to mapping post-disaster radiation in the Chornobyl Exclusion Zone (CEZ)."

15. Clark, Lee Anna, and David Watson. "Constructing validity: New developments in creating objective measuring instruments." Psychological assessment 31, no. 12 (2019): 1412.

15.1. https://psycnet.apa.org/manuscript/2019-14248-001.pdf

15.2. "Measurement is fundamental in science, and, arguably, the two most important qualities related to measurement are reliability and validity."

15.3. "construct validity is the foundation of clinical utility. That is, to the extent that real-world decisions (e.g., eligibility for social services, psycho- or pharmaco-therapy selection) are based on psychological measurements, the quality of those decisions depends on the construct validity of the measurements on which they are based."

15.4. "practitioners increasingly are asked to justify use of specific assessment procedures to third-party payers. Use of psychological measures whose precision and efficiency are well established within an articulated theory that is well supported by multiple types of empirical data (i.e., measure that have demonstrated construct validity) may be required in the future."

15.5. "progress in psychological science, especially as we explore more deeply the interface between psychosocial and neurobiological systems, is critically dependent on measurement validity. Detailed understanding of brain activity will be useful only insofar as we can connect it to phenotypic phenomena, so the more validly and reliably we can measure experienced affects, behaviors, and cognitions, the more we will be able to advance psychology and neuroscience."

15.6. "More generally, conglomerate constructs rarely fulfill their enticing premise that the total is greater than the sum of its parts. If development of such a construct is pursued, the burden of proof is on the developer to show that the conglomerate is superior to the linear combination of its components."

15.7. “Good scale construction is an iterative process involving several stages of item writing, each followed by conceptual and psychometric analysis that sharpen one's understanding of the nature and structure of the target domain and may identify shortcomings in the initial item pool. For instance, factor analysis might identify subscales and also show that the initial pool contains too few items to assess one or more content domains reliably.”

15.8. “Items should be simple, straightforward, and appropriate for the target population’s reading level. Avoid (1) expressions that may become dated quickly; (2) colloquialisms that may be not be familiar across age, ethnicity, region, gender, and so forth; (3) items that virtually everyone (e.g., "Sometimes I am happier than at other times") or no one (e.g., "I am always furious") will endorse; and (4) complex or "double-barreled" items that assess more than one characteristic; for example, “I would never drink and drive for fear that I might be stopped by the police," assesses both a behavior’s (non)occurrence and a putative motive. Finally, the exact phrasing of items can greatly influence the construct that is being measured. For example, the inclusion of almost any negative mood term (e.g., "I worry about...," I am upset [or bothered or troubled] by...") virtually guarantees a substantial neuroticism/ negative affectivity component to an item.”

15.9. “Currently, the two dominant response formats in personality and clinical assessment are dichotomous responding (e.g., true/false; yes/no) and Likert-type rating scales with three or more options.”

15.10. “Likert-type scales are used with various response formats, including frequency (e.g., "never" to "always"), degree or extent (e.g., "not at all" to "very much"), similarity (e.g., "very much like me" to "not at all like me"), and agreement (e.g., "strongly agree" to "strongly disagree").”

15.11. “With an odd number of response options, the middle option’s label must be considered carefully (e.g., "cannot say" confounds uncertainty with a mid-range rating such as “neither agree nor disagree”), whereas even numbers of response options force respondents to "fall on one side of the fence or the other," which some respondents dislike. However, Simms et al. found no systematic differences between odd versus even number of response options. More research of this type is needed using a broad range of constructs (e.g., psychopathology, attitudes), samples (e.g., patients, community adults), type of response formats (i.e., extent, frequency), and so on.”

15.12. “Smith, McCarthy, and Anderson (2000) provide an excellent summary of the many challenges in developing and validating short forms. They address the tendency to try to maintain a similar level of internal consistency (e.g., coefficient alpha) by narrowing the content, which leads into the classic attenuation paradox of psychometrics (Boyle, 1991; Loevinger, 1954): Increasing a test’s internal consistency beyond a certain point can reduce its validity relative to its initially intended interpretation(s).”

15.13. “Too often, scale developers assume that their initial conceptualization is entirely correct, considering only the measure as open to revision. However, it is critical to remain open to rethinking one’s initial construct—to “listen to the data” not “make the data talk.””

16. Zhou, Qihou H., Qina N. Zhou, and John D. Mathews. "Arithmetic average, geometric average, and ranking: Application to incoherent scatter radar data processing." Radio Science 34, no. 5 (1999): 1227-1237.
    16.1. https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/1999RS900062
    16.2. “We examine the statistical characteristics of three commonly used estimators, arithmetic average, geometric average, and ranking as applied to incoherent scatter radar observations in the presence of interference. While the arithmetic average is effective in reducing the statistical error, it is very sensitive to "outlier" contamination, such as meteor returns.”
    16.3. “If the data contain only outlier contamination, the geometric average is a better choice than either simple arithmetic average or the single ranking method.”
    16.4. “When a parameter to be measured contains statistical fluctuation, the arithmetic average is typically used to reduce the fluctuation (variance). Although this method is simple and efficient most of the time, it is not robust when the data contain spurious contamination such as statistical "outliers." The median method and geometric average are more robust than the arithmetic average in dealing with data containing outliers.”
17. Boucher, Philip. "Domesticating the drone: the demilitarisation of unmanned aircraft for civil markets." Science and engineering ethics 21, no. 6 (2015): 1393-1412.
    17.1. https://link.springer.com/content/pdf/10.1007/s11948-014-9603-3.pdf
    17.2. “Remotely piloted aviation systems (RPAS) or ‘drones’ are well known for their military applications, but could also be used for a range of nonmilitary applications for state, industrial, commercial and recreational purposes.”
    17.3. “concerns have been raised about the public rejecting the technology because of their association with military applications and potentially controversial applications, for example in policing and border control.”
    17.4. “The technologies required for C-RPAS operations are ready for market and the principal barriers to development in the sector are regulatory. In response to demand, the European Commission (EC) has published strategies to allow the gradual integration of C-RPAS into normal airspace.”
    17.5. “However, RRI remains a concept under development; it is subject to interpretive flexibility and methodological debate.”
    17.6. “pushing a technology without sufficient dialogue at early stages is irresponsible, and can damage development (von Schomberg 2013).”
    17.7. “We also show how the approach may be self-defeating, leading to increased resistance to the technology, with examples of failed attempts to demilitarise C-RPAS discourse by avoiding the use of the word ‘drone’.”
    17.8. “Our recommendation—also based upon RRI—is that the burden of acceptability is shifted from citizens to the technology.”
    17.9. “Applications of RPAS can be organised into four major categories; military; non-military governmental; commercial; and personal/recreational.”
    17.10. “By far the most visible and debated applications of RPAS fall under the military category (M-RPAS), particularly surveillance and combat applications in the War on Terror. M-RPAS can be piloted from an RPS at the other side of the world, distanced from immediate danger, as well as the mechanisms and consequences of their actions.”

17.11. “RPAS are also well suited to so-called ‘dull dirty and dangerous’ where unmanned solutions are preferred. Some such applications have achieved media interest, such as the rather fantastical, headline-grabbing reports about drone delivery services for pizzerias and bookshops.”

17.12. “These stories have attracted some mainstream debate about privacy, safety and liability.”

17.13. “There is substantial crossover amongst these categories of applications and technologies developed and sold for one purpose can be used for another.”

17.14. “RPAS base vehicles are highly customisable and can be configured with different payloads to deliver various marketable services for government, commercial, recreational and military purposes.”

17.15. “‘‘Once a legal framework exists, a totally new aerial work service supply industry should spout rapidly’’ (European Commission 2009, p. 10).”

17.16. “Most importantly for our purposes, concerns were raised about C-RPAS’ surveillance capabilities and that citizens may be uncomfortable with the RPAS because of their association with military and police applications.”

V. Objectives

Hypotheses

1. H1 hypothesis: Knowledge about drones has a positive effect on their perception.
   1.1. $H1_0$: There is no positive relationship between the level of knowledge about drones and the level of positive perception towards them.
   1.2. $H1_1$: There is a positive relationship between the level of knowledge about drones and the level of positive perception (or attitude) towards them.
2. H2 hypothesis: Women perceive drones as a greater risk to their privacy than men.
   2.1. $H2_0$: There is no difference (or no greater risk) in the perceived threat of drones to personal privacy between women and men.
   2.2. $H2_1$: Women perceive a significantly greater risk from drones to their personal privacy than men.
3. H3 hypothesis: Urban society views the presence of drones more positively.
   3.1. $H3_0$: The urban population perceives the presence of drones more positively than the rural population.
   3.2. $H3_1$: There is no significant difference in the perception of drone presence between the urban and rural populations.
4. H4 hypothesis: There is a correlation between noise pollution and utility of a drone.
   4.1. $H3_0$: There is no negative correlation between the perceived usefulness of a drone and the perceived disturbance caused by its noise.
   4.2. $H3_1$: There is a negative correlation between the perceived usefulness of a drone and the perceived disturbance caused by its noise.

VI. Methods

Talking with colleagues and fellow researchers, the question seems to arise with increasing frequency: How does Hungarian society perceive drones in our everyday life? We decided that this question requires a definite answer in order to plan future solutions and be able to have a more educated discussion for future topics. For example: Should building codes for public institutions mandate Automated External Defibrillators (AEDs[13]) in their first aid stations or the social attitude will be open towards a delivered-by-drone solution. After a quick study in scientific databases we were not able to find any available and comprehensive research to have a confident answer for our question. Hence the idea for this thesis was outlined.

We did literature review in the field of sociology and drone technology in order to identify existing researches which discussed existing practices, questions, concerns and possibilities regarding social attitude towards drones. During literature review, one of my personal observation was that the majority of research in sociology deals with attitudes towards combat and military drones. This part of our research confirmed that work has to be done in order to answer the thesis originating question. During literature review we registered questions that other papers have examined.

Once we identified the most frequent and popular topics we have chosen 4 of them as our hypotheses: Knowledge of drones and positive attitude (H1), female perception of drones and privacy (H2), rural society perception compared to urban society perception (H3), correlation between noise pollution and utility of drones (H4).

After identifying the base concepts for the hypotheses of this thesis we started discussions on the topic on how to measure social acceptance. To solve this part, we utilised the Likert scale[14] as this is a psychometric scale used in research questionnaires. We debated on if our scale should measure from negative to positive interval, but this approach seemed complex to have a simple statistical analysis done on its results. We identified a possible, but unconventional, approach with the use of a SWOT analysis[15]. The SWOT analysis method is most often used to evaluate positive and negative factors affecting an organization and with another dimension we can even split our analysis into 2 additional factors, making the possible research categories into 4 quadrants: Internal positive factors as strengths (S), internal negative factors as weaknesses (W), external positive factors as opportunities (O) and finally, external negative factors as threats (T). With these 2 dimensions (2 axis) our measurements can cover a range of positive-negative and internal-external. We identified and chose 16 questions from our literature review in order to populate our SWOT analysis matrix, 4 questions into each SWOT analysis quadrant.

In order to collect primer data points for our research, we incorporated the 16 selected questions into a web based form and published it under an url. As we were not able to identify a clear group who can represent the Hungarian society, we decided rely on the Law of Large Numbers[16] in our sampling design. Obviously, we were prepared to check and explain the demographic properties of the questionnaire participants.

In order to be able to compute significance from the study, we designed a positive (SO_Attitude) and a negative (WT_Attitude) metric to measure the respective attitudes. For the H1, H2, and H3 hypotheses a Students's t-test[17] was used for determining a statistical significance. For the H4

[13] https://en.wikipedia.org/wiki/Automated_external_defibrillator 2025-12-04
[14] https://en.wikipedia.org/wiki/Likert_scale 2025-12-04
[15] https://en.wikipedia.org/wiki/SWOT_analysis 2025-11-26
[16] https://en.wikipedia.org/wiki/Law_of_large_numbers 2025-12-05
[17] https://en.wikipedia.org/wiki/Student%27s_t-test 2025-12-07

hypothesis, the Person correlation method was selected to test the statistical significance and direction of the correlating relationship.
Utilising the above methodology we were able to compute significance and conclude results listed in the attachment[18] of this thesis.

Questionnaire

The questionnaire was distributed in university chat groups, drone enthusiast Facebook groups, senior hiking Facebook groups, technological forums. Although our sampling methodology cannot be called representative, the high number of respondents allows us to form conclusions.

Published URL

https://docs.google.com/forms/d/14u9qZOu3aKaElrWuNK4D5cvv9NpWyBvI0cJ8vtLcyok/preview

Selecting questions into SWOT quadrants

Strengths (S)

Identifier	Focus of the statement	Attitude statement
S1	Public safety	The everyday presence of drones significantly increases public safety.
S2	Logistics	Drones enable faster and more efficient services.
S3	Disaster management	Drones help in disaster and rescue situations.
S4	Cost-effectiveness	Utilising drones is cost-effective in a lot of situations than deploying people.

Weaknesses (W)

Identifier	Focus of the statement	Attitude statement
W1	Noise pollution	The everyday presence of drones leads to disturbing noise pollution.
W2	Critical infrastructure	Drones possess a threat for critical infrastructure.
W3	Reliability	Drones are not yet technologically reliable.
W4	Immediate risk	Drones imply a great risk of physical threat for anyone who stands under them.

Opportunities (O)

Identifier	Focus of the statement	Attitude statement

[18] https://docs.google.com/document/d/1yhSNHgqUFwsVsQNXPbZdSon4-wTsxca2BZebGvT83HU/edit?tab=t.0#bookmark=id.4vozlqfw3358 2025-12-07

O1	Labor market	The rapid spread of drones provide new jobs in the field of drone development, operations and service.
O2	Agriculture	Drones revolutionize the agricultural sector.
O3	Transportation	Utilising drones decreases traffic and environmental pollution on public roads.
O4	Research	Drone technology promotes scientific research and increases a country's potential for innovation.

Threats (T)

Identifier	Focus of the statement	Attitude statement
T1	Privacy	The spread of drones seriously endangers privacy.
T2	Accidents	Drones increase the risk of accidents in the airspace.
T3	Malicious act	Drones make it easier to execute malicious acts.
T4	Regulation	Drones require complex and expensive regulation of the airspace.

Demographic questions

Gender[19]

This question has 2 choices (Male, Female) and an “other” free entry text field.

Grouping questions

How familiar are you with drones or how often do you use them?[20]

This question had 4 group choices:

1. I have never encountered or engaged with drones[21]
2. I am aware of them; I have seen or heard about them in the media or in my environment[22]
3. I have operated a drone for a short period (e.g., at a friend's house)[23]
4. I regularly use drones (e.g., for hobby or as a profession)[24]

In order to group questionnaire participants into 2 groups for the independent samples Student’s t -test, the following mapping have been applied:

Old group	New group (Familiarity group)
I have never encountered or engaged with drones	Less
I am aware of them; I have seen or heard about them in the media or in my	Less

[19] Neme
[20] Mennyire ismeri vagy használja a drónokat?
[21] Soha nem találkoztam / nem foglalkoztam velük
[22] Láttam már, vagy hallottam róluk a médiában / környezetemben
[23] Kezeltem már drónt rövidebb ideig (pl. ismerősnél)
[24] Rendszeresen használok drónt (pl. hobby vagy munka céljából)

environment	
I have operated a drone for a short period (e.g., at a friend's house)	More
I regularly use drones (e.g., for hobby or as a profession)	More

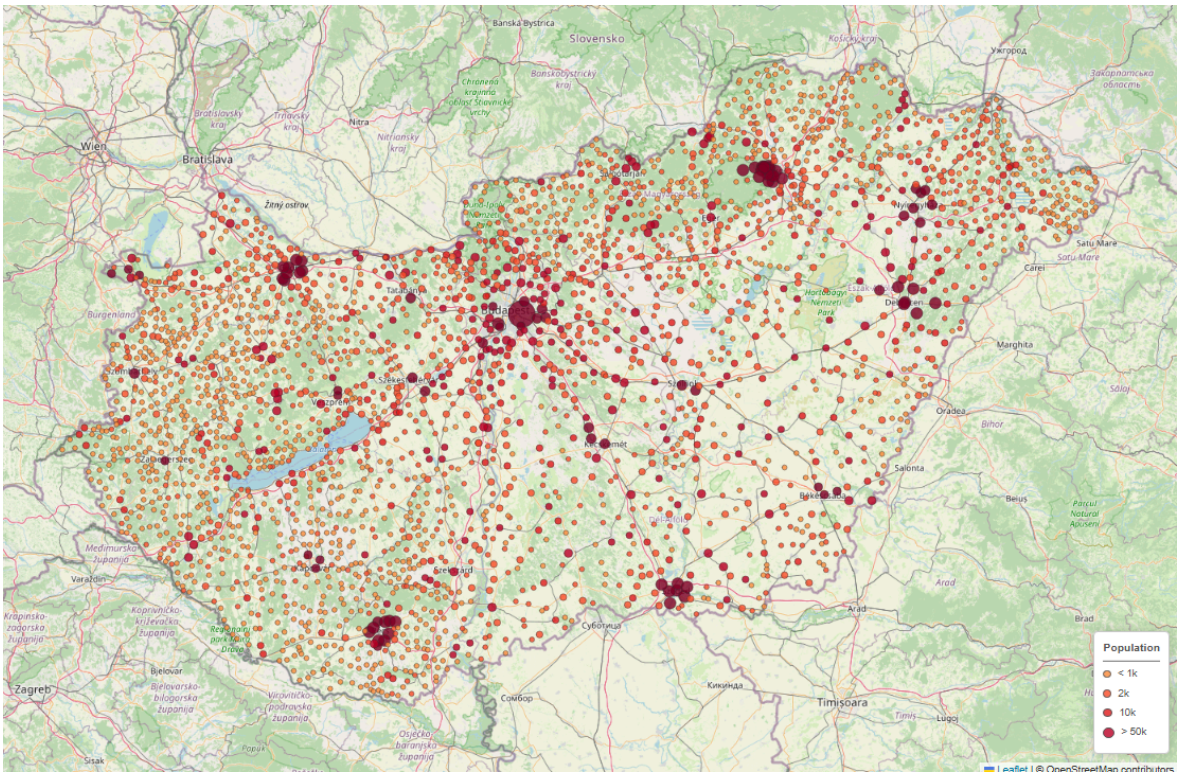
Mapping postal codes

For this thesis, we selected the KSH[25] as the list of our settlements and settlement parts with postal code. The KSH website provides a download[26] option for the settlements information, which will provide with an xlsx[27] file with 2 tabs. “Helységek 2025.01.01.” and “Településrészek 2025.01.01.”. We download them separately as .csv[28] files:

1. hnt_letoltes_2025_helysegek.csv[29]
2. hnt_letoltes_2025_telepulesreszek.csv[30]

The hnt_letoltes_2025_helysegek.csv provides the list of what a layman would consider as cities. The most important information here is the KSH internal identifier, the settlement name and population. The hnt_letoltes_2025_telepulesreszek.csv contains the postal codes and settlement part names. The most important details we will find in this table is the KSH internal identifier of the settlement, the settlement part name, classification, population, dwellings count. Once the csv files are ready, we create a database table with appropriate structure in a relational database schema and load the files. The sql[31] commands are pushed into a version controlled repository[32] in GitHub[33]. Once the list of Hungarian settlements are in place with the complementing settlement parts list we update[34] both tables to be able to store a latitude and longitude attribute. Utilizing an API, called Nominatim[35], we can retrieve the latitude and longitude coordinates of a settlement, based on OpenStreetMap data. Putting this all together into a Python script[36] we only had to execute and wait until the script retrieved geo coordinates one-by-one. This script is committed and pushed into the public repository. Once the script was done updating the Hunagiran settlements geographical coordinates (~1 hour of runtime), we copied over the latitude and longitude values to the Hungarian settlement parts table, where the settlement part is the center of the settlement. This helps us save approximately one hour of script execution and 3178 API calls from 13713 API calls, which is a 23.18% reduction in time and number of API calls. After the Python script runs all the Nominatim API calls we can take a look at the result of the tables we scraped together.

