Gamifying Climate and Crisis

Autonomous Communities

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1 Collective material cloud.

ABSTRACT

As the climate continues to change, the number of communities under threat continues to increase. While large cities are typically considered valuable, due to either economic or other larger interests and, thus, deemed worth protecting, smaller communities are often left to fend for themselves with little to no external support. The impacts and efficacy of centralized and higher-level decision making have their limitations, interests, and stakeholders, suggesting that a decentralized approach can augment the capacity for local negotiations and decisions to be made that respond both practically, and more intimately, to the needs of those facing imminent threat.

The emergence of video game platforms has broadened the possibility for participatory design systems to take place, allowing for a multitude of decisions to be made via a transcalar approach towards issues unresolvable through conventional architectural means, while enabling difference and disagreement to exist. The goal of this paper is to demonstrate, through several research projects, different ways that platforms and gamification can engage with the specifics of different threatened communities, ultimately enabling autonomy.

INTRODUCTION

The term "cli-migration", coined by Alaskan human rights lawyer Robin Bronen in 2008, refers to a community's forced relocation due to climate related issues. In 2021, it was estimated that 59.1 million people were internally displaced across the world, most of which were displaced by climate-related disasters (Fry 2022). Although the notion of climate-provoked relocation is something that precedes modern civilization, the scale, quantity, and complications that arise today are amplified by questions of identity and borders, and inevitably extend into questions of rights. While there is an expectation for local and/or national governments to intervene and assist, there are also reasons why they will not or cannot, something which is later elaborated on with respect to each case study.

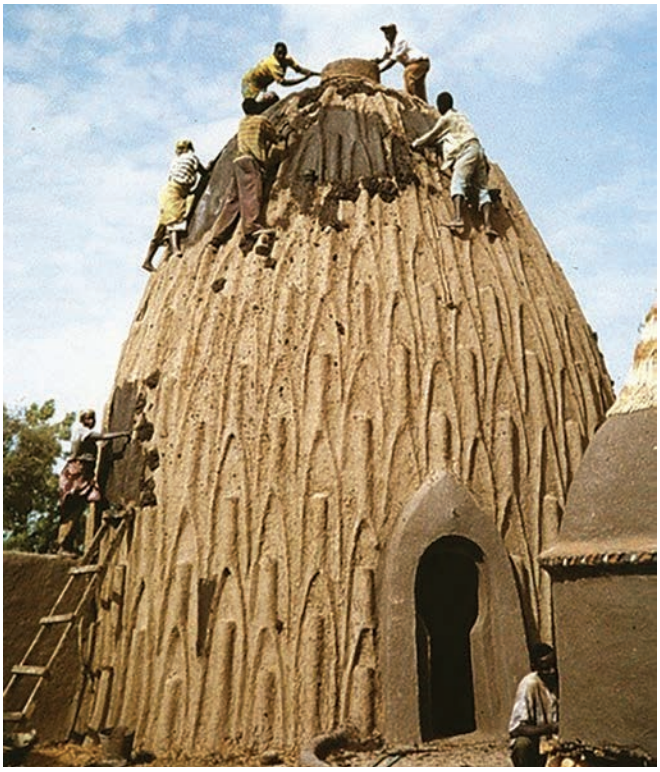
With the inaction from greater central authorities, whose role is to coordinate, delegate, execute, and enforce plans of action, comes the opportunity for decentralized protocols and emerging technologies to be tested in new forms of negotiation, both ideologically and physically. One approach is through the process of gamification (Figure 1), wherein 'gaming platforms have become a central medium to socialize complex simulations including architectural design' (Sanchez 2019).

The question this paper aims to answer is "By what means can cli-migrating be instrumentalized as a vehicle for empowerment and community autonomy, and what roles do participation and gamification have in the process? "

On Architecture

The history of participatory and unauthored architecture finds its roots in the vernacular tradition (Rudofsky 1964). While dwellings such as the Mousgoum Tolek (Figure 2), located between Northern Cameroon and Chad, deal with strict material and technological limitations that largely dictate the type of formal outcomes possible (essentially variations of a parabolic dome), it is a prime example of a collaborative construction process that maximizes constraint limits associated with both labor and material (May 2010). This can also be seen as a form of knowledge transfer and preservation that transmits a skill set to following generations who, in turn, can come to create similar dwellings.

A more recent and contemporary account is found in the work of Walter Segal (1907 to 1985) who, utilizing a modular system for timber frames and modular panels allowed families to self-build their homes, eliminating a reliance and exclusivity provided by builders. While designs are generally regulated by the grid, some variety could be introduced, providing agency to the builder-client-dweller (Figure 3). Further to this 'since whole families could build the houses together, with children and the elderly being welcome on site, the building process itself engendered a strong sense of community (Spatial Agency 2023).



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Finally, Lucien Kroll (1927 to 2022), a European counterpart in some ways, was almost entirely dedicated to the realization of architecture through participatory design. Pushing against the abstraction enforced by modernism at the time, Kroll's design process was distributed among those participating in the process who, again, were those who would ultimately inhabit the buildings. One of the most well-known examples is the Maison-Medical student accommodation in Belgium, which was developed in intense consultation with students and others who would be using the building. This would allow an evolving physical model to become a record of the design process (Figures 4 and 5).

The aforementioned demonstrates to what extent community can be stimulated and preserved through participatory practices, which are both dynamic in their process of creation, as well as static and recorded in their final outcomes.

