

Visualizing Visualisation: Spatial Conceptualisation as a stepping stone in the transition of Real-Virtual World Interactionism

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Abstract— The acquisition of a concept of space is an essential requirement for immersive migration from the real to the virtual worlds. Knowledge of space and place posit a hard-to-acquire concept for the non technological person. The move from a techno-centric reality to a socio-technic one has aided the transposition of the non-technic disciplines to take up the virtual environments as the next level interactive domain. Initial activity would have come from the geographically-equipped disciplines, with eventual porting to the civil-protection-related disciplines and eventually to the social sciences and the arts. The resultant knowledge gain is yet to yet fully established, as technology has outshone the actual transition, with most disciplines still struggling to understand the shift. This paper reviews the issue of knowledge of spaces, the efforts made to acquire a reality-to-virtual transition, as pushed through the establishment of a spatial information system. The paper highlights the initial work carried out to create an initial gaming environment for social interactionism to occur. The target is that based on available gaming engines and focuses on the process employed to establish the launching environment. The DIKA model is employed through its Data acquisition of real space, it being given a meaning through spatial Information, its conversion to 2D environments and in turn to 3D space as a Knowledge markup and the final Action process employed to create the interactive space through the gaming engine.

The paper posits a case study based on the spatial data transition from real to virtual spaces through the creation of a 3D

model of the city of Valletta, which model pivots around the creation of point clouds and the resultant voxel/tin models that can be ported to worlds such as Minecraft. The process is envisaged to include potential visualisation through Virtual Reality technology.

Keywords - GIS; neogeography; DICSMC, DIKA; Minecraft; Malta; virtualisation; LiDAR; interactionism; place

I. INTRODUCTION

Visualization¹ as a process brings to mind the conjuring of a mental image that reflects a recalled 'timestamp' experience, an imaginary landscape or a processed picture. The process of displaying something as an image is termed visualization and is the result of a process that converts data and gives it meaning in the form of information. This can be carried out through a system of tools or methods such as thematic mapping, as well as a host of querying facilities. However, every output needs to be interpreted by the eventual reader and any image must make sense both to the researcher and to the user who may have interpretation differences based on the socio-cultural make-up. Thus through the use of various technologies such as

¹ Visualisation with an "s" refers to the actual mental image that one can see within one's mind. Visualization with a "z" refers to the process that occurs when one converts data into a graphic representation.

geographic information systems (GIS), WebGL, VRML, a user can carry out the process of visualization as part of the mental process of forming an image based on the patterns that are observed in the analysis outputs.

Current realities posit situations where imagery is not perceived as a way of understanding the visual aspect but one where the reader is lost in the detail: detail that at times is in itself an interpreted aspect of the real world being captured for the purpose of analysis [1] [2]. At different scales, a point can represent a tree, a house or a city or a world, as one moves from a large scale (very high resolution zoomed in map such as represented by aerial photos) to a small scale scenario (very low resolution zoomed out map such as a distant-shot satellite imagery).

Lengler and Eppler's (2007) [3] investigation into visualization methods which they adventurously called the Periodic Table of Visualization Methods. Termed the Visual Literacy Project², resulted in their categorisation of the methods into six visualisation categories (DICSMC) based on what they called the Data (Data in schematic form), Information (Data transformed to an image), Concept (Qualitative approach), Strategy (Systematic approach), Metaphor (Structuring information) and Compound approach (Combining different methods). This so-called DICSMC approach runs parallel to the DIKA (Data – Information – Knowledge – Action) [4] one and structures each of its items towards the formulation of a final outcome; that of usage of the tools for implementation. The periodic table also outlines whether the methods define processes or structure. Each of the 'elements' in the periodic table represents a visual tool which results in one of the most comprehensive tools available totaling a list of 100 methods. The table value-adds to the overall visualization concept as it identifies those 'elements' that focus on convergent or divergent thinking, which is an ideal way of expressing oneself away from traditional methods, especially where new concepts are being researched.