[25] https://www.ksh.hu/apps/hntr.egyeb?p_lang=EN&p_sablon=TELEPULESEK_ABC 2026-02-05
[26] https://www.ksh.hu/docs/helysegnevtar/dgh_download_2025.xlsx 2026-02-05
[27] https://excel.cloud.microsoft/ 2026-02-05
[28] https://en.wikipedia.org/wiki/Comma-separated_values 2026-02-05
[29] https://drive.google.com/file/d/1teZqolZxWlr0WeQ98yae9OzXJ_uNoFpu/view?usp=drive_link 2026-02-05
[30] https://drive.google.com/file/d/1x-U-DuFUbPmBbtyb6ADRupOYxxulYy0F/view?usp=drive_link 2026-02-05
[31] https://en.wikipedia.org/wiki/SQL 2026-02-05
[32] https://github.com/ARTidas/DroneResearch/blob/master/sql/setup.sql 2026-02-05
[33] https://github.com/ 2026-02-05
[34] https://github.com/ARTidas/DroneResearch/blob/master/sql/setup.sql#L160 2026-02-05
[35] https://nominatim.org/ 2026-02-05
[36] https://github.com/ARTidas/DroneResearch/blob/master/scrapers/geo/latitude_longitude_scraper.py 2026-02-05



Image[37]: All the settlements and settlement parts with latitude and longitude geographical coordinates displayed from the freshly scraped database tables on a map[38].

The next step in this side project is to check for errors and missing details. Running a left join between the questionnaire dataset and the geospatial dataset, and filtering for NULL values will yield us 65 postal codes with missing details from the questionnaire submissions.

Missing postal code coordinates	65	
From which belongs to Budapest	60	92.31%
Total missing by error	5	7.69%

Table[39]: Shows the result of the geo database joined by the questionnaire participants' responses. 5 postal codes require further investigation to have a latitude and longitude attribute value.

Missing coordinate postal codes
3527
3530
4028
4028
4405

Table[40]: The postal codes submitted by the questionnaire participants which are missing geographical latitude and longitude coordinates.

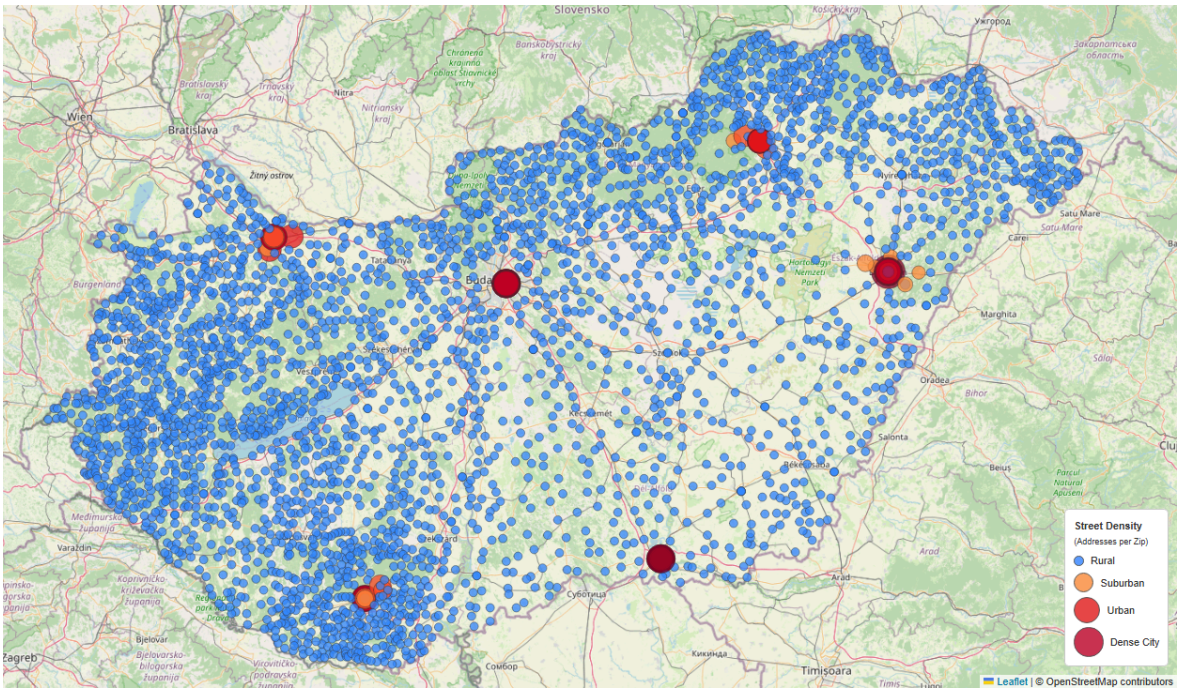
[37] Map_all_settlements.png
[38] https://research.artidas.hu/DroneResearch/map_all_settlements 2026-02-06
[39] DroneResearch
[40] DroneResearch

In order to check the validity of these submitted postal codes, they were manually crosschecked with the Hungarian Post Office table of post office numbers which can be found on their official website[41].

Missing coordinate postal codes	OSM	Found in OSM?	Found in MP?
3527	Hungary, Miskolc 3527	Yes	Yes
3530	Hungary, Miskolc 3530	Yes	Yes
4028	Hungary, Debrecen 4028	Yes	Yes
4028	Hungary, Debrecen 4028	Yes	Yes
4405	Hungary, Nyíregyháza 4405	Yes	Yes

Table[42]: All 5 missing questionnaire submission postal code records are valid and can be found on a level in the Hungarian Post Office datasheet table.

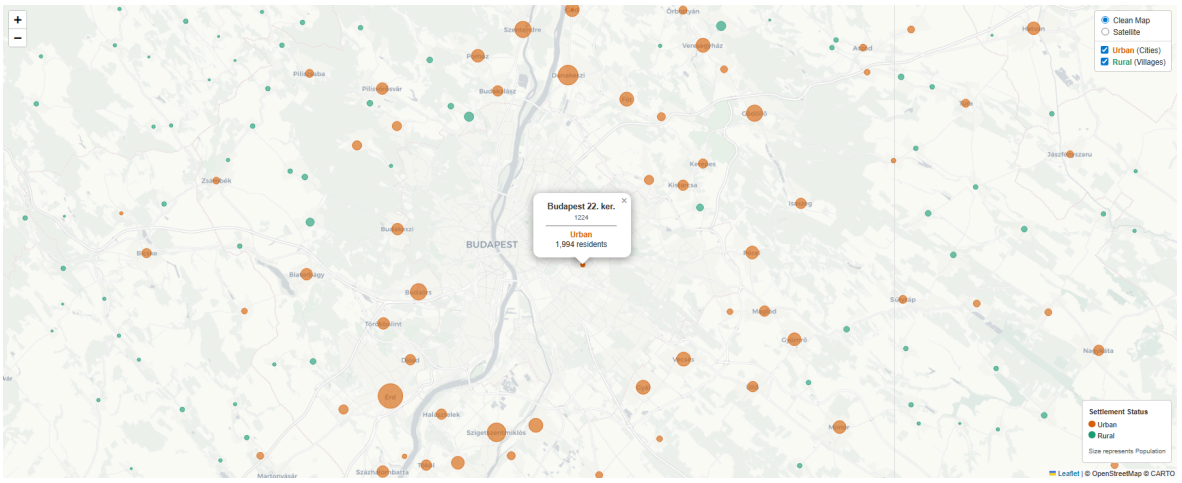
In order to address the missing information, we loaded the Hungarian postal codes from the Hungarian Post Office website[43]. Once the table is loaded with postal system information, we have updated latitude and longitude data from the existing settlements and settlement parts tables. Now we have settlement, settlement part and postal code level information of Hungary.



Image[44]: All Hungarian postal codes visualized on a map, and split into 4 categories depending on the number of streets they contain.

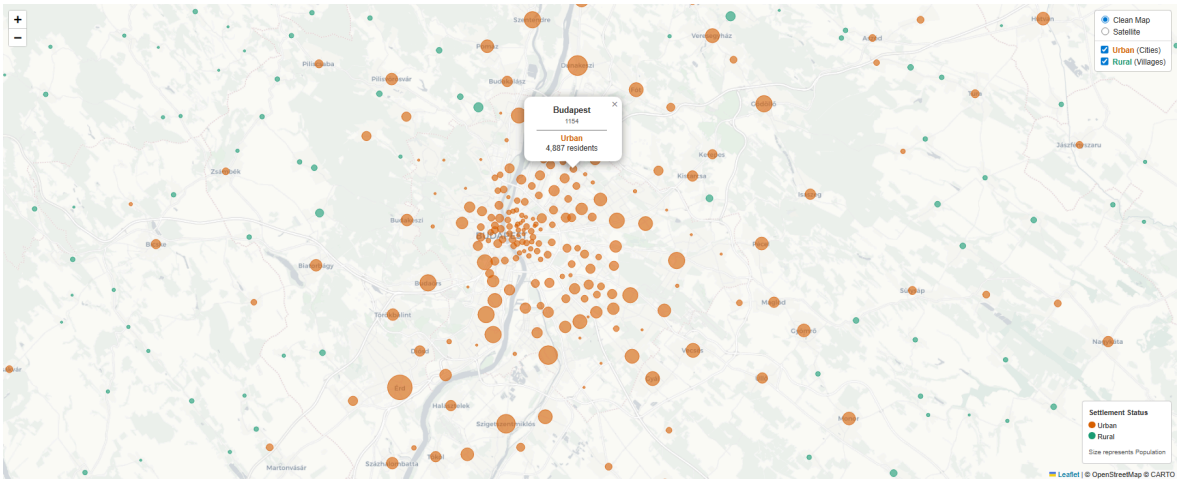
Continuing addressing missing or incorrect districts, we focus on the capital, Budapest.

[41] https://net.posta.hu/dashboard/public/dashboard-ui/iranyitoszam-kereso/download-as-table 2026-02-06
[42] DroneResearch
[43] https://net.posta.hu/dashboard/public/dashboard-ui/iranyitoszam-kereso/download-as-table 2026-02-07
[44] Map_all_postal_codes.png



Image[45]: All the capital districts are grouped in the center of the city.

We wrote a Python script to retrieve latitude and longitude geographical coordinates from the OSM database with an unstructured query in order to fix the grouping of the districts in the center of Budapest.



Image[46]: The capital districts placement after the fix.

After ensuring we do not see any issue with the loaded data we can now work on splitting the postal codes into rural and urban groups. For this, we use the administrative status classification we downloaded from the KSH website and loaded into our settlements table under the settlement_type attribute. For this thesis iteration, we decided that everything above the administrative status village[47] should be Urban.

settlement_type	record_count
főváros	1
megyei jogú város	7
megyeszékhely, megyei jogú város	18
fővárosi kerület	23
nagyközség	130

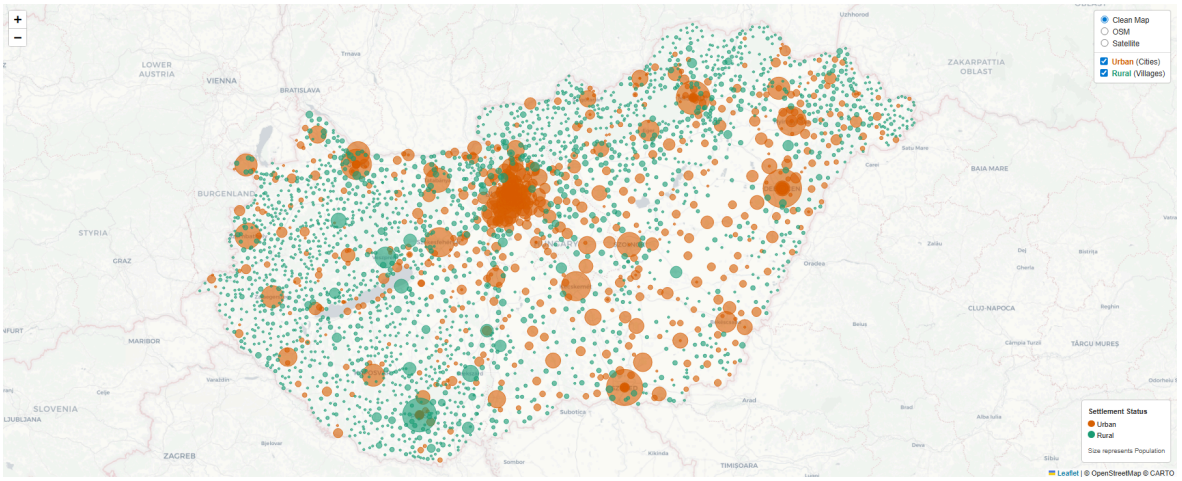
[45] Map_missing_Budapest_districts.png
[46] Map_missing_Budapest_districts_fix.png
[47] Translated from: Község

város	322
község	2677

Table[48]: A split of Hungarian settlements by administrative status classification and their count from our final settlements table.

category	total_population	percent_of_total
Rural	2,396,114	24.95%
Urban	7,207,520	75.05%
Total	9,603,634	

Table[49]: A split of the Hungarian population by our new classification of urban (village) vs rural (above village).



Image[50]: Urban vs. rural categorization of Hungarian postal codes.

Notes

In information technology, security should always be the first and last consideration. Utilizing a versioning control process and pushing code into a publicly visible central repository can lead to accidental password reveals. As database connections require authentication, often we need to hardcode these passwords into a plaintext file. Using the gitignore[51] file and listing the files which can contain such sensitive information, we can omit them from showing up in the public repositories.

Gathering and scraping data from publicly accessible data sources requires careful consideration and review of the actual owners license (and copyrights) under which they provide the information. For example, the KSH has a CC BY 4.0[52] license, which in layman terms mean: “can be copied, reproduced and redistributed without limitations”[53]. The latitude and longitude information retrieved by the Nominatim API is served from the OSM database. In this case we have to consider the OSM copyright and licensing requirements. The OSM licensing[54] states ODbL, which means

[48] DroneResearch
[49] DroneResearch
[50] Map_urban_vs_rural.png
[51] https://git-scm.com/docs/gitignore 2026-02-05
[52] https://creativecommons.org/licenses/by/4.0/ 2026-02-05
[53] https://www.ksh.hu/copyright_hungarian_central_statistical_office 2026-02-05
[54] https://www.openstreetmap.org/copyright 2026-02-05

we can copy, distribute and use the retrieved information from OSM databases, we can produce works, modify, transform and build upon as long as we attribute, share alike and keep open our results.
It is a good practice to not flood any APIs with requests as fast as you can trigger them. This may result in the false sensing from the API side that it is under a DDoS attack and will blacklist the IP address of the requester, or in a more graceful case, just temporarily banned from using the service. Hence, when scraping and building databases, it is a good practice to pace out requests with some sleep or timeout commands.
When scraping public databases, it is always a good practice to check the consistency and outliers in the resulting tables. For example, spreadsheet files can have summary rows at the end of their table. When importing a table file, we can skip the front rows, but often forget to check the end part of the file, assuming it does not contain anything else.
When we already have the data on our side, it is a good practice to update derived and sub tables from our side. This saves a lot of API calls and time.
Keeping data current and up-to-date is necessary for a long-term committed research project. Having a plan on how to identify stale data in a database starts with timestamping records.
Scraping scripts should be resilient and error prone. Handling errors and expecting premature runtime termination should be expected. Hence, designing a scraping script to be able to pick up work where it last encountered an error can save a lot of time and resources.
Running a large update on a database table may run into connection timeout issues and can be error prone. To overcome these burdens, it is recommended to run updates in manageable batches.
Keeping tables normalized can help retain data integrity, however, we must keep in mind to develop tables and produce results first, then work on database normalization. By deliberately omitting higher level normalizations, we can keep the mapping project development in quick iterations by trading off later issues when we would actually like to normalize the tables.

Web based ecosystem

After the first iteration of this thesis, the Google Form served its purpose properly, but as more statistical analysis is involved in the thesis, the more tedious the manual labour is to keep it up to date. Gathering the findings and experiences so far we decided to develop our own web based forms in order to move everything into a single ecosystem of information technology. Also, keeping in mind future work, we decided to introduce the country into the new form. For time saving and sake of simplicity, we decided to stay with the list of European countries. This also provided the first task to achieve, retrieve the list of European countries. The decision fell on the Council of Europe website[55]. Downloaded the website as a raw html file and with a few iterations, the scraper script was ready to provide a list of European countries. From this point it was a simple web development job to incorporate the existing Google Forms survey into our own web-server with our own database in the backend. To test the results, we utilised Selenium[56] to simulate hundreds of form submissions.

[55] https://www.coe.int/en/web/portal/members-states 2026-02-08
[56] https://www.selenium.dev/ 2026-02-09

Notes

When running a trial-and-error approach to brute-force development to create a scraping script, sometimes it is advisable to download the html website as a file and read that with the scraper script, instead of making web calls for each trial.
In conferences we observed it is a good practice to have a QR[57] code for your surveys and questionnaires for ease of access.
When doing an extensive Selenium test, it is always a good practice to have a plan to cleanup records from the database. This can be done in our case by primary key id attribute or by the updated_at attribute.