Despite their various successes, each case presents its own limitations. The Mousgoum huts are generally

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constrained by their limited material palette and lack of contemporary tools. Segal's method is formally constrained, as it is limited by the kit of parts, and Kroll's approach is logistically impractical and highly time consuming, as it takes into account multiple user inputs. However, it should also be noted that each case also responds to a specific context, and successfully overcomes challenges unique to each setting, spanning climate, economy, and socio-political domains. The Mousgoum huts are a sophisticated response to their climatic conditions, building with thermal mass to maintain cooler temperatures, while also having the ability to open or close the orifice at the top of each hut to respond to ventilation, light, and rain. In Seagal's case, the materials used were standardized, allowing a particular efficiency between form, cost, and self-buildability to be easily realized. Finally, in Kroll's case, there is the demonstration of participatory design on a larger scale, integrating user feedback throughout the design phase, which is underpinned by anti-colonial ideologies and political tensions of the times, resonated by protests in May 1968.

On Games

In 2017, on April 1 (commonly known as April Fool's Day), the social networking website Reddit hosted a collaborative experiment called r/place. The experiment consisted of a digital square canvas measuring 1000x1000 pixels, with registered users being able to modify a single pixel every 5 to 20 minutes. The experiment ran for approximately 72 hours, wherein the canvas' dynamic visual updating was a direct reflection of ideologies, alliances, and adversaries.

Indeed, more interesting than the outcome itself are the smaller stories revealed when the canvas is studied evolutionarily over time. A recreation of this time-lapse translated into a virtual reality (VR) visualization was made, through which such investigations can take place (Bahm 2017).

A notable and relevant example is between the French and German flags, which appeared around the center of the bottom left quadrant. The competition began as a battle for dominance along the X-axis of their region. After some time, it became clear that the French flag was not able to able to compete and, thus, opted instead to retreat into the Y-axis, where it could continue expansion away from competition. The contested area thus became the intersection of the two: the French along the vertical and the Germans along the horizontal. Realizing that the efforts spent fighting were an inefficient use of resources, the square region that occupied the intersection of the two was collaboratively made into the flag of the European Union (Figure 6).

While not all stories on the board have a happy ending, this study points to an interesting potential for games to move from adversarial and capitalist logics towards cooperative and the commons. Furthermore, it was able to support and engage a large number of users across the world, broadening the extent of inclusion through interactive virtual interfaces, with nothing more than the ability to change the color of a pixel.

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2 Mousgoum Tolek mud hut being built collaboratively.

3 Walter Segal, two-story frame houses self-built by applicants, with temporary bracing in place, Lewisham, London, 1979.

4 Model of the MéMé building from the participants' workshop.

5 La MéMé, Lucien Kroll. Housing for medical students at the Catholic University of Louvain, 1970.

6 Reddit´s experiment 'r/Place': Timelapse of the Germany/ France encounter from conflict to resolution.

On Games and Architecture

The introduction of video game engines into architecture in the form of interactive and participatory platforms has its merits and advantages that could potentially push beyond some of the previously mentioned limitations. First, as a medium, videogames are generally non-discriminatory; typically, anyone can learn to play rather intuitively, which is even more true today, as most of our daily lives are mediated through virtual interfaces. Secondly, as videogames are inherently computational, processing speeds of user inputs can allow for iterations and data to be both collected and computed almost instantaneously, providing a higher degree of user engagement, feedback, and augmenting the creative process. Finally, there is an aesthetic domain present, which can either heighten or diminish one's affection towards a particular thing or issue, depending on how it is portrayed.

METHODS

Reflecting on the current state of cli-migration and the previous case studies, an initial conclusion is that there is no universal answer, as each case must be taken as something that is highly contextual, and any proposed solution ought to preserve or augment a particular aspect that resonates with the community. A general methodology of 'decoding' and 'recoding' is, thus, applied, emphasizing that there are distinct behavioral modes of living, particularities of site, as well as community values (Charbel and Lopez 2020). There are two strands of research that are intertwined; the first is the analysis of architectural, behavioral, and environmental data using a combination of machine learning, and environmental and agent simulations; and the second is an emphasis on an ethnographic approach that combines first-person accounts, research papers, and narrative. The two, in tandem, allow for a general set of tools and methodologies to be applied, while still affording the ability to generate ad-hoc solutions, which are tested in the three following case studies.

CASE STUDIES

Each of the following three case studies is introduced, first, through a contextual and ethnographic approach, from which a particular approach is derived using the previously mentioned methods.

