Research Paper

Geo-Emotions Mapping App:

Using AI for DE- coding subjective qualitative data into quantitative "system of information networks" in the studies of immersive Psychogeography lived experience.

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Abstract

We are witnessing cities undergo increasingly complex transformations (spatial-physical-social-geographical), emerging from new forms-functions that surface, compromise, hamper previous dynamics that directly affect user's experience; moreover, the predictions of urban population increase promises drastic changes-challenges in terms of cities' ability to welcome-manage new inflows of people with; intense circulation of citizens, needs for housing-work-entertainment and other demands that may not be satisfied with existing infrastructures, because this new population will form new social diversities, inequalities, new- patterns and spatial segregation with differentiation hitherto unknown. Hence, the need for user engagement in user centric participatory design approach; cities and people cannot be siloed in their treatments because human habitus is intertwined with its environment. GeoEmotionCapture-App proposes to address multi-layered, multidimensional, highly complex socio-technical-temporal systems using the advancements of environment scanning Apps with the habitus-emotions capture, and user' live-feedback to support a healthier environmental design. Various psychogeography factors can trigger user's reactions and trajectories, making it difficult to understand the phenomenal relationship and interplay "user-object". This research involves the user through recording spatiotemporal behavior and instant feedback in the corps-à-corps experience with the environment to spatialize intangible and complex emotions generated by the users, which are crucial clues that inform the design process toward a therapeutic and systemic place and space making.

Keywords

MetaversePLAY, Geo-EmotionsMapping, AI, System thinking, Urban analytics, Human ecology

Introduction

At a time when we found ourselves more exposed to systems shutdown (Covid-19), when more data is collected than we know what to do with, and when more applications on smart Phone are capable of scanning our environment with accuracy like never before *(3DSizeME, 3D Creator, Canvas, 3D Scan Anything etc…)*, it seems essential to implement an individual level of efficient data collection that strategically fuses scientifically rooted studies and patterns via artificial intelligence *(AI)* with geolocation to provide an intersecting node that connects academia *(testing Lab -pilot projects)*,

industry *(startups-entrepreneurship)* and City governments *(Geo-community; digital archive of lived experience).* The proposed tool *(ArcGIS QuickCapture[1]App)* relies on innovative blend of existing software architecture, based on client-server communications to leverage urban analytics data, especially those of the citizens collected via handheld devices (tablets, smart phone) for contributing to the development of a more inclusive Smart City by Smarter citizens. The transdisciplinary focus of this work extends to; _understanding the effect of urban space on user's wellbeing or deterioration of wellness, _ quantifying non-tangibles and spatiotemporal human reactions and _ using results as add-on set of needed individual information of the lived experience to help inform decision making. This framework takes on a ***Metaverse-Play*** style concept through involving a muti-cultural, multigenerational, multi geographical blend of participants in a game of creating together the idealized spaces/places that do not yet exist. The user participation creates a systemic complexity with a multi layered contents collection that have not yet been crushed or analyzed together. It then opens new venues for advanced urban analytics research that intend to deepen knowledge in (1) Spatial Definers of Human Performance, (2) Spatial Cognition and Mental representation of space utilization, (3) Spatialized Temporality of Events; it also helps tackle contrasting tensions that emerge from the opportunistic meeting between low-tech and High-tech, efficiency and amateurish, precision and imperfection, digital and tactile, these opposing relationship spark geo-emotion tensions and opportunities through the fusions of cultural-religious or geographical contradictions and toward an evolving culture of transformative blend of societal "nonconformity" (rejection/tension) into knowledge-base and fertile environment for growth.