Filtering questionnaire submission

Once the web based solution is published on our web-server, we can continue researching ways to improve filtering questionnaire responses.
TODO…

Hypothesis testing

Tested hypothesis	Statistical test	Significance measurement	Result interpretation
$H1, H2, H3$	Independent samples t-test	The t-test compares the means between two independent groups.	If $p < 0.05$, then the effect is statistically significant (reject H_0)
$H4$	Person and Spearnam correlation	Correlation measures the strength and direction of the linear relationship between two continuous variables.	If $p < 0.05$, then the effect is statistically significant (reject H_0)

H1 hypothesis

Once the questionnaire results are in our database, we can query down necessary records with attributes.

```
SELECT
        CASE `RESPONSES`.`drone_familiarity`
                WHEN 'Soha nem találkoztam / nem foglalkoztam velük' THEN 'Less'
                WHEN 'Láttam már, vagy hallottam róluk a médiában / környezetemben' THEN 'Less'
                WHEN 'Kezeltem már drónt rövidebb ideig (pl. ismerősnél)' THEN 'More'
                WHEN 'Rendszeresen használok drónt (pl. hobby vagy munka céljából)' THEN 'More'
                ELSE 'ERROR'
        END AS `drone_familiarity_group`,
    ROUND((
                `RESPONSES`.`S1` + `RESPONSES`.`S2` + `RESPONSES`.`S3` + `RESPONSES`.`S4` +
        `RESPONSES`.`O1` + `RESPONSES`.`O2` + `RESPONSES`.`O3` + `RESPONSES`.`O4`
        ) / 8, 4) AS 'SO_Attitude',
    ROUND((
                `RESPONSES`.`W1` + `RESPONSES`.`W2` + `RESPONSES`.`W3` + `RESPONSES`.`W4` +
        `RESPONSES`.`T1` + `RESPONSES`.`T2` + `RESPONSES`.`T3` + `RESPONSES`.`T4`
```

[57] https://en.wikipedia.org/wiki/QR_code 2026-02-09

```
        ) / 8, 4) AS 'WT_Attitude'
FROM
        `02773_research`.`form_responses_drone_society` `RESPONSES`
        LEFT JOIN `02773_research`.`geo_hungary_postal_codes_aggregated` `GEO_SETTLEMENTS`
                ON `RESPONSES`.`postal_code` = `GEO_SETTLEMENTS`.`postal_code`
WHERE
        `RESPONSES`.`postal_code` NOT IN ('1040 Wien','07634','Külföld') AND
        `RESPONSES`.`gender` NOT IN ('Húsos fagyi','') AND
        `RESPONSES`.`postal_code` > 0 AND
        `RESPONSES`.`age` > 17;
```

Code[58]: The query used to retrieve data for H1 hypothesis testing.

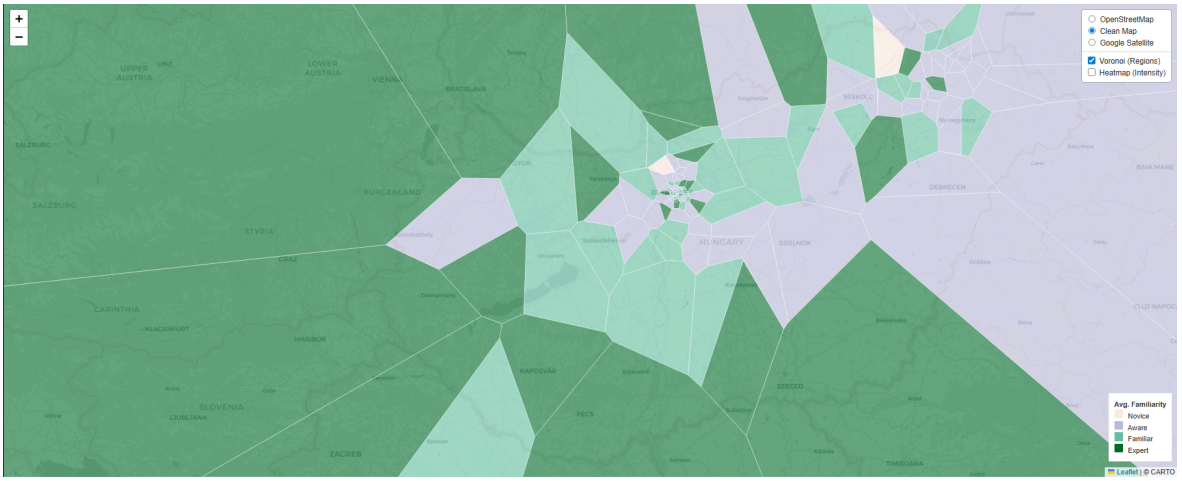
Once we retrieve the data from the database we can utilize JASP or a spreadsheet to calculate significance (p-value). For the H1 hypothesis, we deliberately computed with both methods to gain insights on pros and cons. The spreadsheet approach had an advantage that we were in control and were able to control the computation.

SpreadSheet		JASP	
Pros	Cons	Pros	Cons
Easy to overview computation	Hard to refresh and keep up-to-date	Easier to refresh and keep up-to-date	Hard to overview computation
More features to integrate into a thesis workflow	We need to write all computations	Out-of-the-box computations	Not many features help integration of results.

Experimenting with visualizations

Drone familiarity

TODO: Write paragraph on Voronoi graphs.

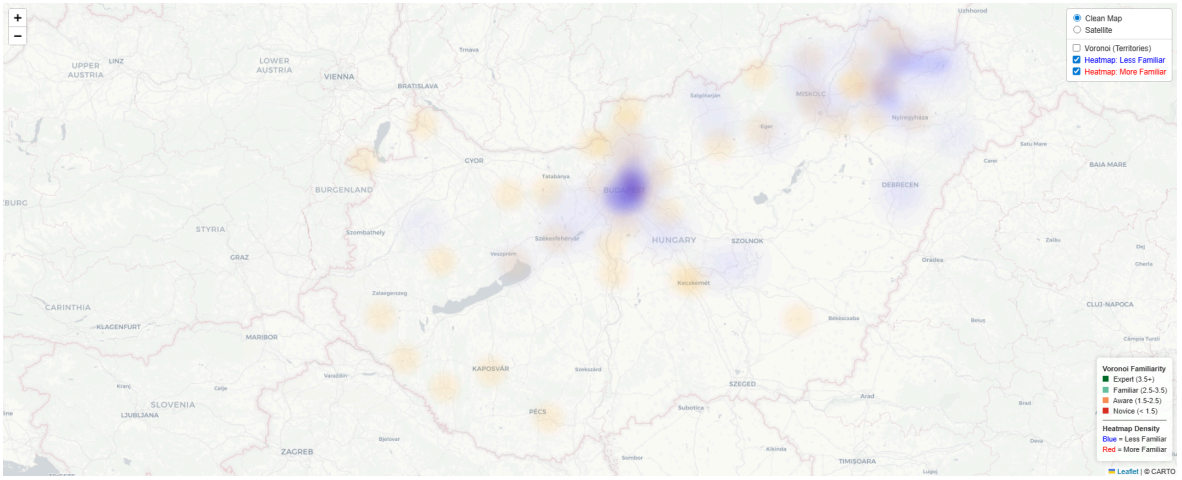


Image[59]: A Voronoi diagram on Hungary, displaying regions of drone familiarity.

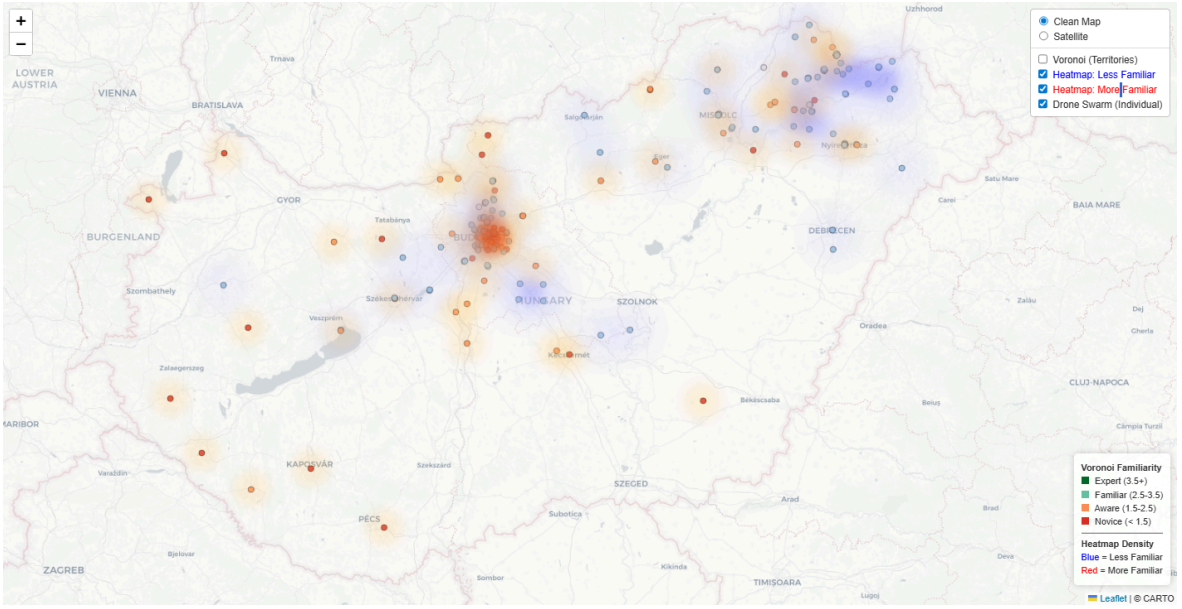
TODO: Write paragraph on heatmaps.

[58] https://github.com/ARTidas/DroneResearch/blob/master/sql/setup.sql 2026-02-11

[59] Map_drone_familiarity_voronoi.png

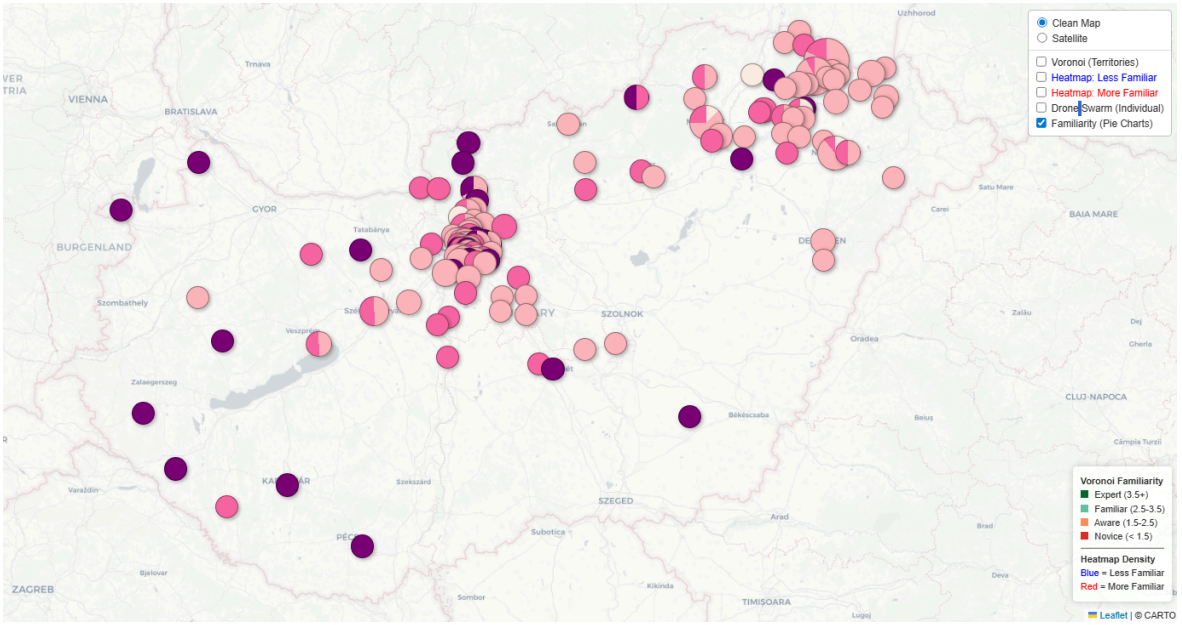


Image[60]: Heat map of “More” and “Less” drone familiarity groups.
TODO: Write paragraph of swarm map.



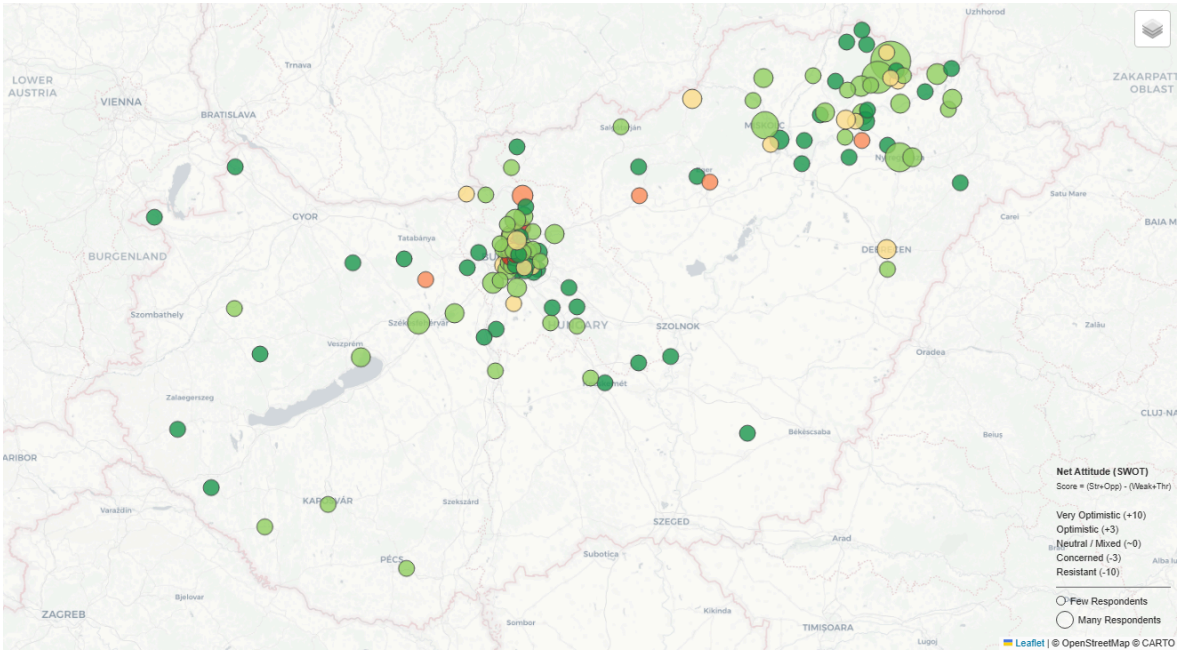
Image[61]: Heat map of “More” and “Less” drone familiarity groups with a swarm display.

[60] Map_drone_familiarity_heat.png
[61] Map_drone_familiarity_swarm.png



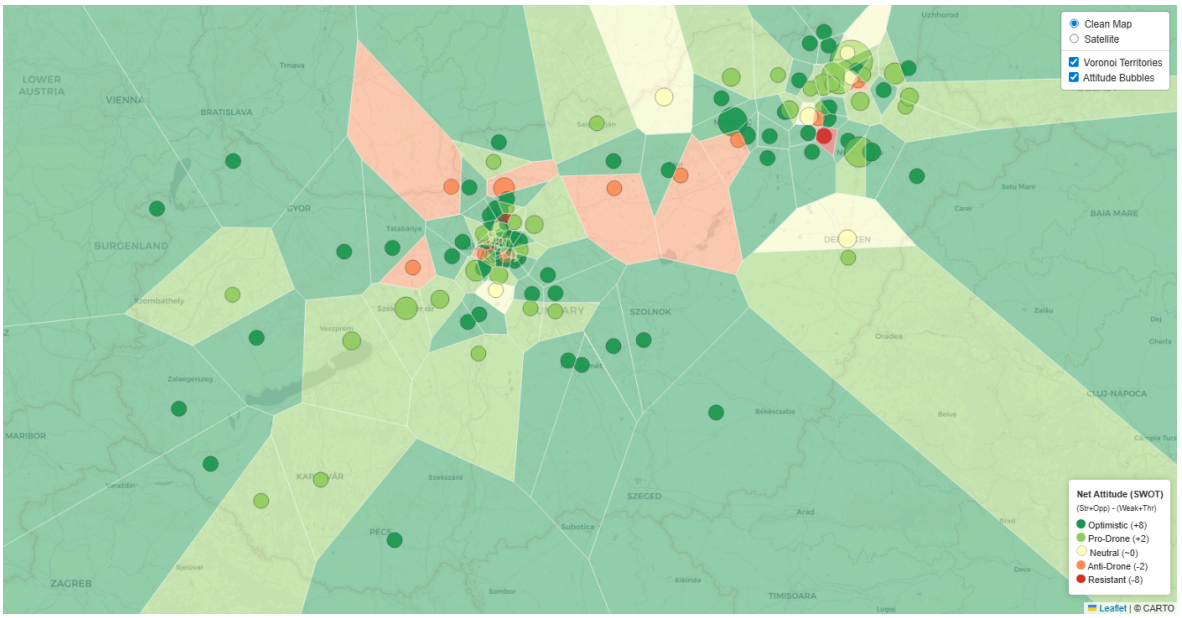
Image[62]: Pie charts displaying the ratio of drone familiarity for each postal code.

SWOT



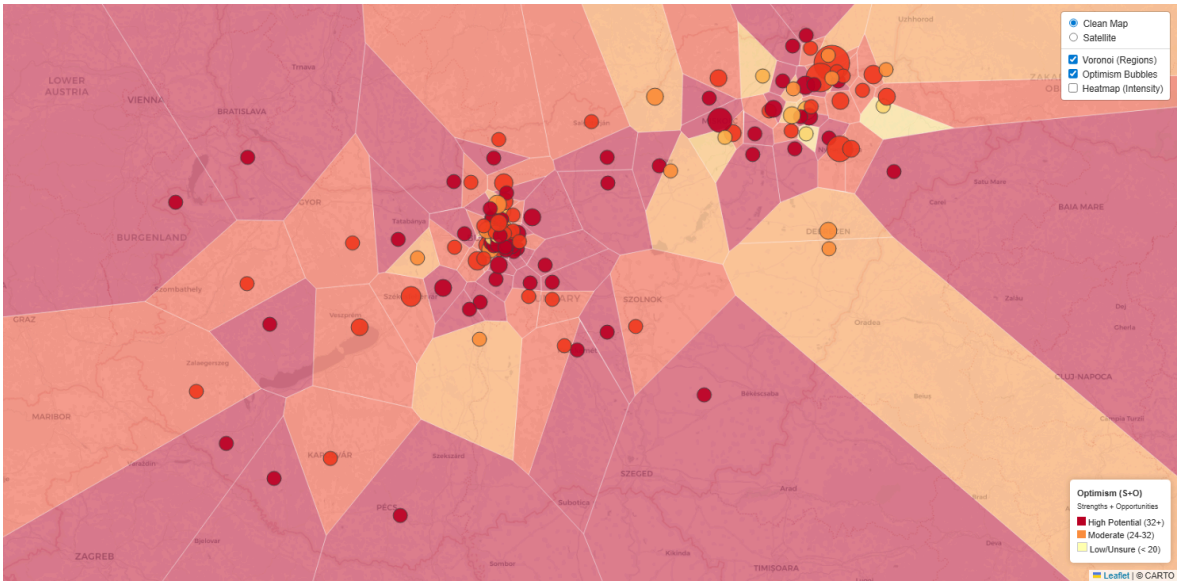
Image[63]: Net attitude visualized on the map of Hungary.