Kivalina, Alaska

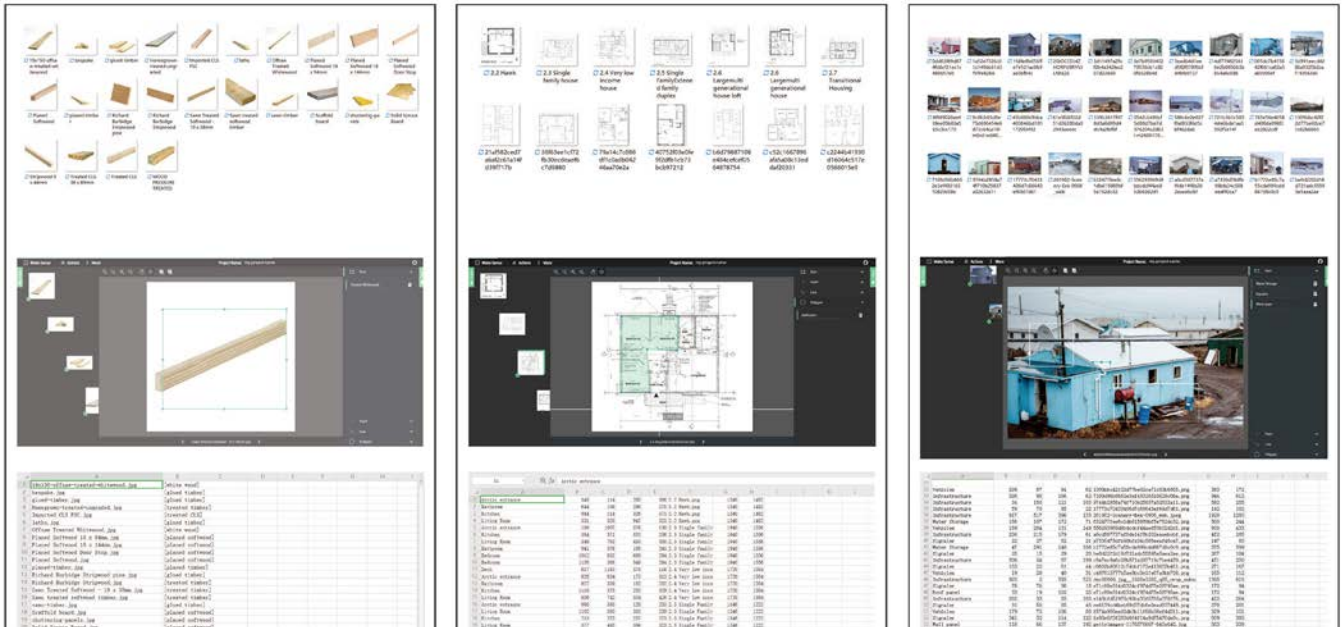
Scenario. The small coastal village of Kivalina is situated on a narrow peninsula in the Northwestern portion of Alaska within the Arctic Circle. The narrow strip of land is currently undergoing coastal erosion, while also experiencing rising sea levels, and is expected to be fully submerged within five years. Various relocation plans have been put forward by both the community and the United States Army Corps of Engineers (USACE), but neither have been accepted by either side. The new village locations selected by the current inhabitants were deemed unsuitable by the USACE due to projected flooding and erosion. Meanwhile, the alternate sites proposed by the USACE have been rejected by the village due to costs and inconvenience to their subsistence activities and cultural lifestyle (Gregg 2010).

Strategy. The village and the USACE are in a timed standstill, the duration of which is determined by the amount of time the peninsula can remain habitable. As consensus among the locals appears to be a strong point, the project emerges as a gamified relocation process that allows the villagers to plan their relocation independent from external aid through various phases, each of which requires consensus making in order to proceed to the next phase.

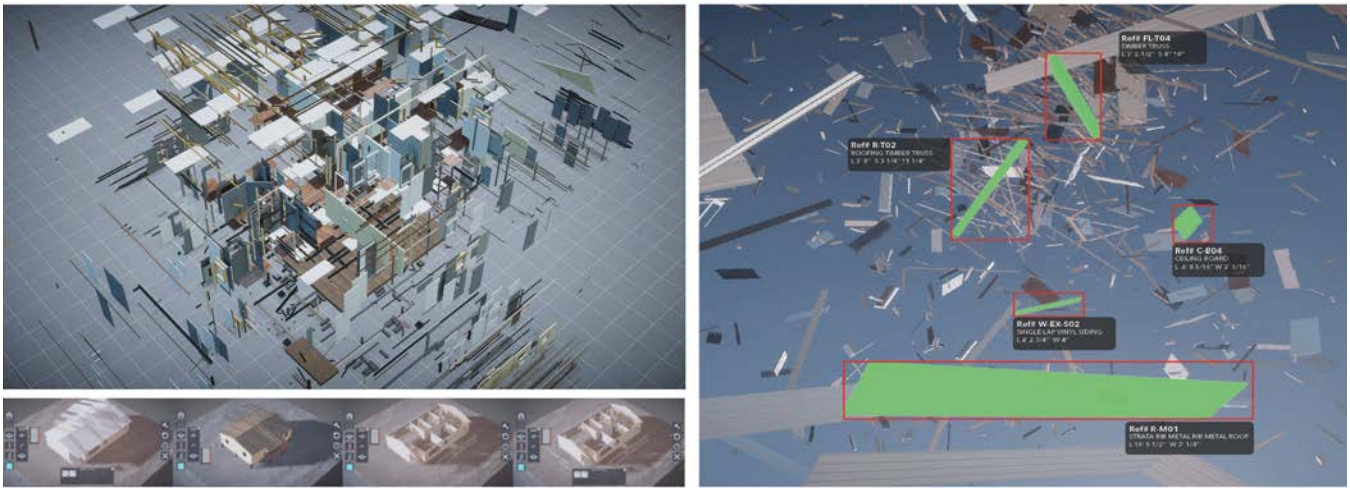
Decoding. Being extremely remote and having limited resources, a process of decommissioning is proposed, turning the existing village into its own material supply and eliminating the need for external aid. A YOLO machine learning model (Redmon and Farhadi 2018) is trained to identify different building materials, such as wood and steel, while also being able to identify functional properties, such as doors and windows, which are digitized and uploaded to a virtual database (Figure 7). Due to the lack of accessibility in the field, a digital twin is recreated allowing for a more synthetic extraction of the data. In the game interface, the components of the building can be exploded, and the components read via real-time identification, where they are then classified (Figure 8). A study of the existing urban plan and house layouts provides a basis for creating programmatic adjacency rules at community and individual house scales.