1. Working hypothesis and state of the question

Existing methods of data capture with the integration *of SLAM (Simultaneous- Localization and Mapping)* seem strongly dependent on technology-specific solutions, though, they provide highly-precise scan of indoor/outdoor environments, as well as digital traces of the actions/activities of the inhabitants, constituents of virtually signified personal and/or collective territories; they use ***objective data*** mostly from homogeneous sources, but fail to capture the citizen's point of view and live feedback on the quality of experience (*subjective-data*), that oftentimes comes as conflicting viewpoints from that suggested by the massive capture. This systemic *model-builder* approach allows this work to explore an augmented cross-collaborative research possibilities on a platform that intends to maximize the contribution of the users toward the development of a user *Geo-InfoHUB*[2] to enhance efficiency in the making of Smart Cities. ArcGIS *QuickCapture* application is not new (*developed for field capture and data collection*), it is customized in this research to support urban analytics through collection of user emotions in time and place. Other applications such as *Shmapped*[3] have been developed for measuring user emotions, with limited studies on emotions around green spaces-parks with no instant feedback, and, despite the improvement of online questionnaires used today for users' feedback, issues related to location accuracy at the time of the events cause users' delayed feedback, which constitute the essential components of the data collected, because in most cases, users' responses are dependent on a specific time and place. *GeoEmotionsAPP* is an application that augments the user's experience through the capture of non-tangible to complement the automated sensor data capture readily available; because having advanced tools for urban analytics is not enough, especially when most tools focus on scanning structures with little focus on the user's individual input ex: "*why"* a specific bifurcation in path? The instant feedback system is novelty and contrasts with the off-site static paper survey questionnaires; because "after-the-fact static questionnaires" lack vital components such as location intelligence, temporal quality, and struggle to process/deploy massive amount of data at once. This approach eliminates silos in users' data collection by using a cloud-based App (*ArcGIS QuickCapture*); to collect heterogenous/objective data for a great blend of users' emotive and subjective information all at once. This ability to concurrently capture data, upload, and provide a cloud-based platform of information wealth that can be compared/contrasted to serve for various needed dashboards of information where human habitus tied to a geography, climate, culture, or religion can be visualized, detected, updated instantly, and generate new research paths on user's

reactions or psychophysical state as it relates to specifics (personal or not).

1.1. Rationale for the proposed strategy

The development of a *Geo-Emotions-CaptureApp* proposes a necessary overhaul of _technological, _human and environmental approach for a pragmatic therapeutic and healing urban design, through geomatic and cognitive sciences, where the advancement of embedded *AI* capability supports optimizing, streamlining, and expanding human experience. This process adds to the conventional capture an emotive layer of information with live-feedback as instant reaction in location which is crucial for it gives more precision on an individual level, in terms of time, day, conditions that helps understand the *cause-effect* in direct link without interference or delay. The user's increasingly demanding lifestyle in an associated complex socio-cultural environment calls for new data-collection-sets and methods that are trans-applications and interoperable to deal with, Complexity in data collection due to the heterogeneity of objective/subjective data, including organized and loose data; the data variability, which makes interpretation of similar data values sensitive to the context and time in which it is collected. Additionally, the issue of data uncertainty and bias, because of the subjective nature of the data. *Objective and subjective data* are often in conflict; however, their interdependency and conflicting nature is essential to this work as their spatialization engages a ***push-pull*** effect that allows the emergence of unexpected, innovated states.
In the present momentum, most reliable Data capture and solutions are controlled by few large organizations or private companies and most require license to access Data that are already filtered. In this context, individual freedoms and ontology in general is reduced to nearly nothing; this proposal aims to Re-register the user in a non-controlled and organic symbiosis with the environment, where the high-tech makes it possible to design a hybrid platform that stitches back together "opposites" while avoiding to disrupt the happenings of human life, in an emotion state that happens at a social, collective and individual level, and call out the essence of humanity, moral, social responsibility of Human beings among themselves and the care and concern for one another and the environment around us. The outcome of this research includes the development of an interactive data analytic framework with an App. that can capture emotions and live feedback from the psychogeography experience. The participation of the user in the collection of data help test a *CitizenSenses-MAPPING* approach that could get to a more direct response on the success or non-success of the well-being of citizen.