One of the methods depicts the use of maps and in turn is extended to data related to a spatial location. Spatial data refers to those information streams that deal with location: data as it is related to a point in space. These are generally known as geographical information systems that allow one to view data in the form of a static image, a dynamic map or an online interactive system. Systems in place include the ERDF156 [5] SEIS (Shared Environmental Information System) [6], the EEA Discomap [7], the MEPA mapserver [8], GoogleMaps, BingMaps and other similar systems.

A. Conceptualisation of Space

Visualization effects different people in diverse ways, as dependent on their digital:analogue background: pre-digitalisation and post-digitalisation. Whilst it may be difficult to conceptualise a scenario where the digital version, such is still a reality for some who cling to hardcopies, atlases and paper. Equally perplexing that the new generations do not access such but immerse themselves in virtual worlds that may yet represent real space, which in turn has resulted in the loss of linkages to the real world. Case in point is the need to

² <http://www.visual-literacy.org/index.html>

establish mental connections of place between the two worlds: the availability of online map services as created by services such as Google Maps, Google Earth, Bing and various other entities have made inroads. These 2D maps and the recent attempts at 3D content by these companies reflects the way that the industry is targeting. In addition, the recent acquisitions of Oculus Rift by Facebook and Minecraft by Microsoft are two cases in point.

Such is the best concept for analysis as this physical interactionism is taking on a parallel shape in virtual worlds: meeting in known spaces in worlds as 2D constructs as are social media (Facebook is an example) and in 3D constructs such as Second life. Gaming enthusiasts have attempted to bridge the gap with such creations as modules or files that depict some kind of known place (SimCity), the Sims, whilst others have taken on a national dimension (such as flight simulators³), though on an ad hoc basis and rarely immersive.

This study depicts the steps taken to establish a dataset that establishes a baseline structure for world building, through the transposition of the known space that all generations are cognizant of, or at least cognizant of the known space. The creation of a national-level dataset encompassing the entire Maltese terrestrial and bathymetric (up to 1 nautical mile from the baseline coast) zone, should enable users to interact in worlds that can be related to the real world, whilst allowing for the creation of new scenarios for the academic and professional domains, wherein they can create scenarios both for social and physical change, as against role gaming. The main scope for testing this in a gaming scenario, was also facilitated through the availability of technology development in this field that moves away from high-end expensive proprietary systems to low-cost and highly accessible systems created for the game engine evolution.

This paper posits a process employed in Malta to bridge the gap between the perceptions of what users think their reality looks like (visualisation) and then employs a visualization process to attempt to create a 3D world for users to interact with that is more realistic than the current laborious Sketchup process or the more recent Google Earth's 3D extrusion that the company employed instead of Sketchup.

The paper attempts to understand whether users know what their surroundings look like and then attempts to create a process that transposes a real space, in this case the city of Valletta, into a digital form that reflects reality in a more understandable mode.

II. TARGETING A WIDE USER-GROUP

The initial steps to understand known space was accomplished through an introductory study on how far users are aware of their known place. The focus was maintained on the knowledge of national space through the depiction of the national map of the islands. Studies show that such a process is highly difficult for all users [3], the higher the expected perceived space is investigated. The study included the request for users to draw a depiction of a map of the Maltese Islands as an attempt to understand whether the target group can

³ www.maltascenery.net

perceive what their city looks like, its location on the island and any other identifying features. The findings were surprising due to the fact that such an image was abstractly defined but highly erroneous in detail enhancement. Figures 1a-f depict some maps drawn of the islands, with Valletta being rendered as double, displaced or totally eliminated, whilst in cases till sporting the classic fish-shape depicted in classic accounts. This outcome is found irrespective of island of provenance, but shows the difficulty encountered in the transforming the visualization process into a comprehensible visualisation. The depiction may be the result of lack of geographic knowledge of one's surroundings, but it may also depict a situation where the visualization process is too difficult for the user, thus caution is essential in the interpretation of the maps as the post-paper re-run that compares the two process would aid the comparison of the two methods.