Recoding. From an initial quantification of the existing materials, a modular voxel system is used as an organizational logic. In order to maximize the potential of the existing materials, all dismantled parts are pooled together to form one large stock pile, thus, the notion of individual property and ownership over one's original house and its constituent parts is dissolved. The dismantled materials are cut and reconfigured to form voxel units, each of which satisfies a particular architectural condition (i.e. floor, window, roof, et cetera). The modular units can, thus, be assembled to form a house (Figure 8). For dwelling space generating, users would input their family size, as well as the number and type of rooms desired. The system would allow users to make higher-level important decisions, such as the location of certain rooms and windows, and after a certain point, would simply fill in the gaps with whatever materials remain. This process was achieved through a wave function collapse (WFC) plug-in in Unity (Boris 2019), allowing users to quickly iterate options. At an urban scale, a similar process was used for communal building locations, such as schools, shops, churches, et cetera. Users could place their desired building in their desired location, submitting it to the platform to be reviewed by others doing the same thing, gradually narrowing options until a desired outcome is agreed upon (Figure 9).

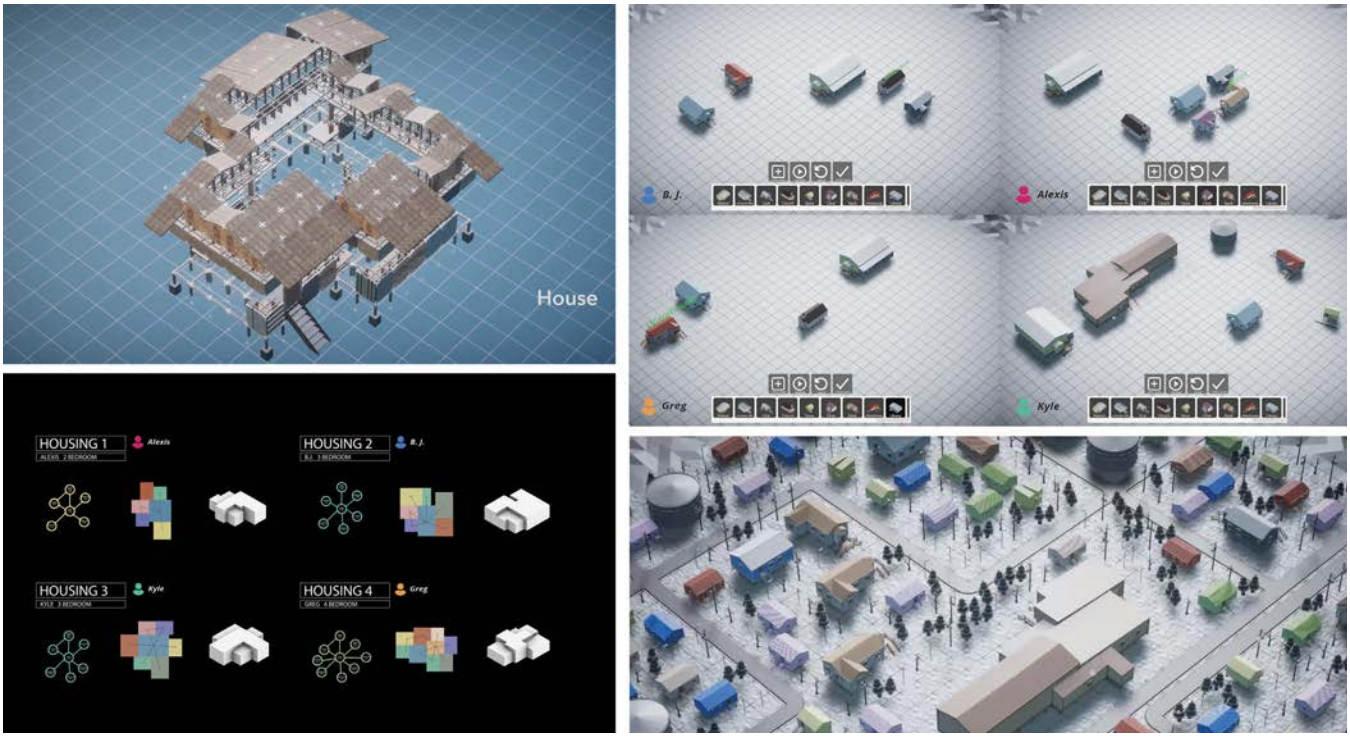
Gamification. As materials are limited and previous plans have been rejected, the goal of gamification is to allow the villagers to participate in the entire relocation process following conventional planning phases: (1) site location, (2) community zoning, and (3) house planning. In order to reach the next step, consensus has to be agreed upon by all inhabitants. This process would ultimately enable the community to relocate under their own terms through



7 Machine learning model trained on material, floor plan, interior spaces, and housing typology.



8 Digital twin of existing building and virtual explosion for YOLO component extraction.



9 House generating phase: floor plan generating, personal voxel selection, and auto voxel filling.

negotiation and consensus making, thus, granting them a degree of autonomy that they currently do not possess (Figure 9).