62 Map_drone_familiarity_mini_pie.png
63 Map_swot_net_attitude.png



Image[64]: Visualizing territories with Voronoi diagram by net attitude.

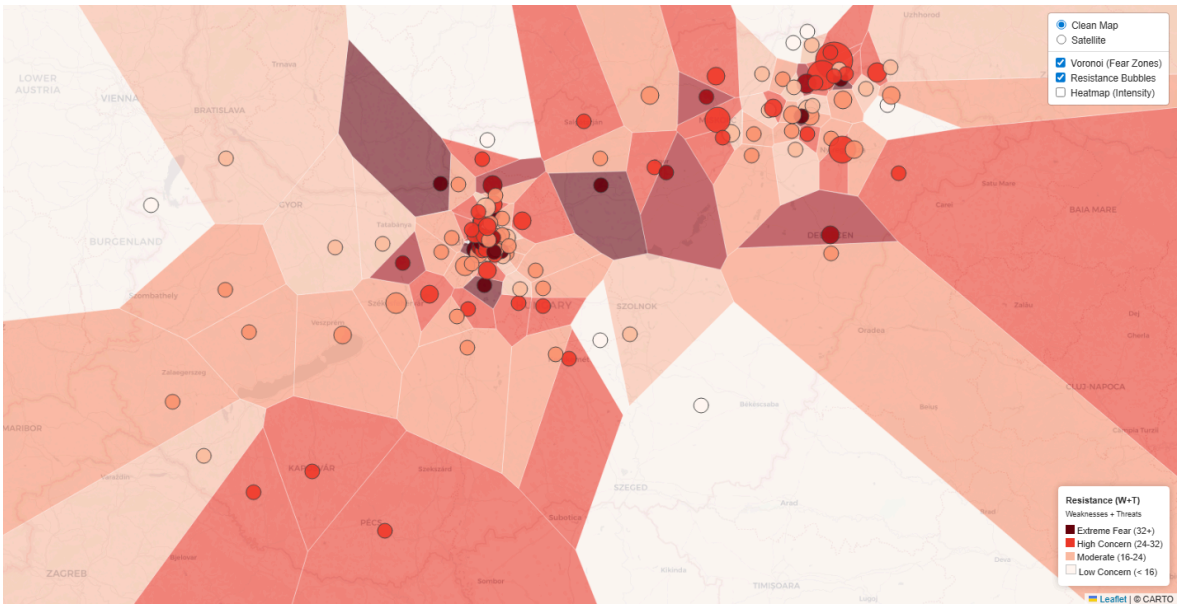
SO_Attitude



Image[65]: Visualizing territories SO_Attitude values.

[64] Map_swot_net_attitude_voronoi.png
[65] Map_so_attribute.png

WT_Attribute



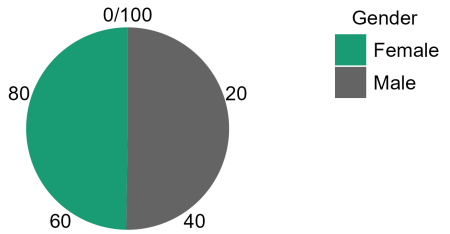
Image[66]: Visualizing territories WT_Attitude values.

[66] Map_wt_sttribute.png

VII. Results

Demographic profile

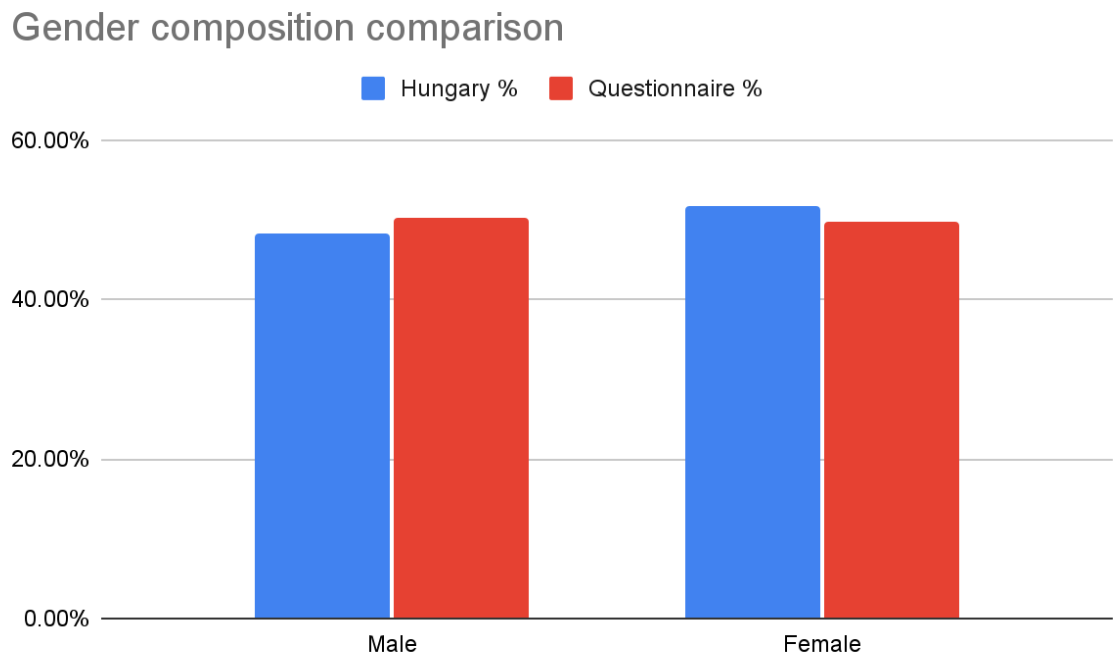
Gender



Descriptive Statistics	
	Gender
Valid	233
Missing	0

Image[67]: A pie chart showing the gender ratio of the questionnaire participants.

Table[68]: Descriptive statistics of the gender responses of the questionnaire participants.



Image[69]: Hungary and questionnaire responders gender composition comparison.

	Hungary	Questionnaire	Hungary %	Questionnaire %	Difference
Male	4,605,666	117	48.28%	50.21%	1.93%

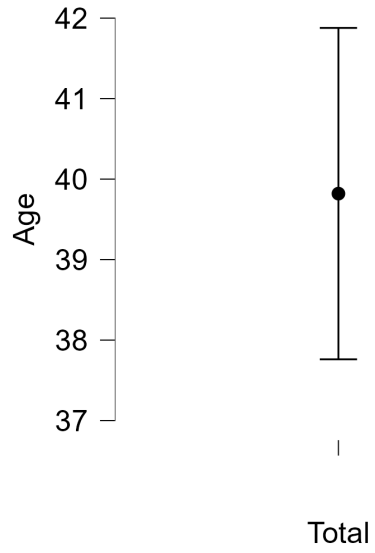
[67] Gender.png
[68] DroneResearch
[69] DroneResearch

Female	4,933,836	116	51.72%	49.79%	-1.93%
Total	9,539,502	233			

Table[70]: The gender composition comparison of Hungary and the questionnaire participants.

Comparing Hungary's gender composition from the KSH website[71] with the thesis questionnaire participants, we see a small difference of 1.93% male overrepresentation and 1.93% female underrepresentation.

Age



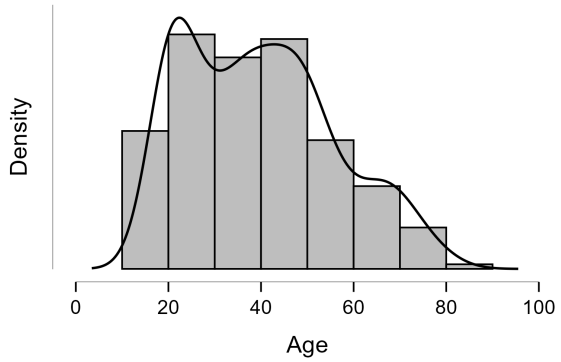
Image[72]: The interval plot of the age value from the questionnaire.

Descriptive Statistics

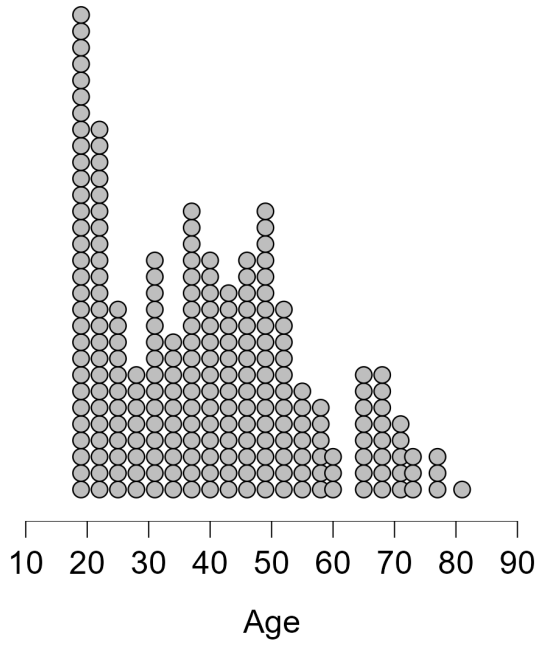
	Age
Valid	233
Missing	0
Median	39
Mean	39.82
Std. Deviation	16.03
MAD	13
Range	63
Minimum	18
Maximum	81

Table[73]: The descriptive statistics of the age values from the questionnaire.

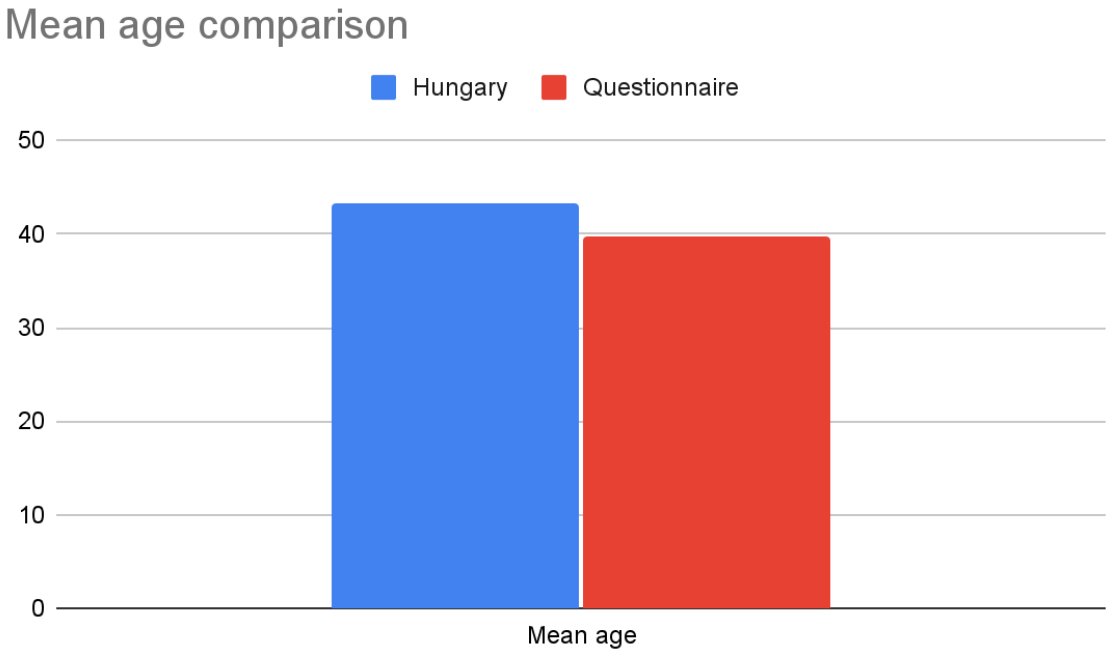
[70] DroneResearch
[71] https://www.ksh.hu/stadat_files/nep/en/nep0001.html 2026-01-31
[72] Age_interval_plot.png
[73] DroneResearch



Image[74]: Age distribution plot of the age value of the questionnaire participants.



Image[75]: Dot plot of the age value from the questionnaire.



Image[76]: Hungary and questionnaire responders mean age comparison.

[74] Age_distribution_plot.png
[75] Age_dot_plot.png
[76] DroneResearch

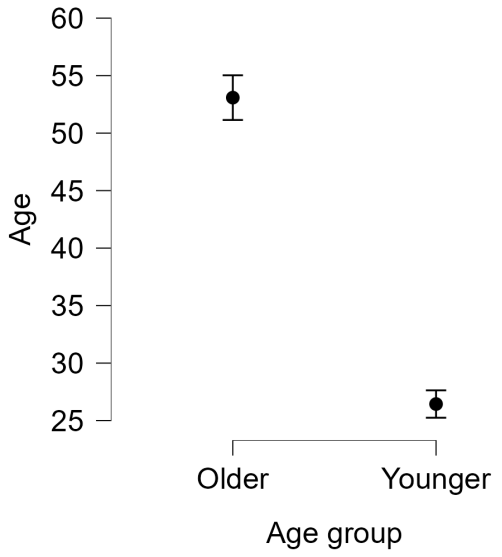
	Hungary	Questionnaire
Mean age	43.4	39.82
Standard deviation	unknown	16.03
Difference (absolute)		-3.58
Difference (percentage)		8.25%

Table[77]: Age comparison of Hungary and the thesis questionnaire.

Comparing the questionnaire responders mean age to the data available on the KSH website[78], we start to see a bigger deviation than we can see at the gender composition. The thesis questionnaire participants' arithmetic mean of age is 3. 58 years younger than the Hungarian population's mean age.

Age group

The life expectancy at birth year in Hungary in 2024 was 76. 64 years. We decided to half this value (38. 32 years) and split the participants into the older and younger age groups according to their age submitted in the questionnaire.



Image[79]: The interval plot of age groups.

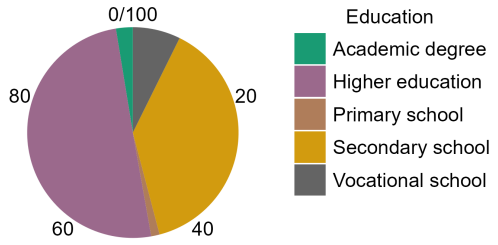
Descriptive Statistics

	Age	
	Older	Younger
Valid	117	116
Missing	0	0
Median	50	24.5
Mean	53.09	26.44
Std. Deviation	10.73	6.547
MAD	7	4.5
Range	42	20
Minimum	39	18
Maximum	81	38

Table[80]: Descriptive statistics of the questionnaire participants grouping into age groups by their selected age on the questionnaire.

[77] DroneResearch
[78] https://www.ksh.hu/stadat_files/nep/en/nep0001.html 2026-01-30
[79] Age_group.png
[80] DroneResearch

Education

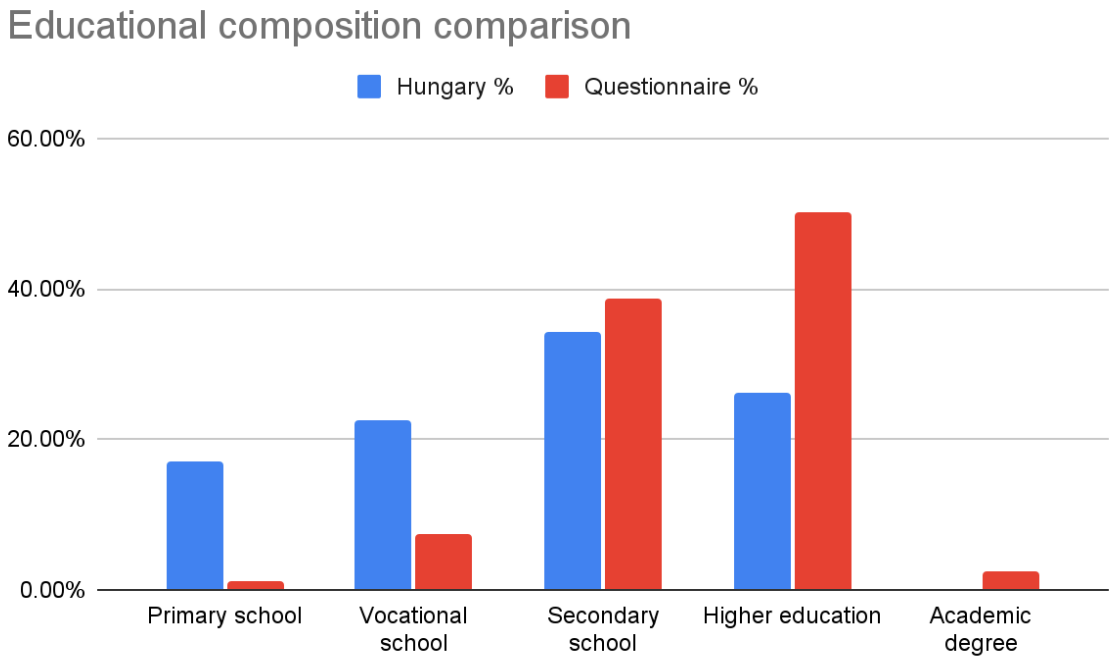


Image[81]: Pie chart of the distribution of the education among questionnaire participants.

Descriptive Statistics

	Education
Valid	233
Missing	0

Table[82]: Descriptive statistics of the education values selected by the questionnaire participants.



Image[83]: Hungary and questionnaire participants

	Hungary	Questionnaire responders	Hungary %	Questionnaire %	Difference
Primary school	1,221,200	3	17.06%	1.29%	-15.78%
Vocational school	1,606,100	17	22.44%	7.30%	-15.15%
Secondary school	2,448,800	90	34.22%	38.63%	4.41%

[81] Education.png
[82] DroneResearch
[83] DroneResearch

Higher education	1,877,700	117	26.24%	50.21%	23.98%
Academic degree	2,919	6	0.04%	2.58%	2.53%
Total	7,156,719	233			

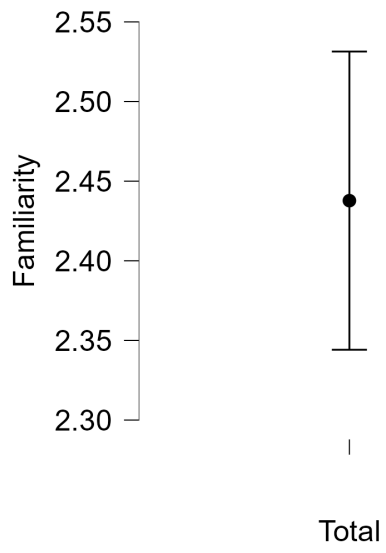
Examining the difference between the Hungarian educational composition and questionnaire participants' educational composition, we can see that the higher than vocational school education is overrepresented and the lower education is underrepresented. The secondary school and academic degree representation is the closest to the Hungarian levels. The higher education group is the most overrepresented (by 23.98%).

Familiarity

We asked the questionnaire participants to define their level of familiarity with drones: "To what extent are you familiar with or do you use drones?[84]". The questionnaire provided 4 options to choose from:

1. I have never encountered or dealt with them[85]
2. I have seen or heard about them in the media or in my surroundings[86]
3. I have operated a drone for a short time (e.g., at a friend's or acquaintance's)[87]
4. I use drones regularly (e.g., for hobbies or work)[88]

And we assigned a numerical value for analytical purposes for each answer: 1-4. This can be considered as a 4 level Likert. The mean of the scale is 2.5.