1.2 Role of the user in the decision making of space and placemaking

This proposal considers the individual user as a key player whose contribution is essential to help rethink urban space, at the same time, it asks essential questions, heretofore unaddressed such as: *_1. what data or information about our mind, body, health can/should be shared with others? _2. What rights and responsibilities do we have in changing the essence of what we've enjoyed as freedom of our individual privacy? _3. What code are we creating for the future generation and how does that translate to a generation that lives a completely different spatial and actual experience?* Assessing the individual role is key because "*… There is no logic that can be superimposed on the city; people make it, and it is to them, not buildings, that we must fit our plans*[4]*".* It requires Re-imagining new methods to coalesce the objective heterogeneous sensors collected data *(location intelligence, traces, and patterns of human habitus in the city)*, with the subjective *data (emotional, biased, internal, instinctive, intuitive, impressionistic)* to optimize urban processes. The question therefore becomes; how to engineer- implement a platform for smooth, engaging and augmented user's participation into the process of building together environments that empower, celebrate groups and individual uniqueness as essential part of the puzzle that makes up the city? As Jane Jacobs[5] quotes: *"Cities have the capability of providing something for everybody, only because, and only when, they are created by everybody"*. It is however fair to announce that the

development of this paper suggests using the existing networks to help support a low-tech data infrastructure building created by citizen to contribute seamlessly toward improving the user's psychogeography experience.

1.3 *The reasoning for anchoring this work on an existing data infrastructure*

This proposal argues that building from the rich existing infrastructure will extend the capabilities and permit a smoother synchronization between the context and the user's spatiotemporal data inputs. Because Urban Science and Citizen Science need to go well beyond advanced analytics of objective/subjective data that are not often used where they help, since most values of cities are rooted within the data their users generate in correlation with the built environment. This development makes a social emotion capture a built-in component of the scanning Apps that already trace users to now add emotions/thoughts to help bring into the environment design a needed layer of anonymous users' information that then broaden and deepen knowledge in citizen science for more accuracy and understanding of the *"why's"* in users' decisions during experience. The benefits include setting up a *GeoInfo-HUB* in a form of *"MetaversePlay"* where virtual, persistent, and shared experiences from one location are accessible and lived via 3D interaction by users globally. The resulting model will boost urban analytics and augment the mega franchise of automated data capture in ways that connect social science and psychogeography experiences for a better understanding of the human emotive experience of urban environment. It requires testing studies to fully understand interdependencies while respecting the relationships of all subsystems, though this work is still in its infancy stage, and can only suggest processes of building and testing results of the *GeoEmotions-APP* at its current stage for discussing next steps.

2 The participatory approach of scenario-builder for alternative and Re-imagined experience emerging from playing with tensions.

With the emergence of crowd-sensing, Augmented Reality *[AR]*, Mixed Reality *[MR]*, Virtual Reality *[VR]*, digital twin transformation and the Internet of things *[IoT]*, we can collect/interact with vast amounts of urban data, to develop strategies in systemic approach that help improve citizens interaction and human well-being in urban environments. Most handheld devices are now grounded to a true geospatial network, which facilitates the feasibility of crowdsourcing and the ability to quickly generate credible virtual models, it is now possible to meet the growing needs in terms systemic and therapeutic urban design. *QuickCapture*App will help create digital platform for information-goods that supports building knowledge and approaches that today's technology cannot yet deliver, this emerges from approaching the city as a socio- technical system with sub-systems: physical-static, and nonphysical-dynamic (*emotional-intellectual);* researches in urban domains reveal the importance of accentuated global studies in the behavioral and social aspect of the city dweller as well as the spatiotemporal interaction in the city, which represent an important aspect of human health, but one that is often overlooked.