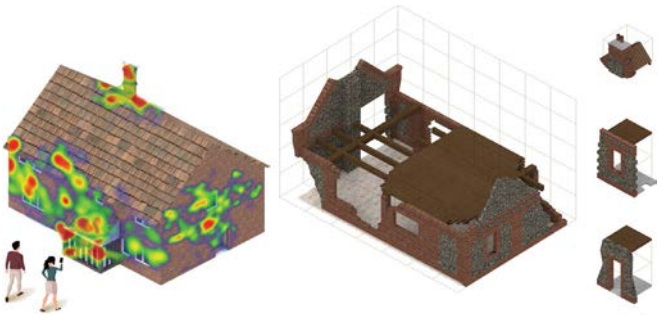
Happisburgh, UK

Scenario. Located on the Eastern coast of the United Kingdom (UK), the village of Happisburgh used to be 250 m from the coastline which, due to coastal erosion and increased storms, now finds itself on the coastline's edge. Houses closest (or in some cases on) the cliff edges are no longer inhabitable, experiencing structural failure, while those more inland are destined to eventually suffer the same fate. Currently home to approximately 1,400 people, the coastline is estimated to recede another 100 meters over the next 20 years (British Geological Survey 2009). Inhabitants find themselves in a peculiar circumstance, as their current homes hold little to no value to financially support a relocation plan, nor would they like to relocate. Other than providing an initial scheme called Pathfinder, which aided in relocation, the government has since halted any further support or protection. They recently changed their stance on preventing erosion from 'hold the line' to 'no active intervention.' Two separate interviews with local activist, Malcolm Kerby, and Councilor Lucy Shires, reveal that the notion of 'identity' in Happisburgh is found in their

community, and many 'do not want to leave their home behind'.

Strategy. Coastal erosion will continue, and inevitably consume the village. Additionally, this is not unique to Happisburgh, but, indeed, affects numerous towns, as some 28% of the coast in England and Wales experiences erosion at rates higher than 0.1 m/year (Burgess et. al. 2005). Reflecting on the stance of the community members, any eventual move ought to reflect their values of comradery and their desire to retain a sense of place. Parallel to this, the presence of government schemes, as the one initially put forward for the village in question, are cast and present in the UK. An interactive platform could facilitate the migration process by synthesizing social networking, architectural design, and available government schemes.

Decoding. To retain a sense of place, two forms of heat mapping are carried out. First, agent simulations recreate daily routines of the inhabitants, producing heatmaps of where their time is spent and at what moments of the day. Then, eye gaze tracking is used to define architectural characteristics of significance. The areas with the highest values have their outlines retrofitted from the heat map into a voxel system, and then are extracted from the architecture as chunks (Figure 10). Finally, a live database of various relevant government schemes, such as agricultural incentives, is overlaid on a virtual map, giving visual and intuitive access for future migrants to plan their next destination.



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10 Decoded housing characteristics into architectural chunks using eye gaze tracking.

11 House generating: agent simulation, spatial layout, chunk assembly, immersive render.

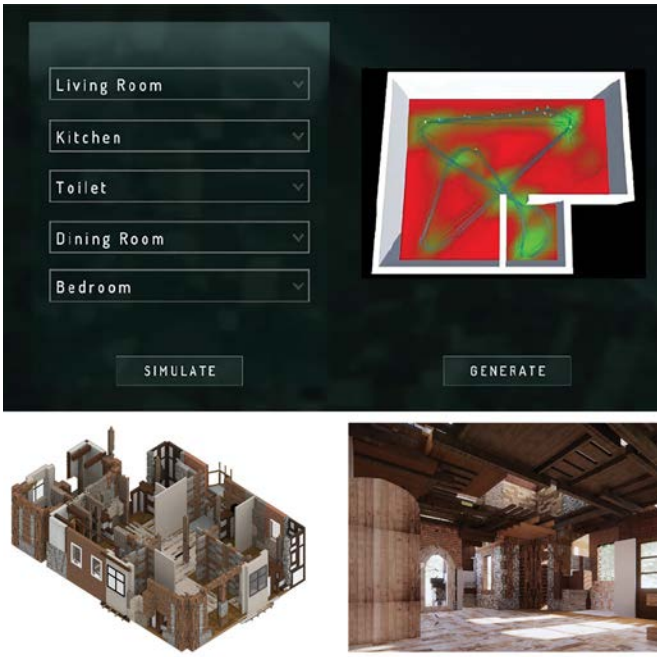
12. House location scoring determined through neighbor proximity, agent simulation, and predicted ecological health (top). Render of final community (bottom).

Recoding. As future migrations are not ruled out, spatial efficiency and flexibility become the prominent drivers. A database of base floor plans is provided, from which users can select the ones that best suit their needs. Thereafter, agent simulations that approximate the user's previous patterns are played out. The floor plans are iterated and adjusted until a desired tolerance of space and material efficiency is found, which is measured through a wave function collapse algorithm that retains the information of the amount of material consumed (Figure 11). Additionally, as users are not trained to read plans, real-time interior visualizations provide instant feedback to enable informed decision-making. At village planning scale, the house location process is also gamified, allowing users to select their preferred location, which are then scored based on results of agent simulations and proximities between houses. The scoring system is designed to favor community building through housing proximities, while also minimizing interference with the local ecology (Figure 12).

Gamification. The migration process generally comes at the expense of familiarity to one's land, home, and community. The interactive platform in this case is speculated to interconnect various communities, allowing migrants to 'community hop' as they please. Nomadism is instead reintroduced as an opportunity to have the option to opt-in or opt-out of particular conditions and circumstances, facilitated by a fully nomadic architectural platform (Figure 12).

Sami, Scandinavia

Scenario. The Sami are a nomadic ethnic group that



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inhabit northern Scandinavia, spanning Norway, Sweden, Finland and parts of Russia, the whole of which is known to them as Sápmi. Effectively, they inhabited the regions prior to modern borders, and thus, despite not recognizing them, are nevertheless impacted by them, as borders imply limits to exchange and enforce separation. They have indeed been on the receiving end of a colonial project, which has increasingly and gradually assimilated their culture in the general contemporary western canon. The risk of loss in this instance is not architectural, but rather, epistemological. One Sami scholar writes "taking Sami society as an example, one can argue that one consequence [of colonialism and western education] is the dissociation from Sami cultural practice by many Sami scholars. Through the Western education system, they have been "immersed" into Western models of doing research which are often characterized by a Cartesian world view, based on metaphysical dualism and laden with perceptions that derive from the Enlightenment: the fragmentation of human knowledge and the distancing of oneself both physically and mentally from the research object." (Kuokkanen 2000).