Image[89]: The interval plot of the familiarity values of the questionnaire.

Descriptive Statistics

	Familiarity
Valid	233
Missing	0
Median	2
Mean	2.438
Std. Deviation	0.729
MAD	0
Range	3
Minimum	1
Maximum	4

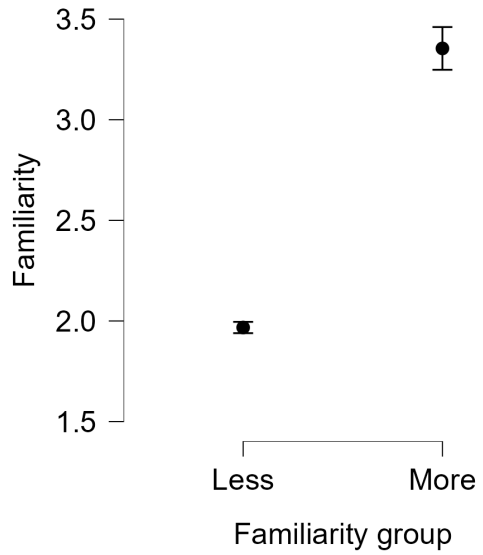
Table[90]: Descriptive statistics of the questionnaire participants familiarity with drones.

[84] Translation from: Mennyire ismeri vagy használja a drónokat?
[85] Translation from: Soha nem találkoztam / nem foglalkoztam velük
[86] Translation from: Láttam már, vagy hallottam róluk a médiában / környezetemben
[87] Translation from: Kezeltem már drónt rövidebb ideig (pl. ismerősnél)
[88] Translation from: Rendszeresen használok drónt (pl. hobby vagy munka céljából)
[89] Familiarity.png
[90] DroneResearch

The questionnaire responses are 2. 48% (2. 438 vs. 2. 5) under the mean of the scale.

Familiarity group

Derived from the numerical familiarity values we introduce the familiarity group concept to categorise and make observations possible. As the questionnaire familiarity group values mean is close to the possible mean value of the questionnaire options we decided to split the questionnaire participants into two categories (groups). “Less” and “More”.



Image[91]: The interval plot of the questionnaire participants drone familiarity values categorised into 2 groups.

Descriptive Statistics

	Familiarity	
	Less	More
Valid	154	79
Missing	0	0
Median	2	3
Mean	1.968	3.354
Std. Deviation	0.178	0.481
MAD	0	0
Range	1	1
Minimum	1	3
Maximum	2	4

Table[92]: Descriptive statistics of the questionnaire participants grouping into familiarity groups by their drone familiarity scale.

Settlement type

In order to map the questionnaire participants to a settlement, we asked them to provide their postal code. With this feature in the questionnaire we still were able to anonymize the responses and have a very good understanding of the questionnaire participants' background.

Reliability analysis

TODO: How many total questionnaire submissions and how it was filtered.

Frequentist Scale Reliability Statistics

			95% CI	
Coefficient	Estimate	Std. Error	Lower	Upper

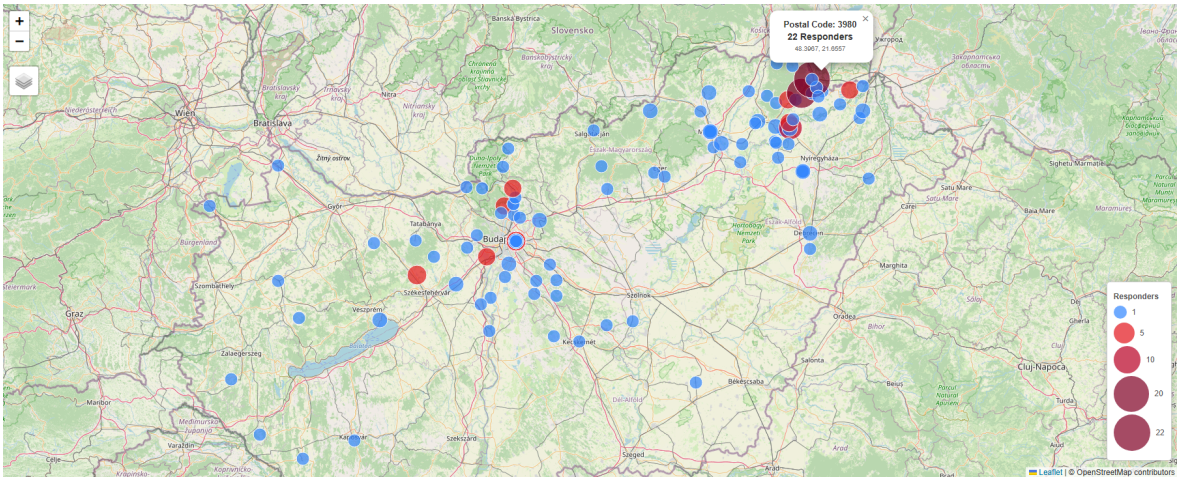
[91] Familiarity_group.png
[92] DroneResearch

Coefficient ω	0.75	0.02	0.70	0.79
Coefficient α	0.79	0.02	0.75	0.84
Mean	3.42	0.04	3.35	3.48
SD	0.53	0.03	0.49	0.58

Examining the questionnaire submissions consistency with Cronbach's α, we can see an acceptable reliability ($\alpha = 0.79,\ 95\%\ CI\ [0.75,\ 0.84]$).

Spatial analysis

We loaded 3178 settlements from the KSH website with longitude and latitude geospatial values with the help of the OSM database through the Nominatim API. Also, we loaded 13713 settlement parts with postal code details and checked the OSB database if we can find latitude and longitude positions for these. While working on the geo database, we found a quick solution to reduce the number of Nominatim API calls by 23.18% and save around an hour of Python script runtime execution. The format of these 2 relational database tables can be used in future projects and research.



Image[9394]: The postal codes of the questionnaire responders displayed on the map of Hungary with counts, represented with circle size and color.

The geographical distribution of the questionnaire responders, based on postal codes, reveals a significant concentration around the University of Tokaj and the capital, Budapest. Examining the map will tell us that the southern part of Hungary is probably under-represented.

[93] Questionnaire_responses_Hungary.png

[94] https://research.artidas.hu/DroneResearch/map_v2 2026-01-30

Word cloud

Image[95]: The Hungarian word cloud of the questionnaire question "What is your greatest fear or hope concerning drones?"[96].

Image[97]: The English word cloud of the questionnaire question "What is your greatest fear or hope concerning drones?"[98].

Descriptive analysis of variables

TODO:

[95] Thesis_WordCloud_Hungarian.png
[96] Translated from: Mi a legnagyobb félelme/reménye a drónokkal kapcsolatban?
[97] Thesis_WordCloud_English.png
[98] Translated from: Mi a legnagyobb félelme/reménye a drónokkal kapcsolatban?

Hypothesis testing

TODO: Write paragraph about result.

Significance

Hypothesis	Statistical Test	Dependent Variable	Value	Result	Conclusion
H1: Knowledge has a positive effect on attitude	t-test	$SO\_Attitude$ (Positive attitude)	$p = 0.031$	Statistically significant ($p < 0.05$)	Confirmed: Higher knowledge is associated with a more positive perception.
H2: Women perceive greater privacy concerns than men	t-test	$WT\_Attitude$ (Negative attitude)	$p = 0.773$	Not statistically significant ($p \geq 0.05$)	Not confirmed: No significant difference between genders was found in overall threat perception.
H3: Urban population has a more positive attitude	t-test	$WT\_Attitude$ (Negative attitude)	$p = 0.002$	Statistically significant ($p < 0.05$)	Surprising inverse finding: Urban residents hold a significantly higher negative attitude toward drones than rural residents.
H4: Inverse correlation between utility and noise	Pearson and Spearman Correlation	$SO\_Attitude$ (Positive attitude) vs. W1 (Noise)	$p < 0.001$ $r = -0.208$	Statistically significant ($p < 0.05$)	Confirmed: Greater perceived utility is strongly linked to lower sensitivity to noise pollution.

Hypotheses

H1: Knowledge about drones has a positive effect on their perception

We categorized the questionnaire participants into 2 groups by their response on the “How familiar are you with drones or how often do you use them?”[99] question.

Descriptives

Group Descriptives	Group	N	Mean	SD	SE	Coefficient of Variation

[99] Drones in Everyday Life: A SWOT Analysis of Social Perception in Hungary

SO_Attitude	Less	154	3.766	0.666	0.054	0.177
	More	79	3.962	0.624	0.070	0.158
WT_Attitude	Less	154	3.061	0.718	0.058	0.235
	More	79	2.881	0.762	0.086	0.265

Independent samples t-test (Student's t-test)

	t	df	p	Mean Difference	SE Difference
SO_Attitude	-2.171	231	0.031	-0.196	0.090
WT_Attitude	1.769	231	0.078	-0.180	0.101

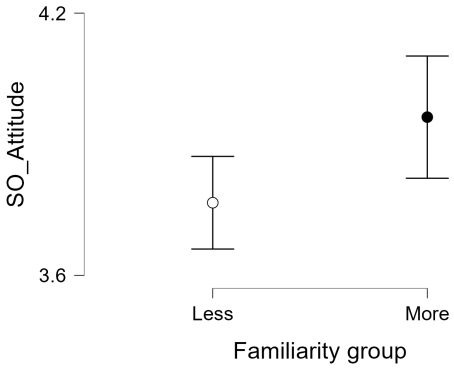
Conclusion

Descriptives for H1 (Knowledge positively affects drone perception) support the hypothesis by comparing attitude means between groups with Less and More drone knowledge.

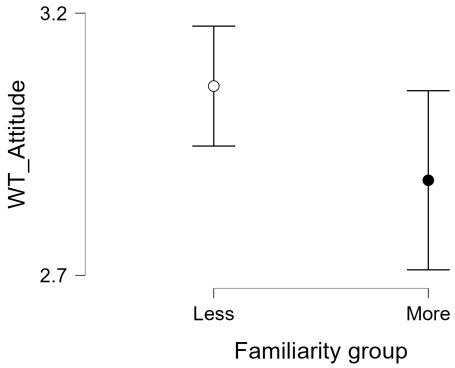
Positive Attitude (SO_Attitude): The "More" knowledge group shows a higher mean (3.962 vs. 3.766) and less variation ($SD = 0.666$, $Coefficient\ of\ Variation = 0.177$), indicating a stronger, more consistent positive perception.

Negative Attitude (WT_Attitude): The "More" knowledge group has a lower mean (2.881 vs. 3.061), suggesting less negative concern, which also supports a more positive perception.

These descriptive patterns confirm the statistically significant H1 result ($p = 0.031$): higher drone knowledge correlates with both higher positive and lower negative attitude scores.



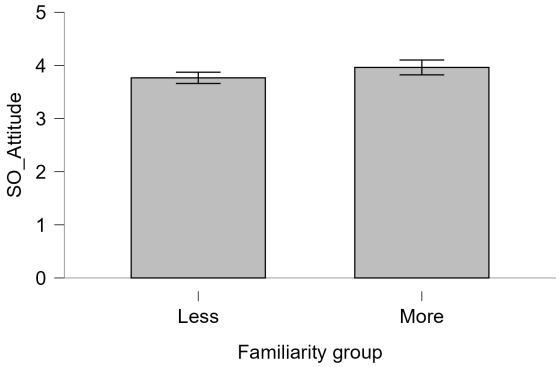
Image[100]: Positive attitude (SO_Attitude) comparison with descriptive plots between the two familiarity groups (More, Less).



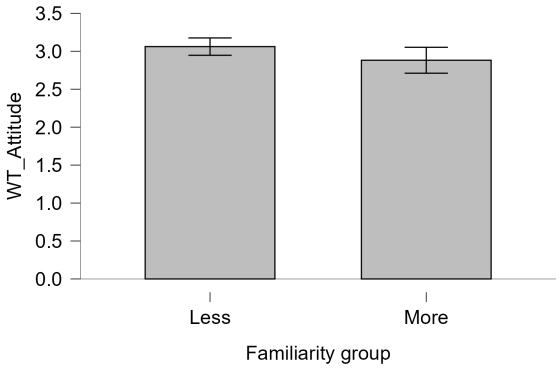
Image[101]: Negative attitude (WT_Attitude) comparison with descriptive plots between the two familiarity groups (More, Less).

[100] H1_descriptives_SO_Attitude.png

[101] H1_descriptives_WT_Attitude.png



Image[102]: Positive attitude (SO_Attitude) comparison with bar plots between the two familiarity groups (More, Less).



Image[103]: Negative attitude (WT_Attitude) comparison with bar plots between the two familiarity groups (More, Less).

[102] H1_bar_plots_SO_Attitude.png
[103] H1_bar_plots_WT_Attitude.png

H2: Women perceive drones as a greater risk to their privacy than men

Descriptives

Group Descriptives	Group	N	Mean	SD	SE	Coefficient of Variation
SO_Attitude	Male	117	3.893	0.652	0.060	0.168
	Female	116	3.772	0.659	0.061	0.175
WT_Attitude	Male	117	3.014	0.771	0.071	0.256
	Female	116	2.986	0.704	0.065	0.236

Independent samples t-test (Student's t-test)

	t	df	p	Mean Difference	SE Difference
SO_Attitude	1.415	231	0.158	0.122	0.086
WT_Attitude	0.288	231	0.773	0.028	0.097

Conclusion

The analysis indicates that the null hypothesis ($H2_0$) (there is no difference in the perceived threat of drones to personal privacy between women and men) was not rejected.
This suggests that, for the measured group, gender does not play a significant role in determining the overall negative attitude toward drones (which includes privacy and threat concerns).

H3: Urban society views the presence of drones more positively

Descriptives

Group Descriptives	Group	N	Mean	SD	SE	Coefficient of Variation
SO_Attitude	Rural	65	3.812	0.664	0.082	0.174
	Urban	168	3.841	0.656	0.051	0.171
WT_Attitude	Rural	65	2.760	0.621	0.077	0.225
	Urban	168	3.093	0.758	0.058	0.245

Independent samples t-test (Student's t-test)

	t	df	p	Mean Difference	SE Difference
SO_Attitude	-0.304	231	0.761	-0.029	0.096

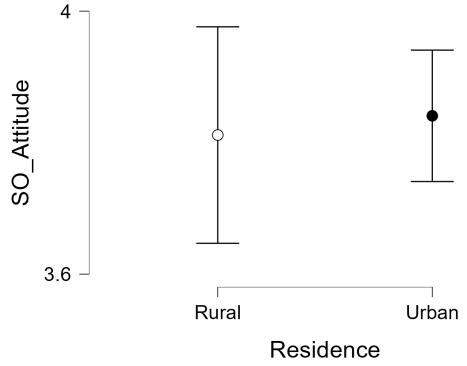
WT_Attitude	-3.158	231	0.002	-0.333	0.106

Conclusion

This result is a surprising inverse finding. The initial expectation, typical in innovation adoption studies, was that urban areas (with higher density, technology familiarity and greater exposure to potential smart city applications) would be more receptive.
Instead, the higher negative attitude (WT_Attitude) in urban settings suggests that city dwellers are more acutely sensitive to negative factors of drone usage.

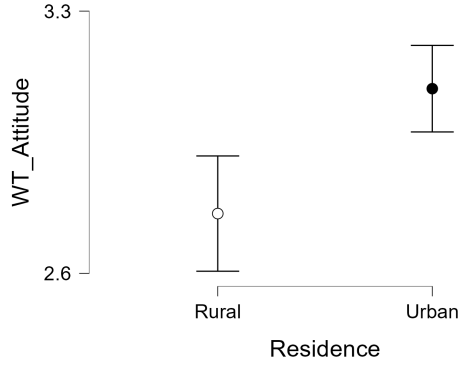
1. Noise pollution (W1): In dense environments, the noise drones make are more likely to be perceived as disturbing.
2. Privacy concerns (T1): Higher density means drones are more likely to capture private spaces, increasing surveillance and privacy anxieties.

These findings imply that any drone implementation in urban centers (such as delivery or surveillance operations) requires strict regulation and careful service design to mitigate perceived disturbances and risks, rather than simply focusing on the technological utility. This runs counter to strategies targeting early technology adopters often found in urban hubs.

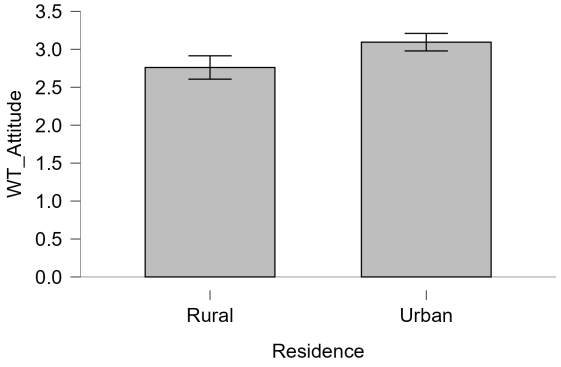


Image[104]: Positive attitude (SO_Attitude) comparison with descriptive plots between the two residency groups (Rural, Urban).

Image[106]: Positive attitude (SO_Attitude) comparison with bar plots between the two residency groups (Rural, Urban).



Image[105]: Negative attitude (WT_Attitude) comparison with descriptive plots between the two residency groups (Rural, Urban).



Image[107]: Negative attitude (WT_Attitude) comparison with bar plots between the two residency groups (Rural, Urban).

[104] H3_descriptives_SO_Attitude.png
[105] H3_descriptives_WT_Attitude.png
[106] H3_bar_plots_SO_Attitude.png
[107] H3_bar_plots_WT_Attitude.png

H4: There is a correlation between noise pollution and utility of a drone

Descriptives

	Positive attitude (SO_Attitude)				
W1 Likert	1	2	3	4	5
Valid	38	54	88	35	18
Missing	0	0	0	0	0
Median	4.125	4.000	3.875	4.000	3.313
Std. Deviation	4.105	3.794	3.831	3.861	3.326
Coefficient of variation	0.167	0.172	0.153	0.135	0.269
Variance	0.472	0.424	0.343	0.270	0.804
Range	3.500	2.750	2.750	1.875	2.750
Minimum	1.500	2.125	2.250	2.750	2.000
Maximum	5.000	4.875	5.000	4.625	4.750

Pearson and Spearman Correlation

Note: All tests are one-tailed for negative correlation.

			Pearson		Spearman		
		n	t	p	r	p	Covariance
W1	SO_Attitude	233	-0.208	<0.001	-0.176	0.004	-0.155

Conclusion

The correlation analysis performed to test H4 found a p-value of < 0.001. Since this value is well below the conventional $\alpha = 0.05$ significance threshold, the result is deemed statistically significant. The null hypothesis ($H4_0$), which stated there is no negative correlation between perceived usefulness and noise disturbance, is therefore rejected.