2.2 The Existing platform proposal endowed with seamless user engagement

In this age of hyper-connection, the integration of technology geared towards the "simplification" of human life is based on the promise of freeing up time for more leisure; better consideration and monitoring of biological rhythms, cycles, and vital measures; and providing a *"superior + augmented"* human experience by facilitating an increasingly demanding lifestyle in an associated

increasingly complex technological environment. These augmented environments; global-local-intimate benefit from AR, MR, VR, and the internet of things (IoT). Users' activity levels are tracked and monitor easily with various existing APPS that link to users' well-being, mental health, productivity for a better enjoyment of life. To bridge those sparces yet important data with personal/cultural values, this paper uses ArGIS platform to create a useful pool of data about how users react to situations while experiencing the city. This work helps grasp what it really means to be a human in a post-Covid urban environment, and expands to an understanding of the scope, nature, and practice of a Collective Social Responsivity -which includes an open platform for social participation on an interplay between human and built, - a moral to participate to the wellbeing of the environment and society-at-large, -to educate oneself and one another to each other's social obligation to humanity.

This concept can be superimposed on the process developed for extracting 3D Building Information and Node Network from Scan resulting in data and schema like released in *IndoorGML*, where the user's Smart Phone is provided with a true light-weight 3D map and network graph of their environment of interest, the 3D Map and Data can be appended with the user's emotive experience for used by academia in novel research experiments.

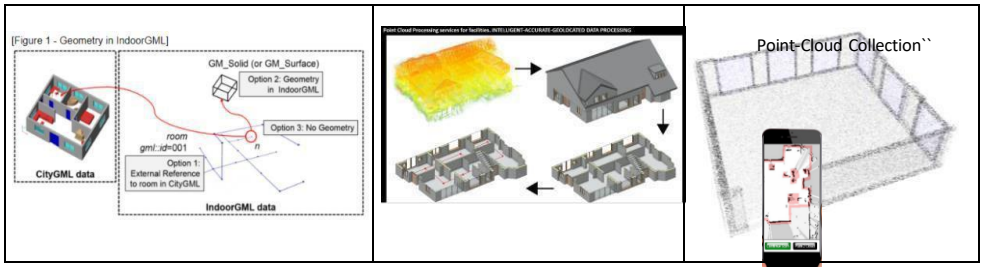


Figure 1. (Left) Existing Geometry, Indoor-GML appended with the traces. (Center) Light-weight 3D extraction, network graph of environment. (Right), Point-cloud Collection by user's handheld device. Source: Geoff Taylor/ Denzel Zang/Christine Wacta 2017.

2.2 ArcGIS *QuickCAPTURE-App*:

QuickCapture app is used for new use cases pertaining to building urban geo-emotional data infrastructure and develop systems that identify users' patterns via capturing and remembering spatiotemporal interactions, re-use computed data to carry out predictions, and ultimately educate on performing informed actions with speed and accuracy. ESRI[6] platform offers a necessary overhaul of _technological, _human and environmental to the conventional capture and yields opportunities in research toward a *therapeutic* urban approach focused on real diagnostic on human ecumene[7], the socio-cultural and environmental interrelatedness that fits into a transdisciplinary framework with focus into the dynamics of urban social life_ understanding of how people live in cities; _ How city can be repurposed to satisfy needs. In contrast with the off-site survey model, this proposal is rooted in an On-site instant-survey; because an" after-the-fact" questionnaire lacks vital location intelligence and struggles to process and deploy a massive amount of data. If the focus here is not on issues of spatial division whether *(cultural, religious, or automatic rejection of the unknown)*, the process however through the participatory approach, reaches far beyond a simplistic emotion capture and could unbridled a wealth of knowledge on people differences as augmented knowledge gained