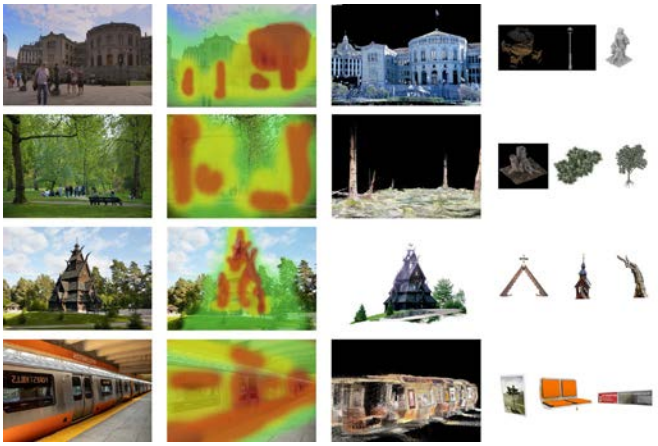
Strategy. A different approach is taken that looks to world-building and what can loosely be referred to as the metaverse to produce a collaborative archive through user participation that transcends borders and generations. Resisting the tendency towards dualism and the distancing of the self, auto-ethnographic procedures are paired with computational logics with the aim of producing a more authentic and less curated outcome. One limitation of current archival methods is their dimensionality and linearity, which influence each other. On the one hand, dimensionality has evolved from writing/drawing, to photography, to video recording into most recently 3d scanning and volumetric reconstruction; while in terms of linearity, these mediums are experienced from a start to finish fashion, making each visit to the archive identical.

Decoding. Eye gaze tracking is deployed on daily walks to create heat map overlays, both in the rural context

of the Sami as well as more urban and contemporary experiences. Objects within a certain threshold of the heat maps are then virtually extracted, archived, and geotagged and hash tagged with a selection of keywords (Figure 13).

Recoding. As histories and belief systems can contain both individual and collective understandings, two archives are generated in parallel: (1) the personal, and (2) the collective. The reconstruction of these virtual worlds is governed by a procedural word2vec system, with different audio and visual layers that can be toggled on and off. Using WFC, the objects are classed with different weights, which are updated with each new entry. At the start of each world is a random set of objects; the order in which one interacts with the objects influences and alters the trajectory of the user's journey, allowing a single memory reconstruction to be revisited in a unique manner each time (Figure 14 and 15). At the collective level, the system naturally behaves similar to a block-chain, validating or invalidating particular entries based on a system of checks of parallel or similar entries.

Gamification. The link between the Sami population, culture, and territory is essential for constructing nationhood (Gaski 2008). Located across vast amounts of land divided by borders and sceneries, gamification of the archiving process through a more embodied medium (in this case, 3D and VR), may both prioritize and facilitate engagement, reinstating a sense of community through the archive, as well as



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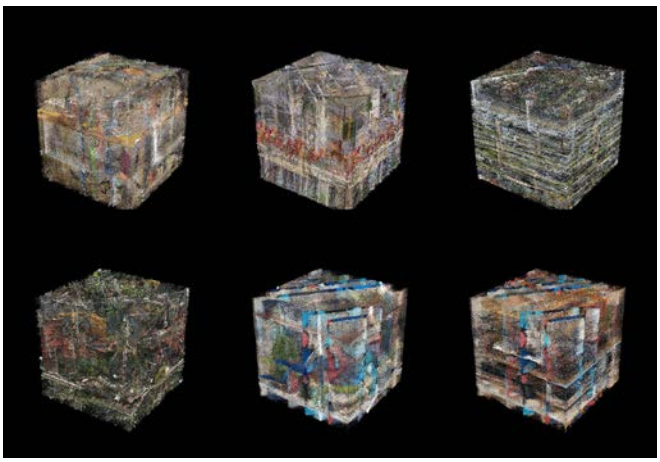