The main outcome of this step depicted the fact that the need for a review of national knowledge of both geographic and neo-geographic spaces through the implementation of a phased approach to the creation of quasi-realistic worlds that are situated in virtual space: worlds that one can move into and interact with through known landmarks.

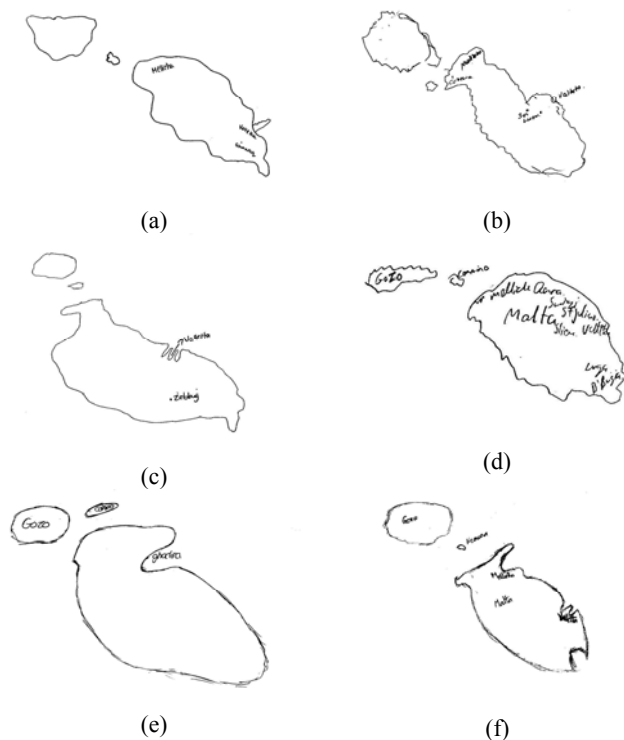


Figure 1: Valletta's depiction across the age groups

III. CONCEPTUALISING VIRTUAL SPACE

In order to move from a conceptual model to a working model, one must move towards an unravelling of the complexities built into the reality being studied. Thus, the conceptual model's reincarnations are tools that would be used in a computer to replicate the real world process one is trying to model.

This process is based on the steps identified by Pequet [9] in his description of Levels of Abstraction. Pequet's work on GIS can be translated to a mind map which drafts the process from reality to abstract user-oriented information structure to concrete machine-oriented storage structure of the computer. From the latter, one can then run the necessary queries and implement to outputs from the model. The modified Pequet structure below takes the model and transposes it for any data type.

There are 3 stages that need to be taken into account:

Stage 1: identify those entities one is interested in and decide how to represent them;

Stage 2: choose a data model that computers are able to display, analyse and store your entity representation;

Stage 3: draft a "nuts and bolts" stage where one instructs the computer how to recreate the identified entities.

The DIKA model detailing the data cycle process was employed in this paper through its data acquisition of real world coordinates, it being given a meaning through spatial information systems as are GIS, its conversion to 2D environments (raster mapping) and in turn to 3D space (vrm, obj, stl, WebGL) as a knowledge markup (recognition of known space in the virtual environment, with the final action process employed to create the interactive space). New technologies employing WebGL resulted in better depictions of the LiDAR data points that are not dependent on heavy TIN files that may require pre-loading or access to a fat-client, but are readily available through a pyramidal thin-client / fat-server system that employs platform-free browsers. The current online maps, employ the pyramidal system that loads more detailed data as one zooms in though the outputs are essentially resultant as image files. The WebGL option employs this process but maintains the data point integrity and even allows for geographic analysis.

This process goes beyond the geo-server approach to spatial information that are normally depicted as 2D maps but depicts the data as 3D point cloud outputs with the option to visualise it in different modes.