The strength and direction of the linear relationship were measured using the Pearson correlation coefficient (r). The coefficient is negative ($r = -0.208$). This confirms the hypothesized inverse relationship: As the score for perceived utility (SO_Attitude) increases (more positive), the score for perceived noise disturbance (W1) decreases (less disruptive). The magnitude of the correlation ($|r| \approx 0.2$) suggest a weak, but measurable relationship.

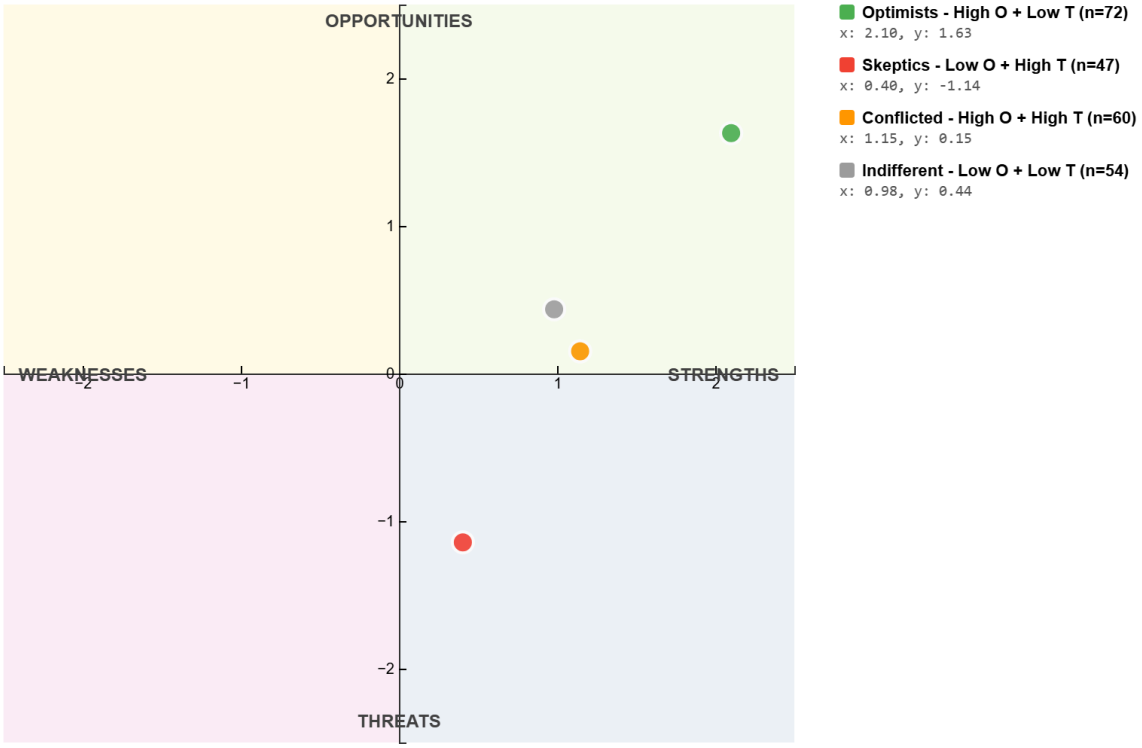
This is a critical implication for adoption strategies: Focusing on tangible benefits and positive services is more likely effective in increasing public tolerance for nuisance like noise than trying to address the noise issue in isolation.

Psychographic Clusters (Optimist vs Skeptic)

We split the questionnaire participants into 4 categories. Optimists, skeptics, conflicted and indifferent. The split will be done on the arithmetic average of the opportunity attitude (O_attitude value[108]):

$$O\_Attitude = \frac{O1+O2+O3+O4}{4}$$

The purpose of this split is to inspect how the questionnaire participants perceive drones in their everyday life.



Image[109]: Strategic Comparison (Clusters).

Cluster	Optimists	Skeptics	Conflicted	Indifferent
Profile	High opportunity (O) + low threat (T)	Low opportunity (O) + high threat (T)	High opportunity (O) + high threat (T)	Low opportunity (O) + low threat (T)
n	72	47	60	54
x	2.10	0.40	1.15	0.98
y	1.63	−1.14	0.15	0.44
% of total	30.90%	20.17%	25.75%	23.18%

[108] Drones in Everyday Life: A SWOT Analysis of Social Perception in Hungary
[109] SWOT_clusters_net_position.png

The “Optimists”, alias “Champions”

Strong conviction. The optimists clusters x-axis value is very high (2.10). They probably believe drones are reliable, capable and barely see any weaknesses. These people do not require any convincing and can be the biggest advocates if mobilized for the popularity of drones.

The “Skeptics”, alias “Resisters”

Surprisingly, the skeptics x-axis value is still positive (0.40). They probably admit the drone technology works and is necessary. We could translate this as they believe drones are not “bad junk”, but “dangerous tools”. Their negative y-axis (-1.14) shows they still see the downsides. They do not see enough value to justify the risk. These people cannot be won with strengths. We can only mitigate their opposition by addressing the threats with strict safety regulations.

The “Conflicted”, alias “Swinging vote”

They are the most critical groups for policy makers and usually held back by fear. If we address the conflicted clusters' fears with regulations and safety precautions, they probably migrate to the optimist camp. If we ignore their concerns, they will slide into skepticism.

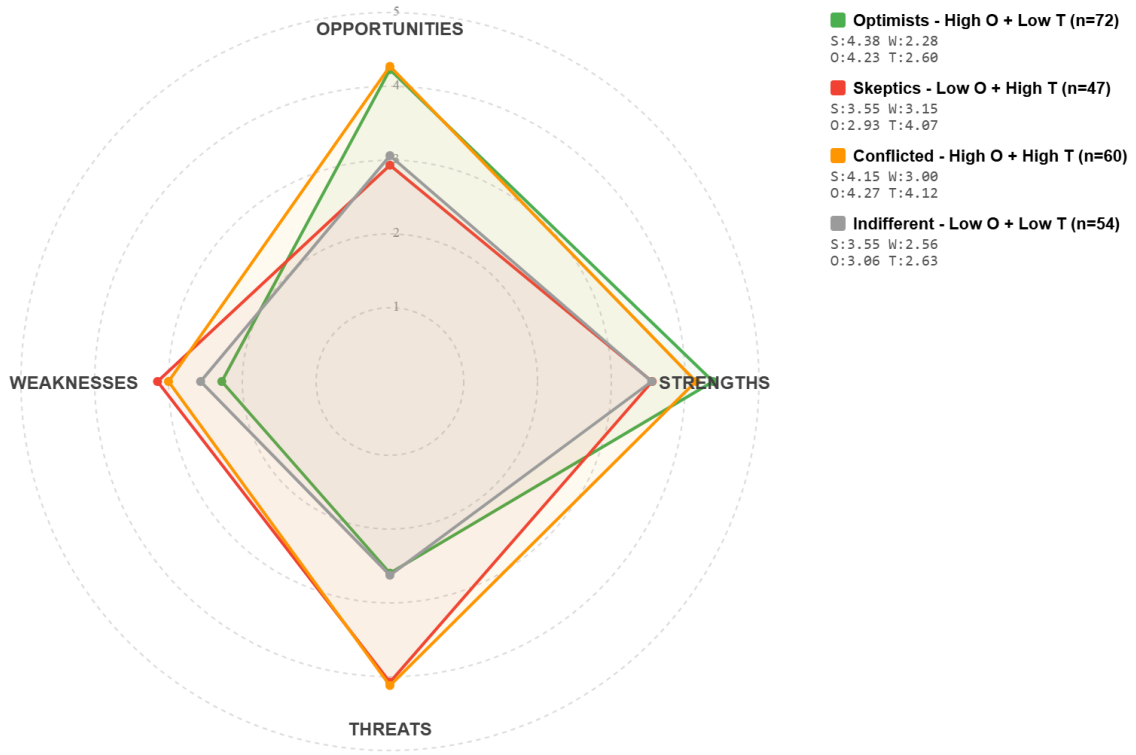
The “Indifferent”, alias “Silent majority”

Their score usually found near the origo of the x and y axis. Probably, for them, the drones are just a toy. They do not see the technology as a life-changing opportunity or a civilization-ending threat. For them, drones are toys and a niche tool. Will not oppose drones around themselves, but will be unengaged.

Conclusion

This split signifies that the barrier to drone acceptance is external threats and not internal weaknesses.

1. The technology is accepted. Even the skeptics has a positive x-axis value (0.40).
2. Fear is the divider, The considerable y-axis distance (2.77) between optimists $(y = 1.63)$ and skeptics $(y = -1.14)$ is entirely driven by how external threats (privacy, safety) are perceived.
3. There are a considerable percentage (total $n = 233$ of which 60 is conflicted (25.75%)) of people who are ready to support drones if their fears are reassured.
4. Future drone integration strategies should focus on regulatory frameworks that mitigate perceived threats instead of proving the drone technology’s capability.



Image[110]: Component Comparison (Clusters).

Website form

Once the first iteration of the thesis yielded insightful presentations, the next great task was to implement our findings into a web based form. For sake of simplicity, we decided to only focus on the European region first as even finding a thorough list of countries can be challenging. The decision fell on the Council of Europe website.

Notes.

It is necessary to keep in mind to always sanitize user input data and make the form as robust and error resistant as possible.
We find that questionnaire participants sometimes share sensitive data in their responses. By this excuse, we will not publish raw questionnaire csv files nor the contents of the questionnaire response tables.
Managing internationalization and introducing best practices early on will pay off in the long run.
Invest some thoughts on managing even the simplest country selection.

Live updating geographical heatmap

TODO…

[110] SWOT_clusters_components.png

Hungarian postal map

Settlements

TODO…

Settlement parts

TODO…

Postal codes

TODO…

Postal codes aggregated

TODO…

VIII. Discussions

1. What is the best method to analyze social attitude towards a conception?
2. What are the advantages and disadvantages of a few level (e.g: 5) versus many level Likert scale (e.g: 10)?
3. An odd or even leveled Likert scale would provide more precise results for our measurements?
4. What demographic group would have the most positive attitude towards drones?
5. What demographic group would have the most negative attitude towards drones?
6. What comes to mind when they hear a drone rotor?
7. What could be the best methodology representing average for our purpose? Mean, median, mode?
8. How can this research project be valuable as a long-running research? Time series data visualisations? Can they have benefits?
9. How to develop drone promoting campaigns for the populus?
10. Is the public ready for a widespread drone introduction into their everyday life?
11. What possible challenges can a widespread drone introduction could yield from the general public?
12. Which is better and why from the point of scientific research? Postal code or settlement name? What would be the best for geospatial analysis?
13. What are the best practices to make this study and survey international?
14. What are the best user experience[111] features to implement? How can we improve our survey?
15. How to prevent abuse of the public facing form submission?
16. How can we protect our form against automated fill out services? Like FormFutar[112]?
17. What are the best tools to conduct research? What tools can be integrated into what workflows?

[111] https://en.wikipedia.org/wiki/User_experience 2026-02-09
[112] https://formfutar.hu/ 2026-02-09

IX. Conclusions

X. Future work

1. Implementing the questionnaire into our own website and solution.
2. Continuously monitor the drone perception among questionnaire participants.
3. Testing and analysing for different averages (geometric, median, mode).
4. Incorporate the same demographic splits as the Hungarian KSH website uses, for a much more comprehensive check on representation.
5. Spatial analysis of Hungary's population density compared to the questionnaire participants' postal code density.
6. Create a questionnaire to test what the generic population associates with the word: Drone.
7. Considerations on how to split the population into older and younger buckets
   7.1. Maybe instead of the half value of the average life expectancy at birth can be improved upon.
   7.2. Maybe the average age from the Hungarian KSH website[113]?
8. Have an updated_at timestamp in our database tables to be able to have an update policy by most stale data.
9. Consider testing Qualtrics[114] for survey submissions.
10. Identify drone solutions populizing agenda and identify how to turn the conflicted population into optimists.
11. Create forms in multiple languages and start surveying the neighbouring countries.
12. Find a reliable and up-to-date kept source for countries.
13. Refactor codebase.
14. Enlist the services of a research agency for survey fills.
15. Research services which can be provided by drones and survey how these services would be welcomed in various regions.
16. Measure financial situation. Showcase if there is a “Digital divide” in Hungary.

[113] https://www.ksh.hu/stadat_files/nep/en/nep0002.html 2026-02-03
[114] https://www.qualtrics.com/market-research/ 2026-02-05

XI. Attachments

Acknowledgments

1. Eszter
    1.1. My Wife, thank you for holding the fort while I am researching.
2. Ábel
    2.1. My Son, thank you for your patience.
3. Dr. István Takács
    3.1. Thank you for showing me the SWOT analysis idea and being my Consultant and spending those countless hours discussing our research.
4. OpenStreetMap (OSM)
    4.1. https://www.openstreetmap.org/copyright
    4.2. https://opendatacommons.org/licenses/odbl/
    4.3. Hungarian settlement geo coordinates were retrieved from this source.
5. Központi Statisztikai Hivatal (KSH, Hungarian Central Statistical Office)
    5.1. https://www.ksh.hu/copyright_hungarian_central_statistical_office
    5.2. https://creativecommons.org/licenses/by-nc/4.0/
    5.3. Hungarian demographic data was downloaded from this source.
    5.4. Hungarian settlement data was downloaded from this source.
6. Magyar Posta (MP, Hungarian Post Office)
    6.1. https://net.posta.hu/dashboard/public/dashboard-ui/iranyitoszam-kereso/download-as-table
    6.2. https://www.posta.hu/ugyfelszolgalat/aszf
    6.3. Hungarian postal codes data was downloaded from this source.
7. Council of Europe
    7.1. https://www.coe.int/en/web/portal/members-states
    7.2. https://www.coe.int/en/web/portal/disclaimer
    7.3. List of European countries

Formulas and metrics

1. Arithmetic average (mean)
    1.1. $\bar{\xi} = \frac{1}{n}\sum_{i=1}^{n} \xi_i = \frac{\xi_1+\xi_2+\ldots+\xi_n}{n}$
2. Standard deviation
    2.1. $\sigma = \sqrt{\frac{\sum_{i=1}^{n} (\xi_i-\bar{\xi})^2}{n}}$
3. $Net\_Attitude$
    3.1. This metric signifies the direction of the general attitude. A positive value signifies a positive attitude, a negative value signifies a negative attitude.
    3.2. $Net\_Attitude = (\sum S + \sum O) - (\sum W - \sum T)$
4. $SO\_Attitude$ (Positive attitude)

4.1. This metric represents the arithmetic average (mean) Likert score related to Strengths (S) and Opportunities (O), indicating the perceived attitude towards drones. A higher $SO\_Attitude$ value signifies a more positive perception.

4.1.1. $SO\_Attitude = \frac{S1+S2+S3+S4+O1+O2+O3+O4}{8} \Rightarrow \frac{1}{n}\sum_{i=1}^{\frac{n}{2}} (S_i + O_i)$

4.1.2. Note: We have to carefully consider the n value as we sum the pairs of S and O values, we only have to sum half the amount someone originally would come to the incorrect conclusion looking at the original arithmetic average formula.

5. $WT\_Attitude$ (Negative attitude)

5.1. This metric represents the arithmetic average (mean) Likert score related to Weaknesses (W) and Threats (T), indicating the perceived attitude towards drones. A lower $WT\_Attitude$ value signifies a more positive perception.

5.1.1. $WT\_Attitude = \frac{W1+W2+W3+W4+T1+T2+T3+T4}{8}$

6. $O\_Attitude$ (Opportunity attitude)

6.1. This metric represents the arithmetic average (mean) Likert score related to the Opportunities (O), indicating the perceived attitude towards drones. A higher $O\_Attitude$ value signifies a more opportunistic perception.

6.1.1. $O\_Attitude = \frac{O1+O2+O3+O4}{4} \Rightarrow \frac{1}{n}\sum_{i=1}^{n} O_i$

7. $T\_Attitude$ (Threat attitude)

7.1. This metric represents the arithmetic average (mean) Likert score related to the Threats (T), indicating the perceived attitude towards drones. A higher $T\_Attitude$ value signifies a more threatened perception.

7.1.1. $T\_Attitude = \frac{T1+T2+T3+T4}{4} \Rightarrow \frac{1}{n}\sum_{i=1}^{n} T_i$

List of Abbreviations and Expressions

1. Metrics
   - 1.1. SD (Standard deviation)
   - 1.2. Cronbach's α (Coefficient α)
   - 1.3. SWOT analysis
     - 1.3.1. A strategic planning technique that identifies strengths (S), weaknesses (W), opportunities (O) and threats (T).
     - 1.3.2. TOWS
   - 1.4. Likert scale
     - 1.4.1. A psychometric (sociology) scale used in research, named after its inventor, Rensis Likert[115].
2. AED (Automatic external defibrillator)
3. API (Application programming interface[116])
4. CC (Creative commons[117])
5. CPR (Cardiopulmonary resuscitation)
6. D2D (Drone to drone)
7. DDoS (Distributed denial-of-service)
   - 7.1. DoS (Denial-of-service)
8. Drone
   - 8.1. UAV (Unmanned aerial vehicle, Uninhabited aerial vehicles)
   - 8.2. UCAV (Unmanned combat air vehicles)
   - 8.3. UAS (Unmanned aerial system, Unmanned aircraft system)
   - 8.4. RPAS (Remotely piloted aerial system)
   - 8.5. M-RPAS (Military purpose remotely piloted vehicle)
   - 8.6. C-RPAS (Civilian purpose remotely piloted vehicle)
   - 8.7. RPV (Remotely piloted vehicle)
   - 8.8. UPS (Unpiloted system)
   - 8.9. UMS (Unmanned system)
   - 8.10. Aerial robot
   - 8.11. RPS (Remote pilot station)
9. Drones in the context of military application
   - 9.1. Uninhabited remotely controlled weapons
   - 9.2. PUR (Principle of unnecessary risk)
   - 9.3. IAW (Independent autonomous weapons)
   - 9.4. GWOT (Global war on terror)
10. Drones in the context of civilian application
    - 10.1. DO (Drone operations)
    - 10.2. DTCO (Drone-truck combined operation)
11. EC (European Commission)
12. GPS (Global positioning system)
13. GIS (Geographic information system)
14. IP (Internet protocol[118])

[115] https://en.wikipedia.org/wiki/Rensis_Likert 2025-12-03
[116] https://en.wikipedia.org/wiki/API 2026-02-05
[117] https://creativecommons.org/ 2026-02-05
[118] https://en.wikipedia.org/wiki/IP_address 2026-02-05

15. IT (Information technology)
16. KSH (Központi Statisztikai Hivatal[119])
    16.1. (HCIS) Hungarian Central Statistical Office
17. Lidar (Light detection and ranging sensor)
18. LOS (Line of sight)
19. ODbL[120] (Open database license)
20. OSM (OpenStreetMap[121])
21. P2P (Peer to peer)
22. R&I (Research and innovation)
23. RRI (Responsible research and innovation)

Repository

Repository is pushed into the following GitHub public repository:

1. https://github.com/ARTidas/DroneResearch

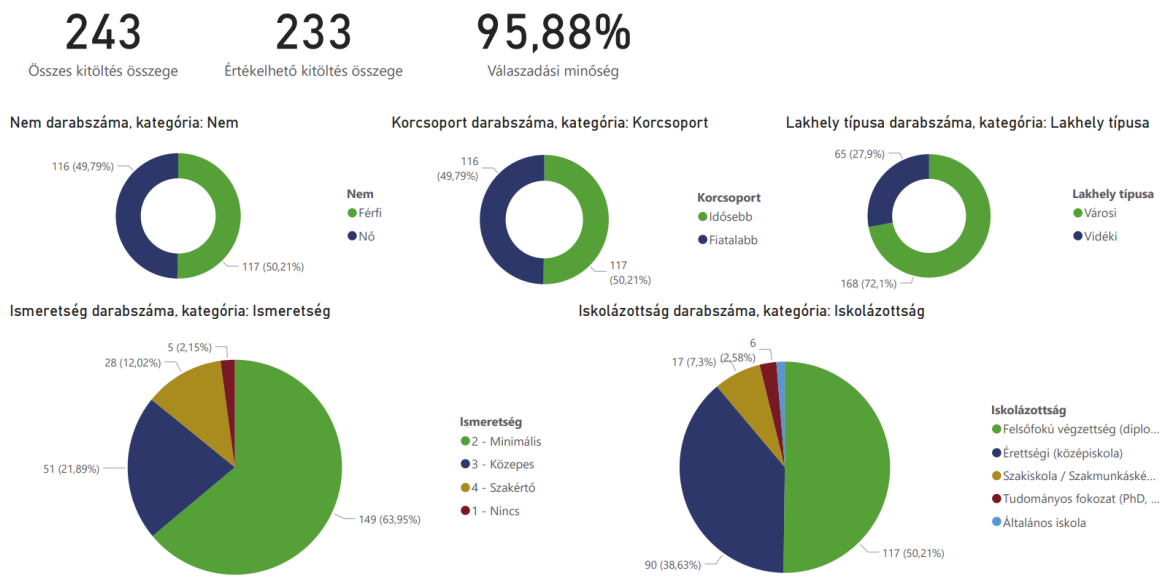
Website

The published research and code is available at the following website:

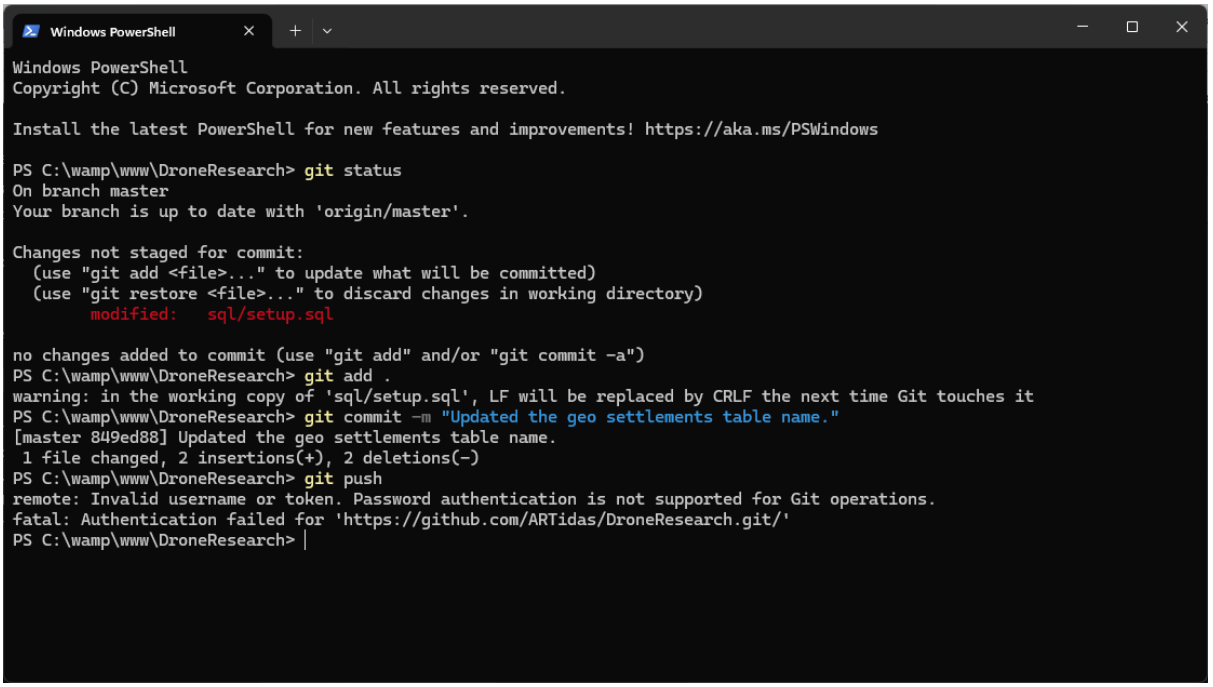
1. https://research.artidas.hu/DroneResearch

[119] https://www.ksh.hu/ 2026-01-30
[120] https://opendatacommons.org/licenses/odbl/ 2026-02-05
[121] https://www.openstreetmap.org/ 2026-02-05

Images

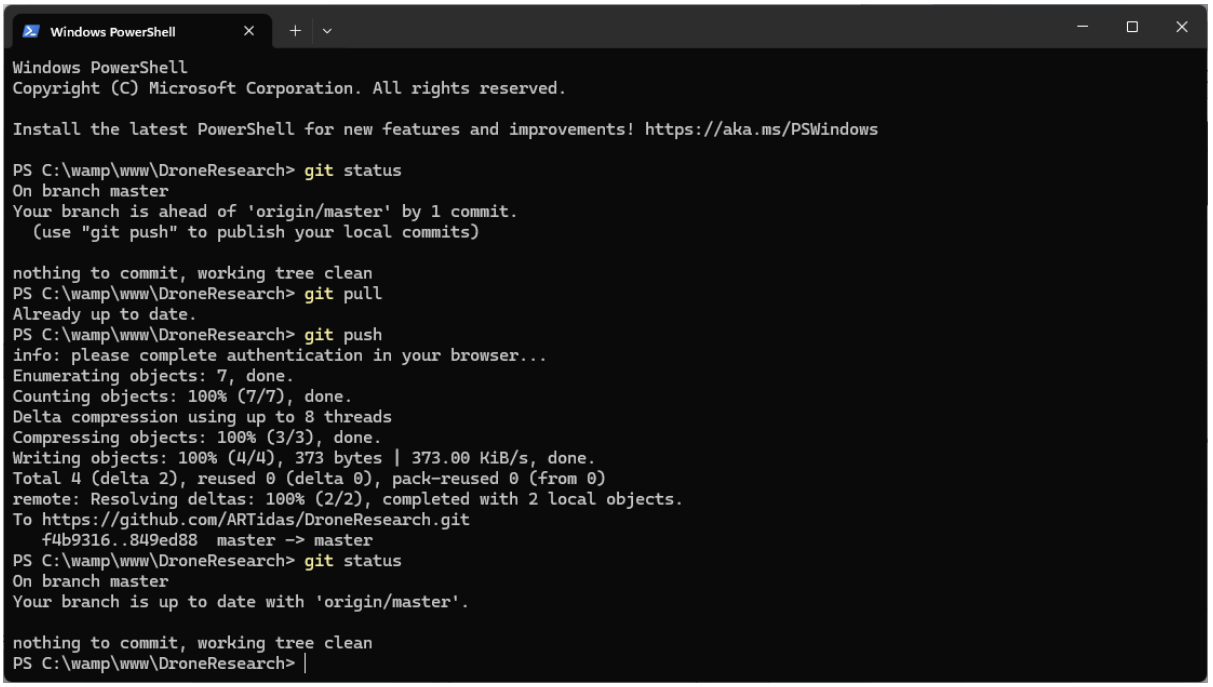


Image[122]: Viewing demographic composition of the questionnaire responders in PowerBI[123].

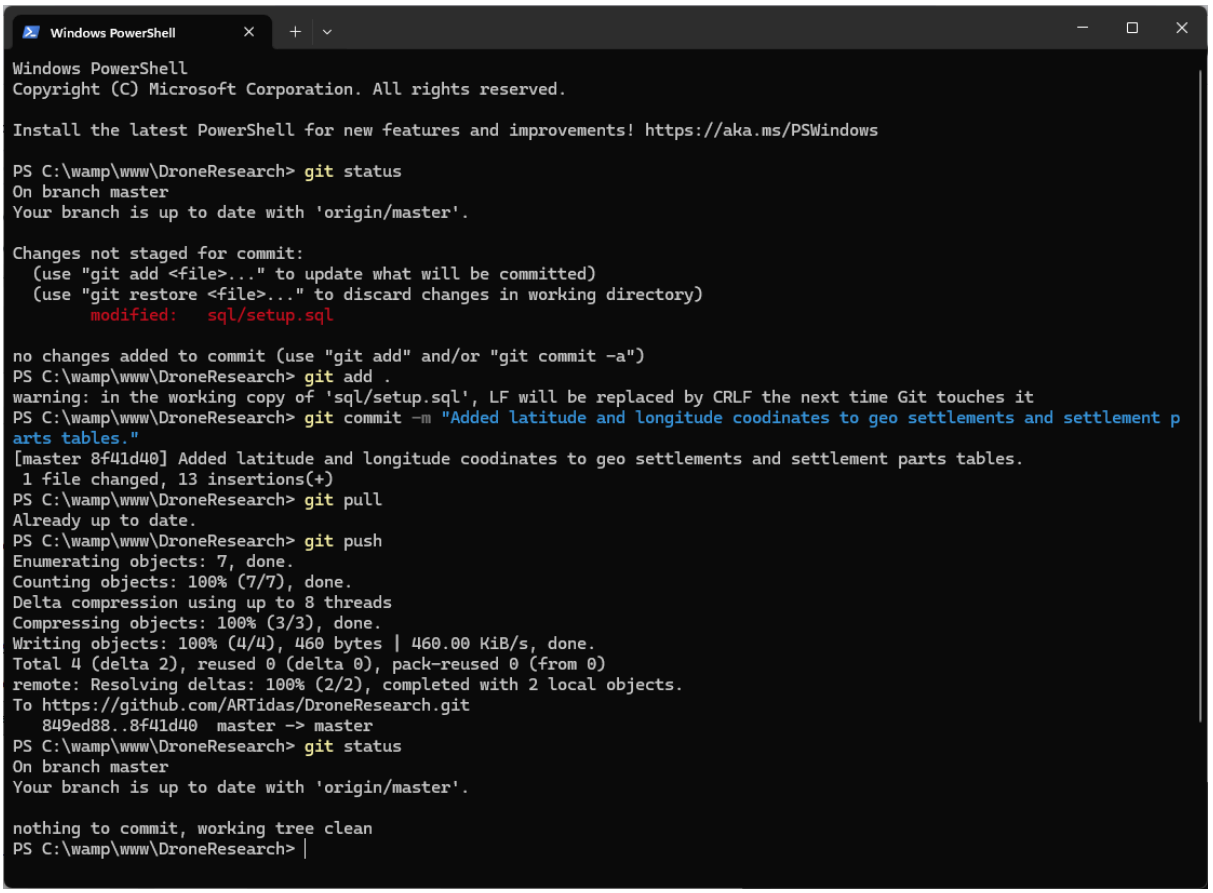


Image[124]: Working with versioning software in the terminal.

[122] PowerBI_top_level_view.png
[123] https://app.powerbi.com/ 2026-01-30
[124] Git_terminal.png

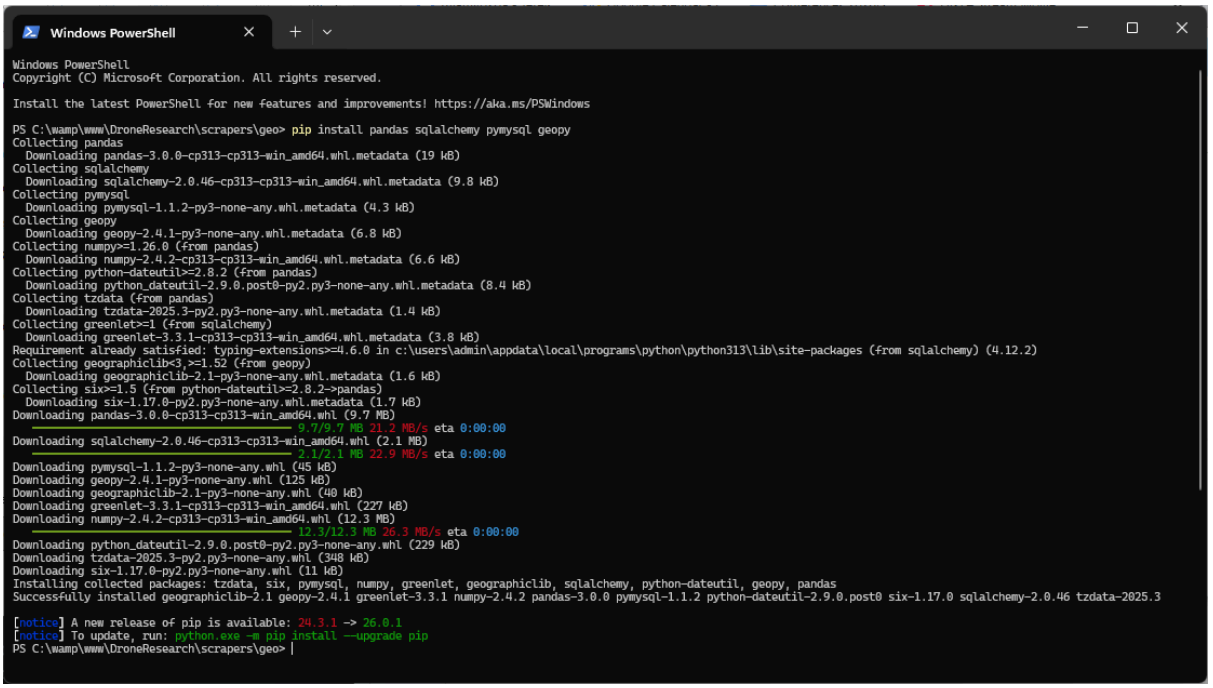


Image[125]: Pushing into a central repository with the versioning software.

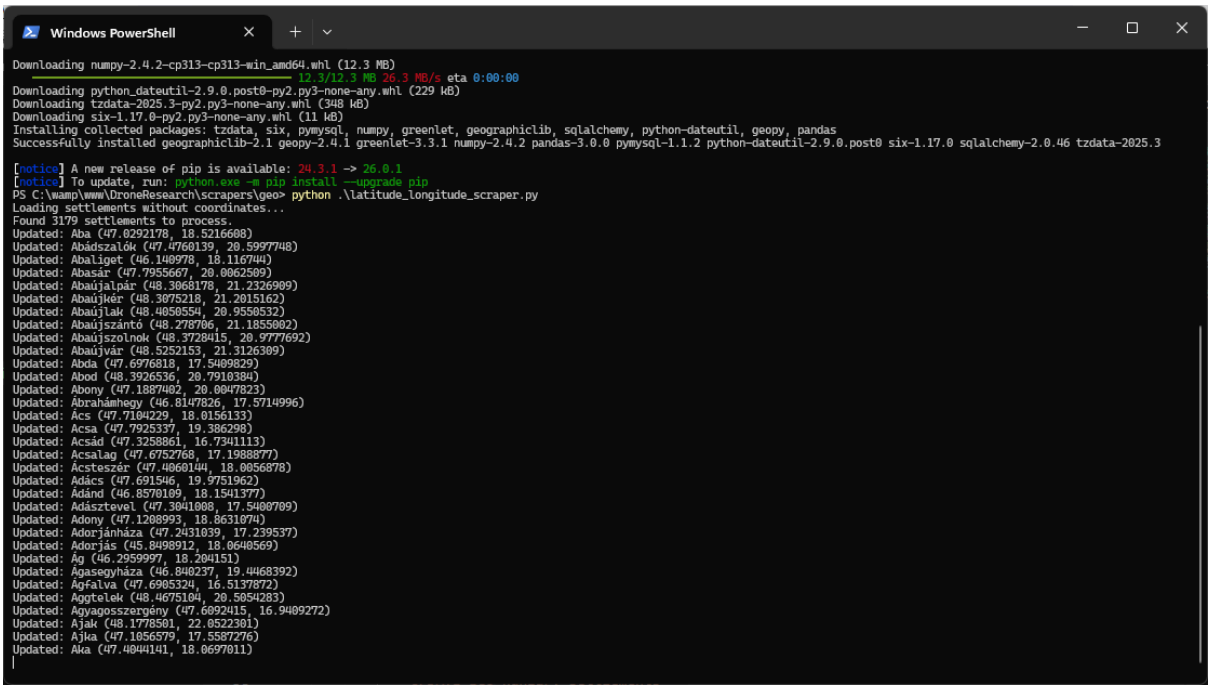


Image[126]: Committing and pushing code changes with the versioning software.

[125] Git_terminal_push.png
[126] Git_terminal_commit_push.png

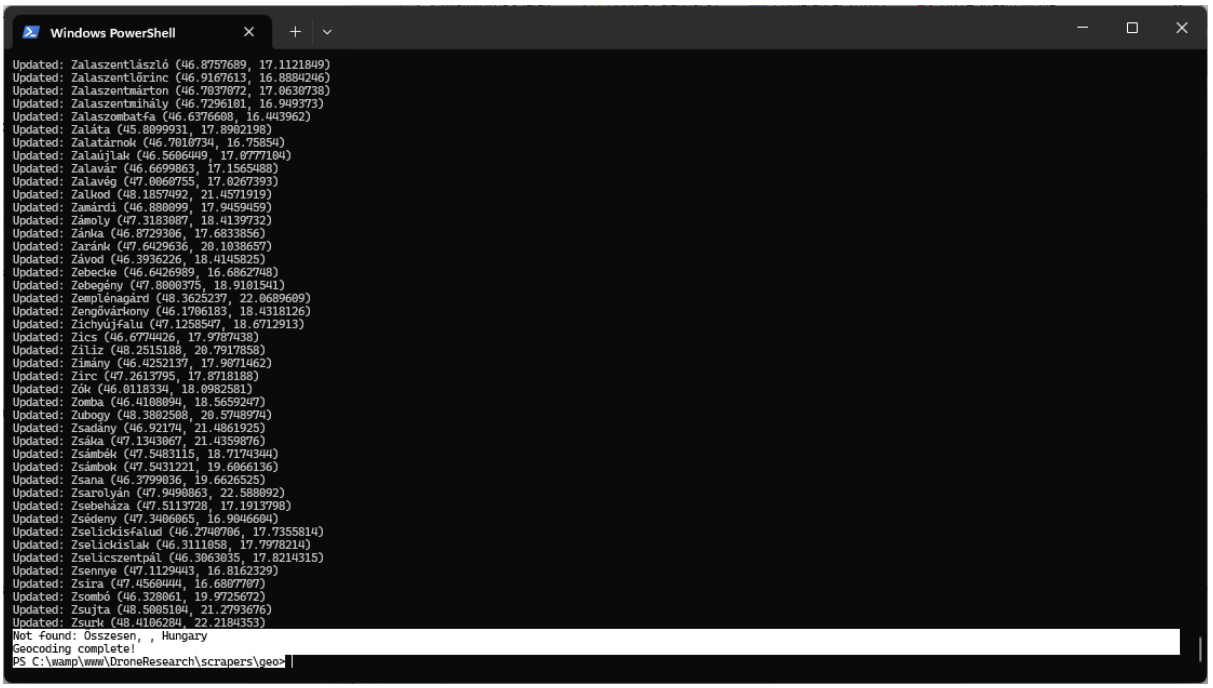


Image[127]: Installing dependencies and packages with the PIP[128] (Package installer for Python).