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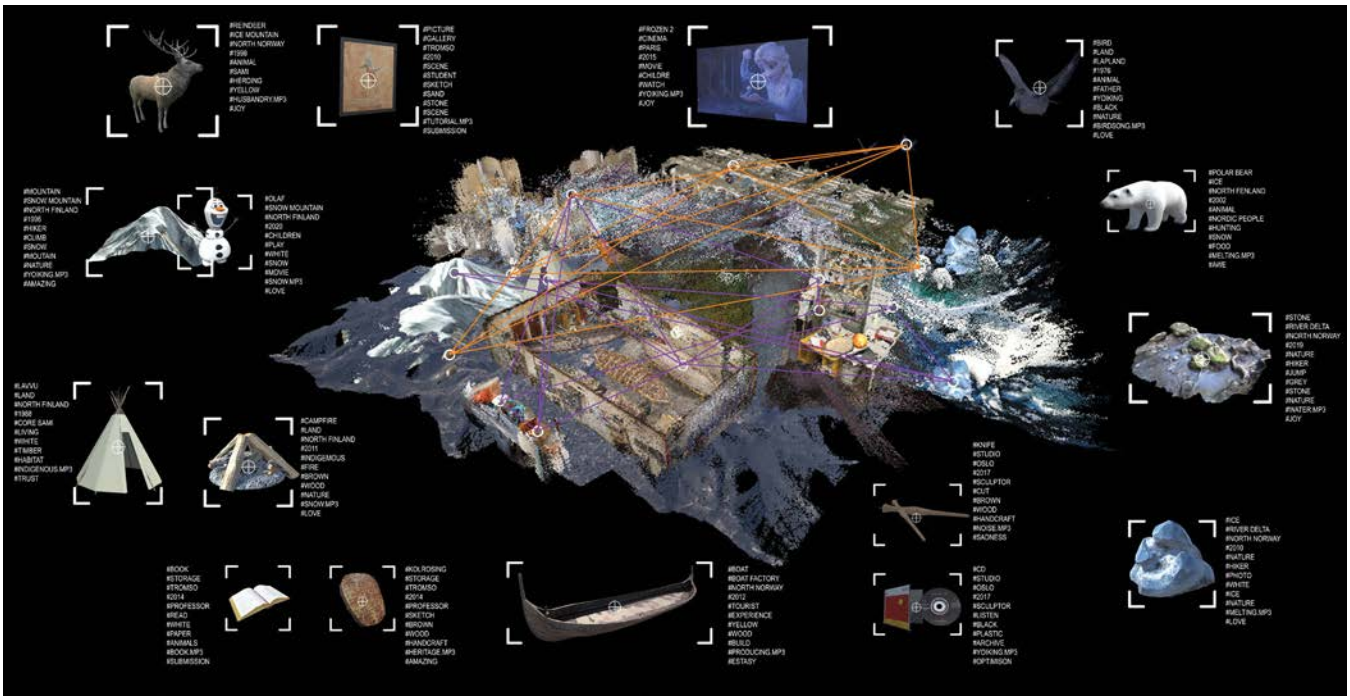
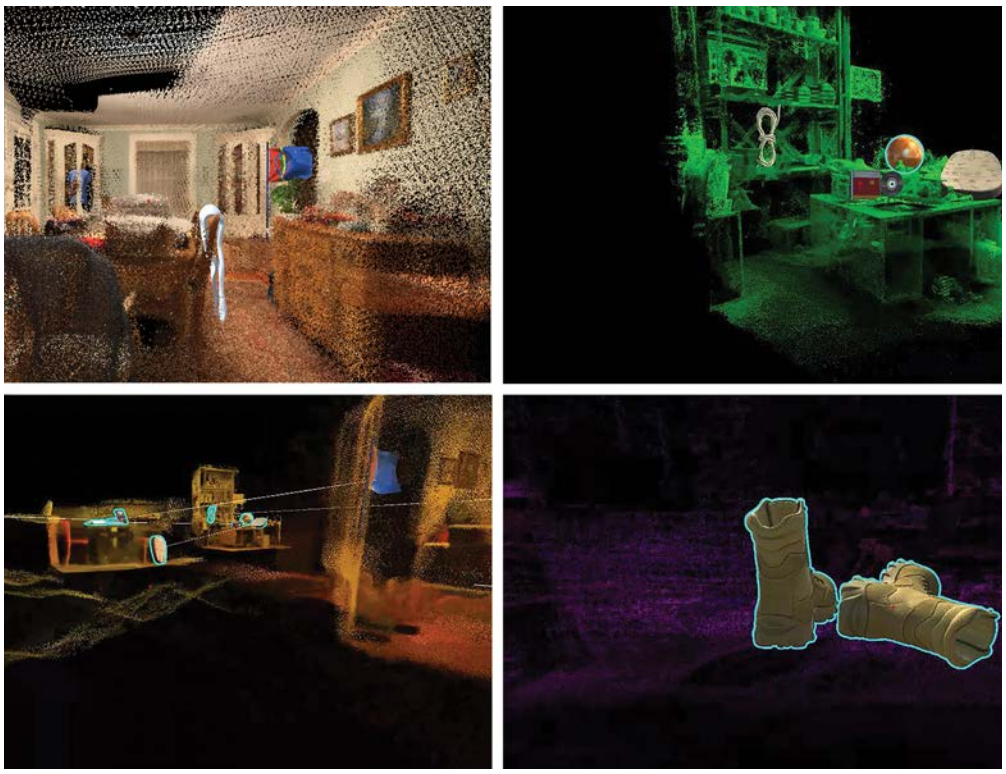


15. Reconstruction of a self-world through object association.



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13 Segmented objects extracted through eye-gaze heat maps.

14 Multiple self-worlds.

15 Reconstruction of a self-world through object association.

16 Examples of the virtual environment and the various layers: visual (top left), audio (top right), object (bottom left), word2vec (bottom right).

17 Still: Two people negotiating a material trade.

18 Still: Panning shot through the community.

19 Still: Houses in the process of exchanging materials within the gaming environment.

20 Still: The trade offer is rejected and one decides to deconstruct and redesign their house.

21 Still: The game proposing an update.

the collaborative process, which are both feedback through a virtual experience allowing dominant and non-dominant narratives to emerge and evolve with new information (Figure 16).

RESULTS AND DISCUSSIONS

Each case study, though sharing similar methodologies, sought to address a particular context through a unique approach tailored to the situation. Each also developed a film and a playable demo in order to test the limitations and explore various scenarios and outcomes. Importantly, the speculations play out plausible scenarios, which do not favor happy endings over potentially upsetting ones.

Kivalina. In the case of Kivalina, speculation on the project's evolution saw consensus become an increasingly difficult task to accomplish. While selection of the town's new location and layout were easily accomplished, concessions on individual houses, due to individual wants and preferences, complicated consensus making and halted the migration process (Figures 17, 18, 19, 20 and 21).