The next steps depict the conversion process employed in the creation of this Valletta 3D world in two main formats: that employing WebGL and an interactive world-building gaming engine entitled Minecraft. In turn, this paper will serve as the launching pad for the next phase of the study post-this paper, where the process is rerun the user's perception of the city to their perception of a 3D world.

IV. CREATING VIRTUAL SPACES:

The data used in this study was that emanating from a project funded under the European Regional Development Fund (ERDF), specifically through the project entitled Developing National Environmental Monitoring Infrastructure and Capacity [5].

The project's baseline data was acquired specifically for the terrestrial and bathymetric areas of the Maltese Islands which also included innovative imagery captures such as oblique imagery and Light Detection and Ranging (LiDAR) data.

The outputs were made possible through the creation of baseline data having a sole aim of the provision of an Open Data structure where the series of 3D aerial and bathymetric surveys which facilitated the dissemination of data to the general public. The resultant datasets were employed for this study through the creation of detailed point clouds of Valletta.

V. MOVEMENT TOWARDS VIRTUALITY

A. The WebGL Option

The process analysed for this study related to that employed in the conversion of various datasets emanating from the ERDF156 project, a process that required the transposition of the bathymetric and terrestrial data from a LiDAR height point to a 3D visualization structure. This was initially taken up through the implementation of lineage protocols that recorded the steps undertaken in line with the INSPIRE Directive [10], to be followed by a series of analytical processes (3d-ification) that converted the LiDAR data depicting the City of Valletta (Figure 2a) and its historical Fort St Elmo (Figure 2b) to a coloured cloud (Figure 2c) that is viewable in a 3D format. The colorisation of the LiDAR points serves a dual purpose: that of depicting the real-world colour of the point in question as captured from aerial imagery (Figure 2c) or that depicting a thematic output such as the combined landcover/landuse map (Figure 2d) or outputted as an intensity map (Figure 2e) or a height map (Figure 2f). Two applications were used for this process with the integrator entitled GlobalMapper and the conversion engine entitled Potreeconverter. The output reflects a 3D depiction of the city that can be rotated, zoomed into, as well as measured for distance, area and volume.

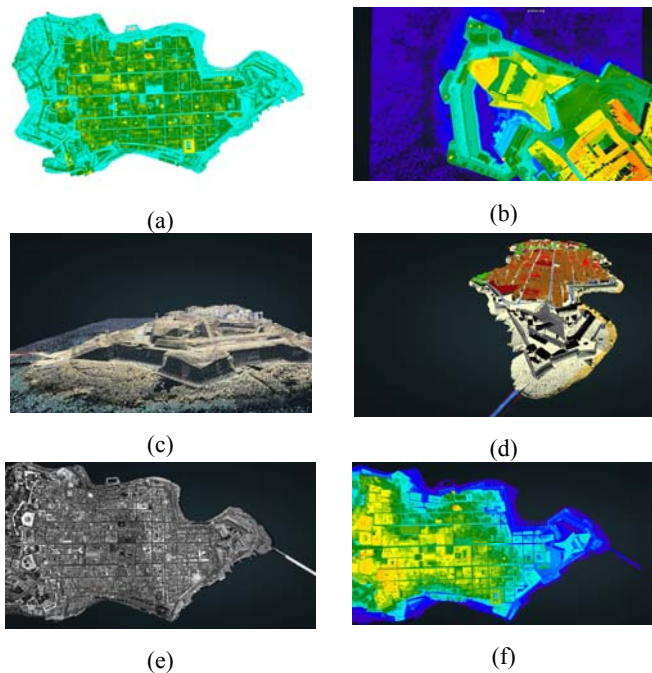


Figure 2: The transformative process

B. Blocks over blocks

The second process that would enable users to visualise the zone from an entirely different perspective is that employing a game engine entitled Minecraft. The process entailed the usage of the LiDAR data (Figure 3a) to a raster image or a tin file (Figure 3b) that is viewable in a 3D format. The raster image is cleaned of outliers and ported to a bridging application that converts the raster imagery to the respective format for immersive experience, where the data is exported as a 3D world that allows users to fly over, move within, demolish and build blocks, as well as interact with other users. Two applications were used for this process with the converter entitled Worldpainter (Figure 3c) and the game engine entitled Minecraft (Figure 3d).