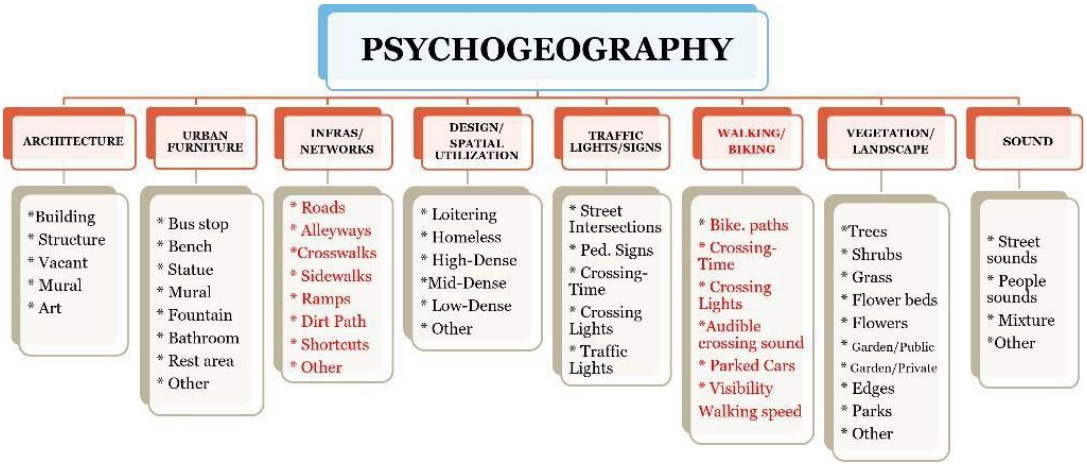
potential for individuals and community benefits and educate on unique urban morphologies as location-based phenomenon.

Figure 2. *(Left)*App's various uses: attributes show available inputs and feedback mechanism including time, speed, duration, direction, latitude, notes. *(Right)* user interface for; _1. vineyard data collection, _2. road Debris collection and _3. Arial Pipeline patrol. Source: Esri, Christine Wacta

3 The Concept stages and methodology

3.2 The concept:

The development of the App includes a variety of category that should evolve to each user's needs, by customizing based on location, capture preferences and interests. A shell is created as a basic draft that suggests categories that are interchangeable and/or replaceable (Fig.3.). This setting encourages more user participation effort toward building systems of data captured that exhibit high complexity unlike any data structure available. It then opens new research venues in _Spatial Definers of Human Performance, _ Spatial Cognition through mental and graphical representation of space utilization, _Spatialized Temporality, this helps tackle the tensions that emerge from the opportunistic meeting between Low-tech and *High-tech* between *efficiency* and *amateurish*, *precision* and *imperfection*, *digital* and *tactile*; for leveraging cultural and geographical contradictions toward a positive outcome that transforms rejection or tension of a societal "nonconformity" to an area of study



and growth.

Figure 3. Capture categories customizable by users with interface design capacity. Source: Christine Wacta

3.3 Step 1: Creating the shell for the app

This process sets up in the app what the user is interested in capturing as well as the interface design, to customize the user interface. The *QuickCapture App* framework provides sufficient information to draw from. The user shall select an Area of Interest *(AOI)*.

3.4 Step 2: Developing attributes for Capture

Development process: the *Geo*-Emotions function on the *QuickCapture App* gives users the freedom to redesign all buttons as they see fit with their context, culture, environment, or personal preferences, this provides flexibility that attract more people to participate to a ludic experience where citizens are in charge, set the rules and guide the process to becoming part of a larger scale *"MetaversePlay"* that intends to - leverage on spatially enabled data for urban applications, - catalyze the development of 3D geoinformation by Smart Citizen, - make sense of big geospatial data and digital twins in the built environment, - and cater to disciplines such as architecture, Interior Design, History preservation, urban planning, Game, Real Estate, etc…to serve the 3D GIS ecosystem while continuously exploring new frontiers in the evolution of systemic and wholistic urban spatial thinking. Setting up the application uses three attributes to represent the captures; _ ***Points*** represent all physical infrastructures (bus stops, roads, lights, buildings….) or any visible structure. It is represented by a point on the final map _ ***Lines*** represent the tracing of the movement the path taken by the user; represented as a line on the Map. _ ***Polygons*** are for creating a close loop of an area of studies. For example, in a park, areas can be outlined for showing certain areas of studies.