Happisburgh. Incentivized by government schemes, and forced by changing climate conditions, nomadism is strategically adopted by cli-migrants and supported by the virtual platform. As the network grows, and different settlements appear, what was originally created out of subsistence transforms into a lifestyle that runs parallel to those that opt for urban living. Additionally, each community is expected to continue growing and forming its own identity and internal system of governance which, through the platform, allows members to opt-in and opt-out, migrating as often or as little as they please.

Sami. With generational gaps and cultural differences emerging as now belonging to different nations, narratives vary, as do value systems. Despite the increased heterogeneity, the virtual archive and worldbuilding allows for the personalized and non-dominant narratives to be recorded, while majority and larger narratives will inevitably dominate the collective.

CONCLUSION

One of the current limitations in the research is the gap between development, testability, and feedback directly from the communities in the research. Although in some instances, such as in the case of Happisburgh, direct interviews were conducted, the games themselves, as both interfaces and overall objectives, would benefit from an iterative process through direct involvement of the communities at hand. Additionally, though the research is primarily directed towards testing the gameplay and responding to specific scenarios, future development will seek to integrate feasibility of those dealing with buildings through a combination of digital and physical prototyping.

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CONSENSUS PROGRESS

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CONSENSUS PROGRESS

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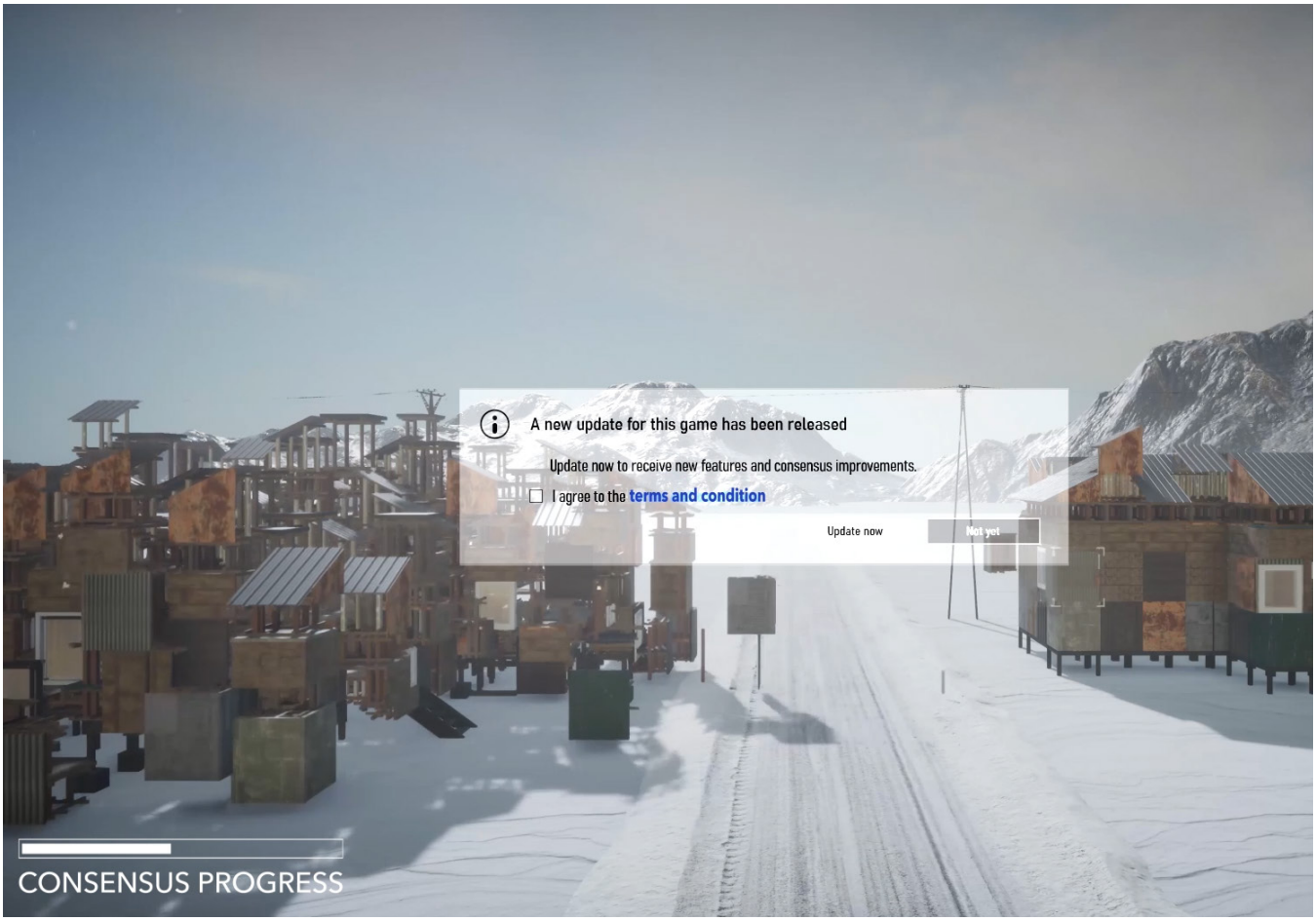
A new update for this game has been released
Update now to receive new features and consensus improvements.
I agree to the terms and condition
Update now
Not yet
CONSENSUS PROGRESS

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Despite these challenges to overcome in future studies, the methodology is believed to propose a valid approach that combines emerging computational and interactive technologies with an approach from a socio-economical, cultural, and humanitarian perspective.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the students' role and contribution in developing the research. They would also like to thank Joris Putteneers, Zehao Qin, Brian Cox, Patrick Danahy, and Sherif El Tarabishy for their technical support.

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IMAGE CREDITS

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