Users can move within the areas under study not only as a pedestrian in a streetscape (Figure 3e) or as a landscape view (Figure 3f), but also as an interactionist within enclosed environments such as the Hal-Saflieni Hypogeum (Figure 3g) and the above-ground temple of Skorba (Figure 3h).

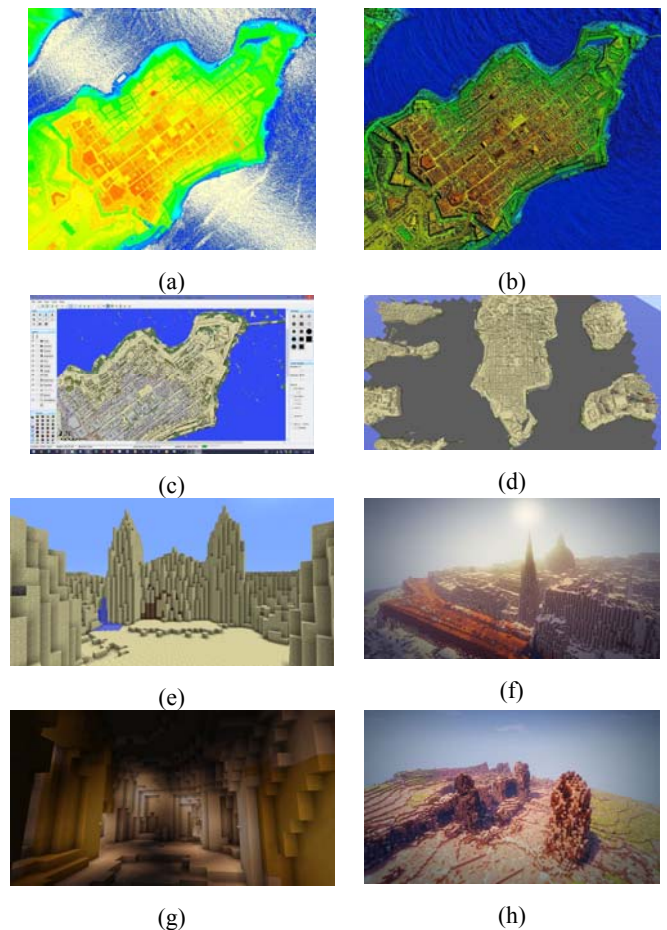


Figure 3: 3d-ification process

VI. CONCLUSIONS

The conceptualisation of real world spaces may be perceived as a natural process that people can readily relate to, though the process of visualization shows that the resultant visualisation is far from that reflected in reality. The hand-drawn maps are testament to this phenomenon, a phenomenon that requires further investigation, now that the 2D and 3D depictions have been generated. In turn the investigation can be further compared to the recognition of real-world spaces within a 3D interactive environment. The latter would also allow for the generation of spaces reflecting reality, creating period-specific maps and generating fantastic or surreal spaces for educational, academic, planning activities and a plethora of other activities.

Gaming applications and intermediate conversion tools served the basis for the push to the creation of virtual worlds that are loyal to the real one, inherently due to their being resultant of real world coordinates. In term of GIS technology, this development could also result in gaming integration in these information systems, allowing for scenario building and testing, a step above today's dedicated thematic modules that allow one to view but not interact. With the implementation of new immersive technologies such as Oculus Rift, the Minecraft experience can be ported to the immersive environment that one could interact with whilst walking through the real-world Valletta streets.

The resultant recognition of place within a virtual world in turn helps to create a legacy of space, knowledge, scenario-building and recollection of moments in time once informational packets are tagged to the 3d points or volumetric voxels.

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