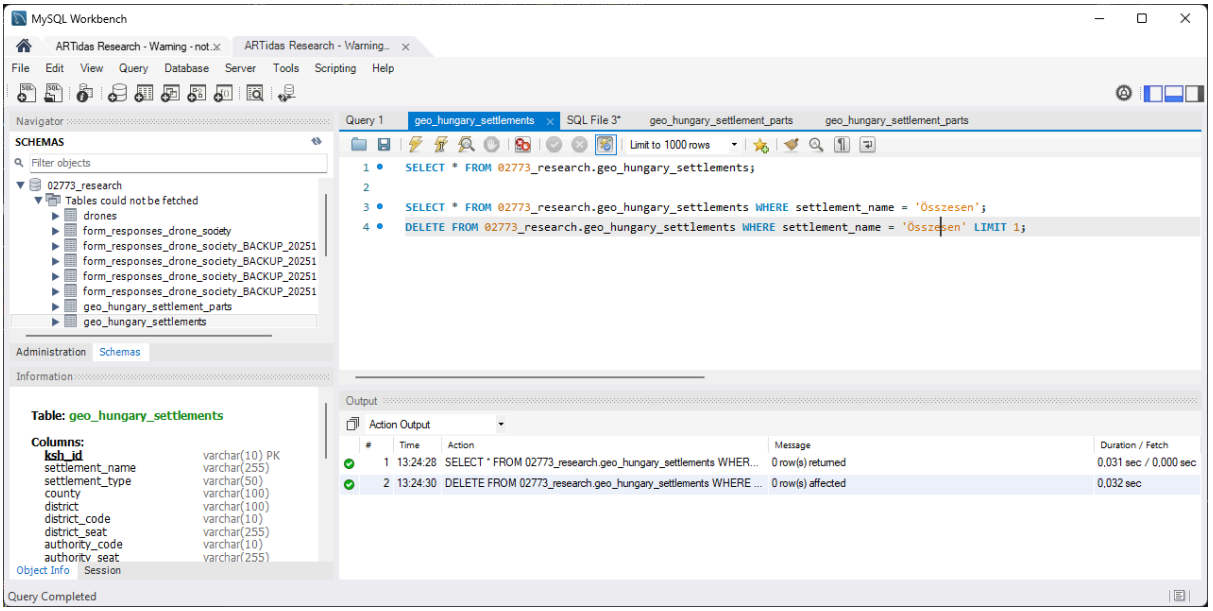


Image[129]: Running a Python script and retrieving geo coordinates (latitude and longitude) from OSM using Nominatim API for Hungarian settlements.

[127] PIP_install_dependencies.png
[128] https://pypi.org/project/pip/ 2026-02-05
[129] Python_running_geo_scraper.png

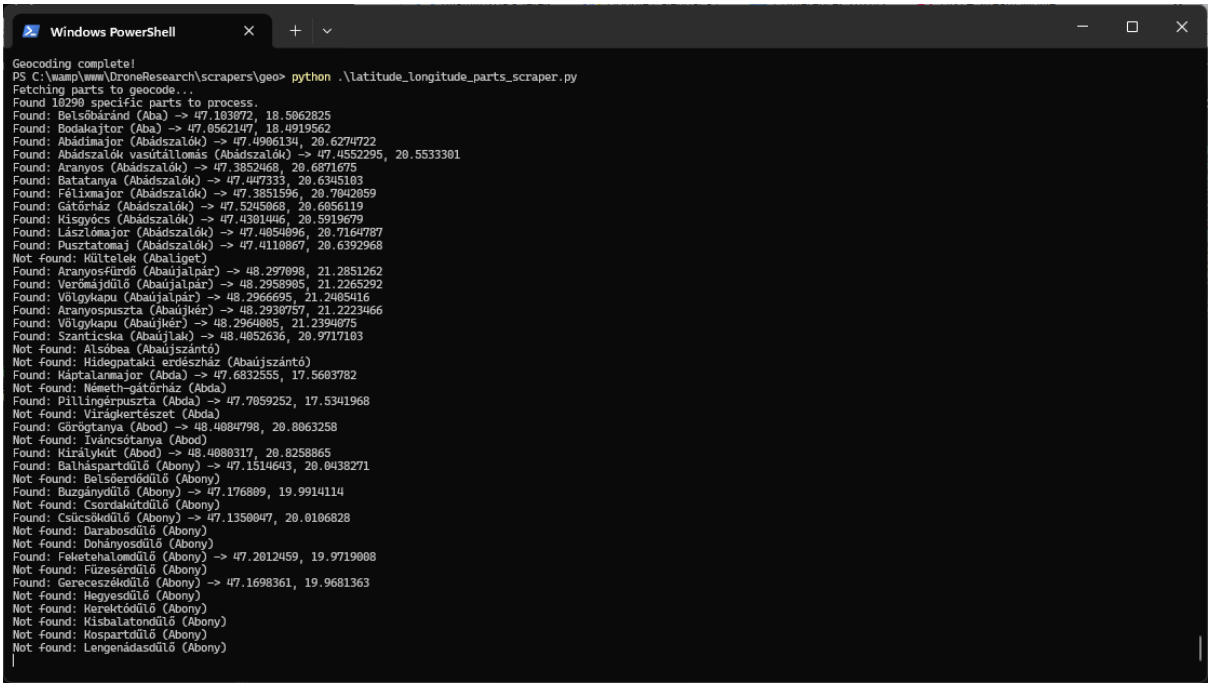


Image[130]: Finding incorrect records in the database by chance (Note: This is before any checks were made on the imported records).

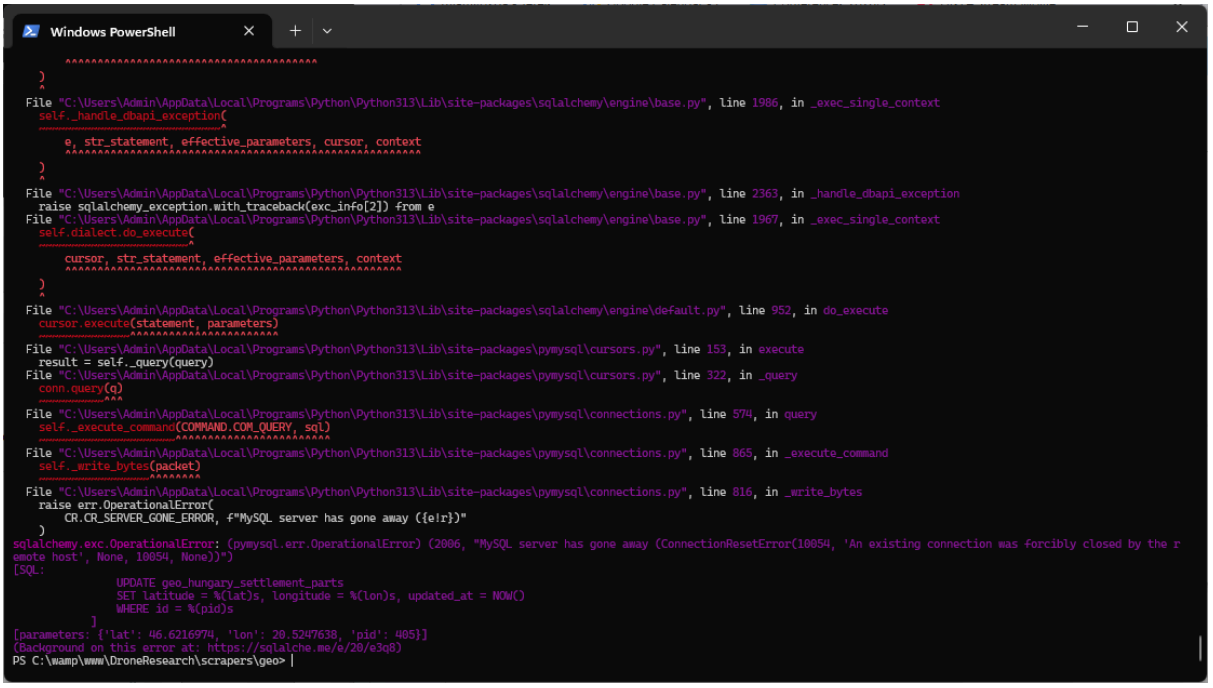


Image[131]: Selecting incorrect records and deleting them from our database using MySQL WorkBench.

130 Geo_scraping_finding_error.png
131 MySQL_WorkBench_select_delete.png



Image[132]: Running a Python script and retrieving geo coordinates (latitude and longitude) from OSM using Nominatim API for Hungarian settlement parts.

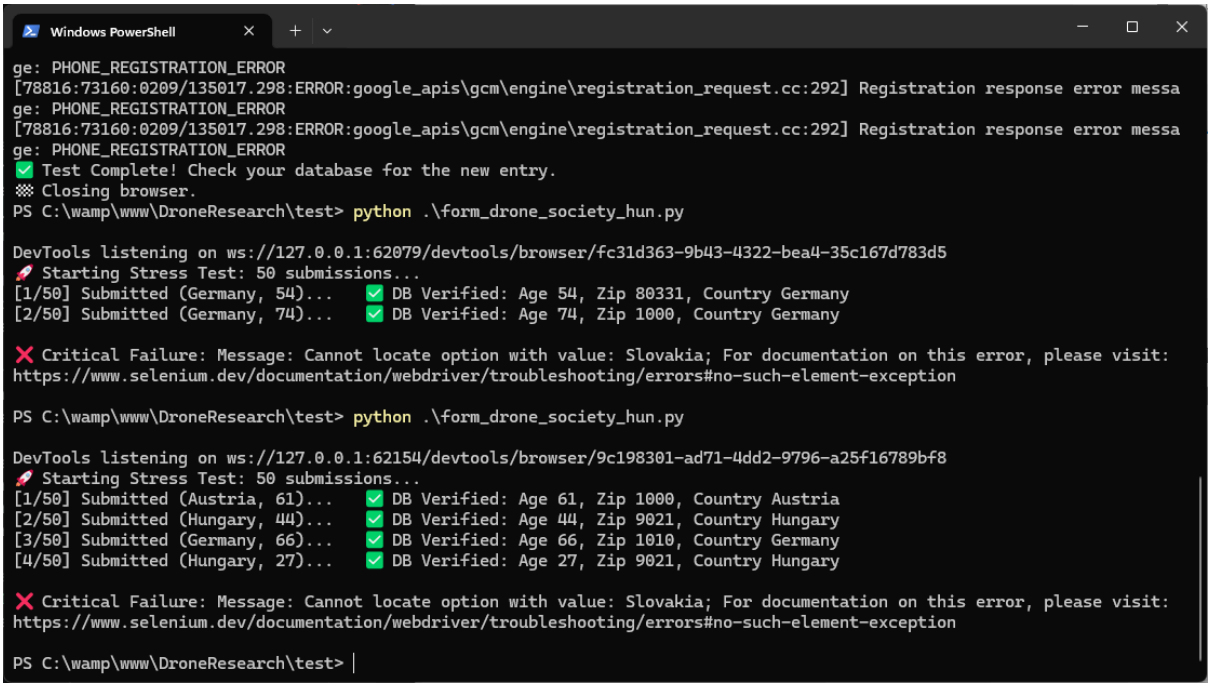


Image[133]: Encountering a fatal error while executing a Python scraping script.

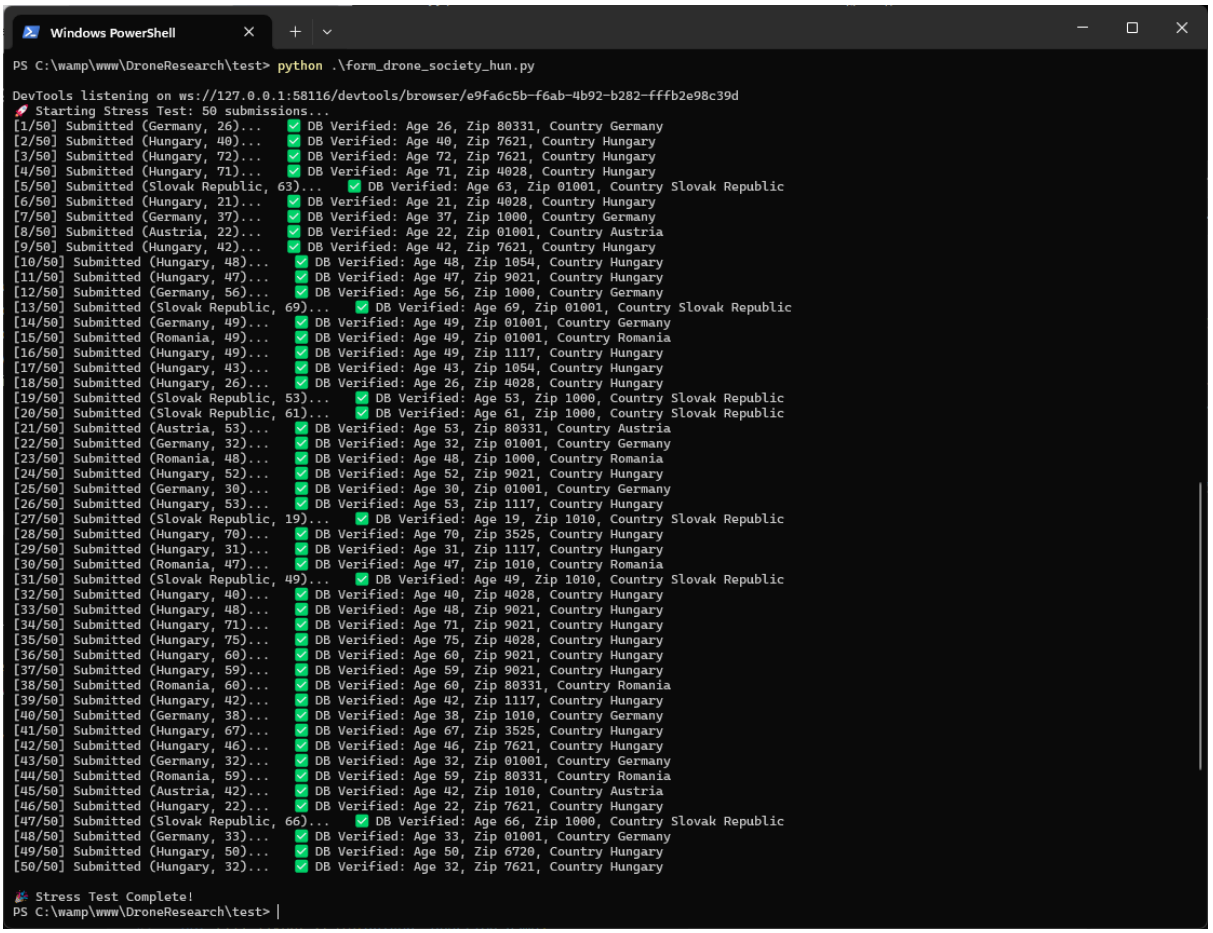
[132] Python_running_settlement_parts_geo_scraper.png
[133] Python_running_settlement_parts_geo_scraper_error.png

Image[134]: A QR[135] code for the Hungarian drone research survey. Generated with Adobe free QR code generator[136].

[134] qr_droneresearch_hun.png
[135] https://en.wikipedia.org/wiki/QR_code 2026-02-09
[136] https://www.adobe.com/express/feature/image/qr-code-generator 2026-02-09



Image[137]: Finding issues on our web form with Selenium.



Image[138]: A random submission of 50 forms submitted with Selenium.

[137] Selenium_testing_form_error.png
[138] Selenium_testing_form.png

drone_familiarity_group	SO_Attitude	(SO_Attitude - Mean)^2	WT_Attitude	(WT_Attitude - Mean)^2
Less	3.63	0.02	2.63	0.19
Less	2.88	0.79	4.13	1.13
More	4.38	0.17	4.25	1.87
More	3.63	0.11	2.50	0.15
More	4.75	0.62	3.25	0.14
Less	2.88	0.79	3.25	0.04
Less	4.88	1.23	2.13	0.88
More	4.25	0.08	2.38	0.26
More	4.88	0.83	3.00	0.01
More	4.50	0.29	1.88	1.01
More	4.00	0.00	4.25	1.87
Less	5.00	1.52	2.63	0.19
More	3.38	0.34	2.38	0.26
More	4.25	0.08	3.25	0.14

Table[139]: Sample of a retrieved table for hypothesis testing.

SO_Attitude	Group	N	Mean	SD	SE	MeanDiff	SS	DF	SP^2	SEDiff	t	p
	Less	154	3.766	0.666	0.054	0.196	67.80	231	0.425	0.090	2.170	0.0310
	More	79	3.962	0.624	0.070		30.39					
WT_Attitude	Group	N	Mean	SD	SE	MeanDiff	SS	DF	SP^2	SEDiff	t	p
	Less	154	3.061	0.718	0.058	0.180	78.88	231	0.538	0.101	1.769	0.0781
	More	79	2.881	0.762	0.086		45.31					
SD	Standard Deviation											
SS	Sum of Squared Mean											
SE	Standard Error											
DF	Degree of Freedom											
SP^2	Pooled Variance											

Table: Calculating p-value.

[139] DroneResearch

H1: Independent Samples T-Test ▼

Independent Samples T-Test ▼

	Test	Statistic	df	p	Mean Difference	SE Difference	Cohen's d	SE Cohen's d
SO_Attitude	Student	−2.170	231.0	.031	−0.196	0.090	−0.300	0.139
	Welch	−2.216	166.7	.028	−0.196	0.088	−0.303	0.139
WT_Attitude	Student	1.769	231.0	.078	0.180	0.101	0.245	0.139
	Welch	1.736	149.4	.085	0.180	0.103	0.242	0.139

Descriptives

Group Descriptives

	Group	N	Mean	SD	SE	Coefficient of variation
SO_Attitude	Less	154	3.766	0.666	0.054	0.177
	More	79	3.962	0.624	0.070	0.158
WT_Attitude	Less	154	3.061	0.718	0.058	0.235
	More	79	2.881	0.762	0.086	0.265

Image[140]: H1 hypothesis independent samples t-test.

[140] JSAP_H1_descriptive_t.png