Figure 4. ***(left)*** **the three built in attributes for capture and their representation on a map.** ***Points*** **(with camera option),** ***Lines*** **(with tracing option) and** ***polygons*** **(tracing option). Source: Christine Wacta.**

3.5 Designing and customizing user interface for capture

The user interface is designed by him/her on needs and visual preferences. One can use all three or only one category. Data capture can be done by individuals, groups or community, the ideal scenarios is at the city level; hypothetically, a city launching a citizen-engaged campaign to understand how the designs and improvements in the city affect their citizen, to access city planning and learn from the users to serve the neighborhoods. Such citywide approach is in line with healthier alternatives for sustainable future goals to encourage more citizen experiences in the streets. To support this effort, citizen download and use *GeoEmotions-App* for collecting emotions across the city and participate to an ongoing conversation about projects and making their voices heard through this mapping/visualization exercise.

Figure 5. (Left) User interface for 1. Urban Infrastructure – 2. Spatial Utilization and 3. Urban Sound, the choices are illimited and the App can be customized to address individual user interests as it fits. Source: Christine Wacta.

This concept encourages participation of citizens into urban place and space making. The capture can extend to illimited combination of options such as; _Urban Ecology *(vegetation-urban species)*, _ Hybrid capture *(patchwork including environment, urban ecology and more),* _Cultural ecology, _ societal trends etc…..

3.5 Procedure

_*1.* users are invited to join a *geo-Hub* group through a link, **_2.** Invited users download the App., **_3.** Users start the experience by selecting one or many buttons to activate the capture of a structure/mood or both. Categories can be used concurrently, *i.e.*: users experience *surprise* and *happy* at the same time and as emotions end, its specific button is turned off independently from others. This is repeated for all categories with possibility to take pictures that attach to the map. **Figure 5.** *(Right).* The App. has *interoperability* capabilities and can pull *information from various sources; smart phone camera, ESRI Survey 1,2, 3.etc…*

3.6 User Interface and representation

Striving for statistical significance in urban science requires augmenting the conventional methods, which typically separate the data collection phase from the data analysis. By contrast, this approach performs data collection and analysis concurrently in real-time (during data collection) to guide the subsequent steps**.** The analysis of users' instant feedback *(through AI-based feature extraction and textual analysis)* combined with context feedback (location and information from each user) leads to a significant acceleration and accuracy to the overall process.

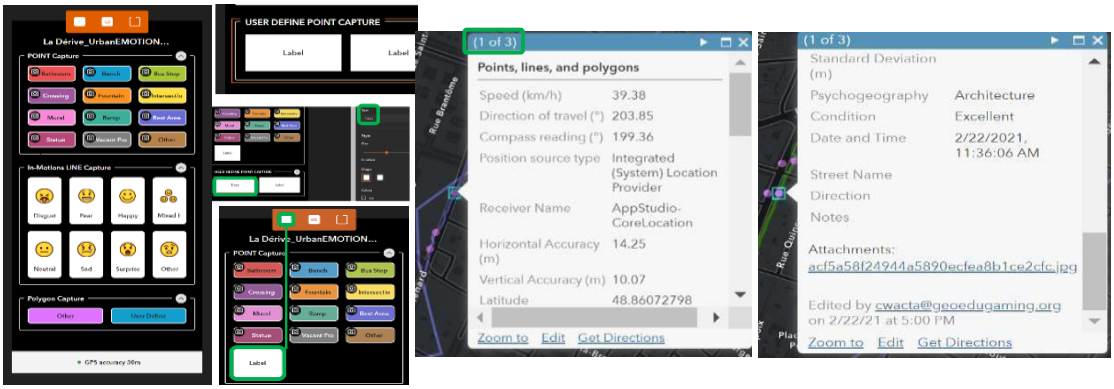


Figure 6. Interface customizable for specific location customization, *(right)* attributes appended to points during capture (*1 of 3* indicates that there are three layers of information on the same spot). Source: Christine Wacta.

3.7 Geo-Registration and Cloud Data process and management.

The captured emotions reregister following the same process as scanning (**Figure** 7.). Captures are immediately uploaded to the cloud, processed, and finally geo-registered. This mix of textual, 2D lines, points, and 3D polygons, can then be leveraged to allow users to produce a crowdsource digital mapping representation of their real-world with emotive attributes. The space model is appended to the trace of the users' experience and participate to increasing the performance of device platform for AR/VR/MR applications *(as the environment will now require scanning less often)*, and an increase of the accuracy of where objects are placed in relation to the user within the environment in AR and MR applications. Upon successful transfer *(Figure7. right)*, the point cloud volume cube previously uploaded to the server can be deleted for further processing and faster functionality.

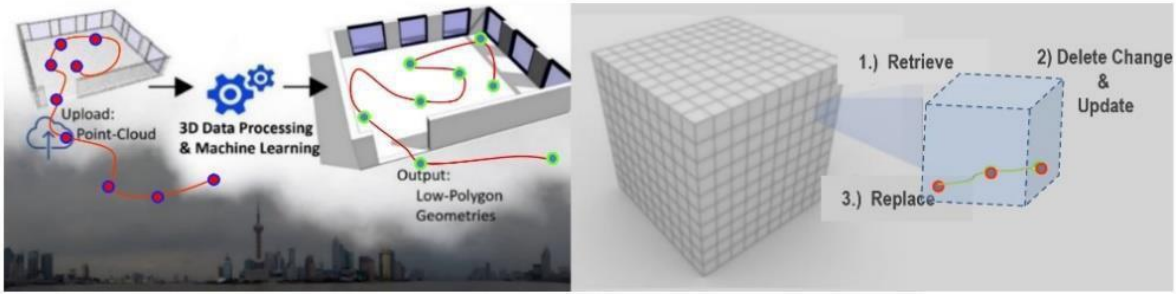


Figure 7. Data processing scheme through Machine Learning with indoor tracking, *(right)* 3D Cube LiDAR grid dataset retrieved-Detected & Updated, then deleted and replaced. Source: Christine Wacta.

4 Expected results; spatializing immersive urban experience

The result below illustrated a sample dashboard with its weblink to explore the interactive infographics of user urban experience behaviors tied to the geographical context of Paris (France), it is predictable that the *MetaversePlay* concept proposed here may constitute an

ultimate push for user to out-innovate through a patchwork of collective capacity building that engages people on an essential common component to all regardless of differences. The inventiveness of this data creation comes from the collective work of many and makes room for emergences in urban architectural language that dare to break with "*dogmatic styles*" still used in the field today.

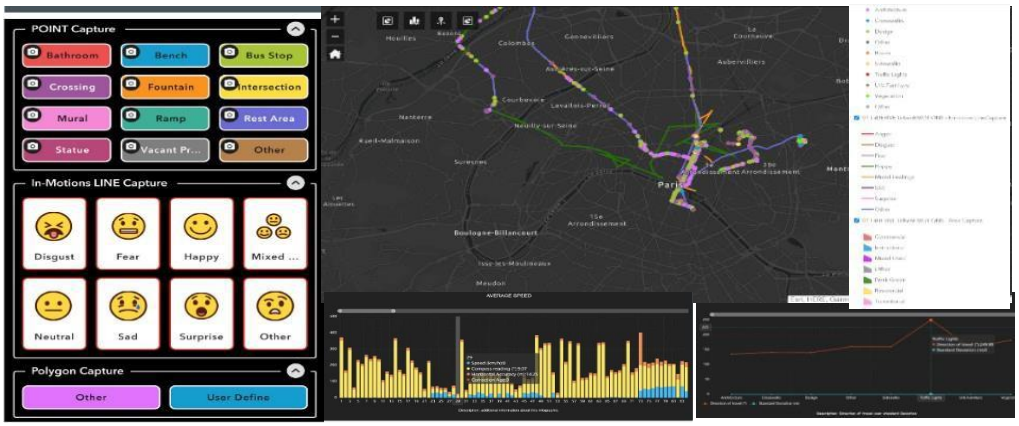


Figure 8. Infographics of Paris, Dots are for locations and line traces with attributes emotions- speed-direction-time, quality of experience. *See interactive infographics here* https://arcg.is/0rm9em
Source: Christine Wacta

4.1 Benefits and beneficiaries of such concept

The benefices are enormous, including governments, academia, researchers and communities in a number of ways: _the research community gains from a tested methodological approach and from theorizing this proposal, _ Universities can test and expand similar researches toward more discoveries; _local communities *(including individuals)* gain visibility in making individual voices heard for greater access through increased understanding and inclusiveness; _ local planners and officials benefit through increased competence resulting from capacity building and heightened knowledge of encouraging Collective Social Responsibility to urban experience, allowing to keep up with an increasingly complex urban system and advanced Robotics that enhances collaboration between architects and machine; for building an adaptive, flexible, and functional design, such as ones inspired by complex biological structure *(like biomimicry, where nature's patterns and strategies are imitated)*.– A Digital data spatialization archive is created of, behaviors from various geographical areas and transformed into learning contents linked to cultures/environments/socio-cultural norms, in a context that celebrates others' differences.

4.2 Potential Impacts of such concept

This work is framed to adapt and support ongoing research and offers opportunities to test the development in an educational setting (pilot projects) to allow academia to exploit the new technologies that facilitate self-starter and enable users to take advantage of the collective cross disciplinary evolution. At the same time, this facilitates collaboration with a broader community of investigators and decision makers through testing the concept of "***Model builder***" that engages and expose architects/planners to advanced geospatial analysis tools and methods for advanced statistical expertise.

4.3 The Challenges

An urban area represents a set of data too large to assimilate, modeled, or easily visualized, there need to be a multi-resolution approach based on nested logical structures that helps directly decompose this set into successive levels of details. Modeling urban areas represents challenge; as real city follows construction rules (implicit or explicit) and often reflects multiple historical, cultural, and social influences over time. Collecting subjective data at large scale presents challenges in terms of automation and statistical significance even with today's advance technology. Developing *Geo-Emotions-Capture App* is a socio-cultural and scientifically challenging idea*,* the concept presents advantages in breaking down to an individual system of thinking, and reactions to a spatiotemporal context, it does however run a risk of allowing individuals to make decision in what to share before they can understand the ramifications of spatializing intimate feelings on platforms that publicize them instantly. It then calls for safeguards for user protection with the control to erase-change-update information before and after it can *is/has been* perceived or accessed by the public, which could cause delays in the sharing process of *temporal quality of experience*. Another issue is the intrusiveness of this method of mapping intimate emotions that are never made public, unlike a paper survey, this method requests a response on the spot, at the time of the experience with no lapse of time (that causes decrease in feedback accuracy).

Conclusion

We cannot no longer separate environment scanning applications from human emotions capture without widening the gap and increasing public health issues in such fast-evolving technology era. *AI* and machine learning have made developing application so ubiquitous it seems right to extend the capability into the hands of the users to help feed architectural education in form of research. It is in such mindset that this work attempts to adapt tools developed in ArcGIS and expand-open new possibilities in other fields. In this context, the integration of intelligent technology in the user's handheld device could not be more opportune. The difficult awakening from the pandemic disrupted all known functions of a world we understood, it forced us to acknowledge the underlying and essential interconnectivities of our global ecosystems down to the city-individual level. It re- affirmed that our economies, socio-cultural, political, intellectual, and physiological states are interdependent; that the core interdependencies between cities and people cannot be undone. These multi layered-multidimensional and highly complex socio-technical and temporal systems have been addressed in this proposal through a hybrid blend of the *AI* capabilities with that of the quick *GeoEmotions*App. This *transcultural, trans- generational,* and *trans-trends* approach of engaging users into data capture development is key to bringing new ways of tackling citizen science issues and detecting new emergences through data visualization. It helps develop user engagement toward focusing on the ethic of CARE for our environment and others at global scale.

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