

SynopCity - Virtual HUB for Smart Cities

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Abstract— The paper is proposing a framework of a complex platform, set of collaborating applications representing a SynopCity Virtual HUB project serving as tool for a research of smart city concept. HUB represents in this concept a connection between a physical and virtual centers, social and physical networks collecting and exchanging data.

Keywords— Smart city, social network, virtual reality, augmented reality, cyber physical system - CPS, city model, city visualization.

I. INTRODUCTION

SMART city concept covers cities of various sizes and urban constellation, including small settlement as well as large megacities. Each of these urban development structures [1, 2] has many physical layers created in unrepeatable pattern working at different level of performance measured by Key Performance Indicators (KPI).

A social network platform is an essential part of everyday life of all social type and age groups. It is used to communicate and share information and data. This sharing process is mainly provided through the Internet. Most of these social websites are resource of big amount of data, information, innovation ideas, creativity or expertise placed into a virtual space by their users from all over the world.

Information and Communication Technologies (ICT) intermediate this communication process by mobile phones, tablets, or wearable and elements connected in Internet of Thing and other networks connecting physical objects into complex systems [4-7].

Some social networks as Facebook, WhatsUp, LinkedIn, Skype are mainly used as a communication tool, other are used to share photos (Flickr, Pinterest) or video (YouTube, Vine).

II. CONCEPT OF SYNOPCITY VIRTUAL HUB

Our approach is to create SynopCity - a Social Network specifically created to share information, data, knowledge, experience, projects, events and best practices examples of Smart City designing process and development around the world.

The expectation is that smart city is more effective to operate and organize all categories of its infrastructures to improve a typical daily life actions of citizens and visitors, livability and spatial flow in a space and elevate a quality of

life of whole society, living area and connected neighborhood.

Wide approval from citizens and their engagement in smart city development is a fundamental pre-requisite to make changes in existing development and design process of new urban developments. Online applications and platforms can be immensely useful to engage citizens and collect input.

To explore social and physical processes, relations, connections and between subjects acting in city environment we designed a Social – Cyber Physical Space Model called SynopCity Virtual HUB (SVH).

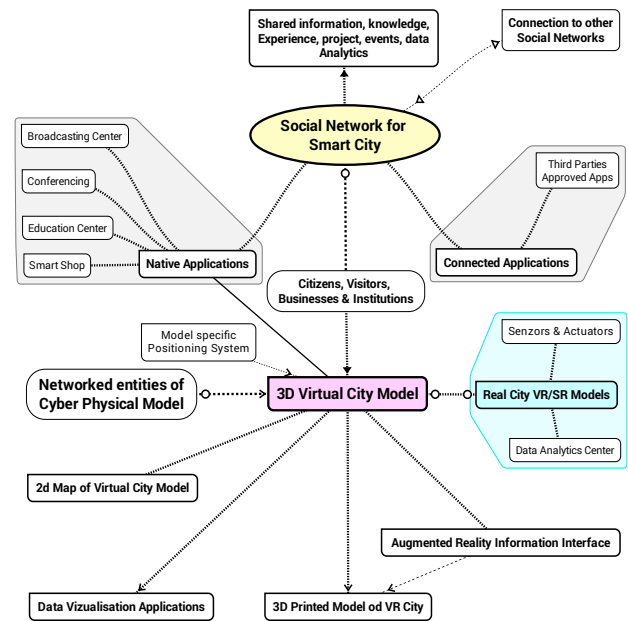


Fig. 1: Diagram of SynopCity Virtual HUB (SVH)

Parts of SynopCity Virtual HUB (SVH) shown on Fig. 1 are:

- SynopCity Social Network
- Virtual SynopCity HUB 3D Model
- SynopCity Virtual / Simulated Reality (VR/SR) Clones Models
- Applications, Networked objects from Physical world and 3D Printed Models

SynopCity Virtual HUB (SVH) is a collaborative instrument with tools and methods used for an education, research, project collaboration, presentations, conferences, business, real estate activities, urbanism, city governing processes, crowdfunding, team work purposes with users collaborated from around the world.

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III. SYNOPCITY SOCIAL NETWORK

SynopCity Social Network (SSN) supply data in database of people and information collected, posted and shared by network users and by analytics of their active interaction.

SSN, shown on Fig. 2, is designed as a tool to examine processes how citizens behave, collaborate and communicate as individuals, groups or business subjects or communities.

It is a smart city community platform where individual members of network share their content and interact over the network structure. To enhance a collaboration functions of a social network specific applications are implemented into a communication system of SSN.

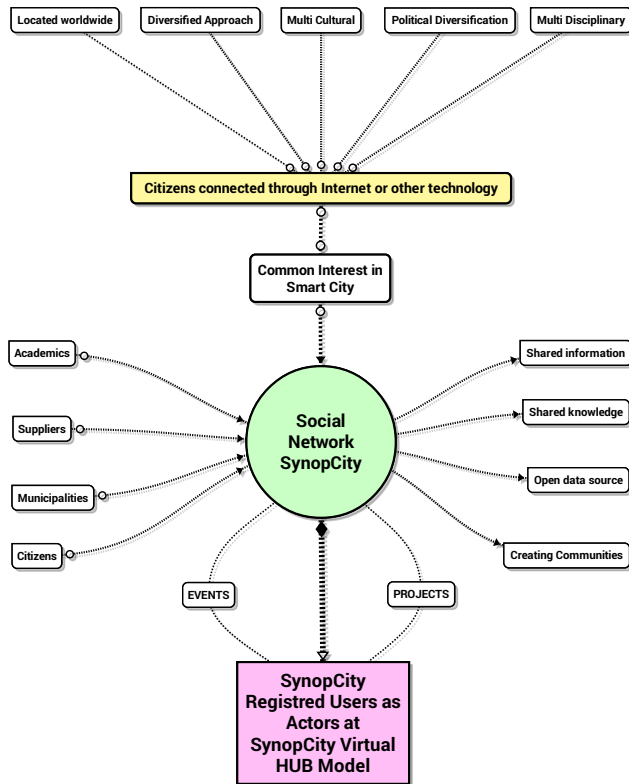


Fig. 2: Diagram of SynopCity Social Network Structure

SSN has all typical indicators, functions and tools of a social network site distributed on the Internet.

It is an interdisciplinary, cross-lingual knowledge platform, with a content supplied by their users to share an international and multicultural experience, and database of smart projects and best practices.

One of most important goal of this social network platform for smart city is to help overcome technical and bureaucratic language barriers between policy makers, implementers, technologists and citizens.

To create a communication channels between specific type of users four basic User Profiles were created.

All users have to be Registered Members to share a content. Each Member has to be registered under one of User Profile:

- Academics
- Municipality representatives

- Suppliers of products, services or solutions (commercial subjects)
- Individual citizens, Communities, Cities (or other type of urbanized unit, and other non-profit organizations)

Events and Projects are registered under specific Profiles:

- Event
- Project

Unregistered users may only read a content open for public on main website page with no interaction with other users.

Permanent interchange of information between their users produce vast amount of data. Data can be analyzed and used to design communication channels and control mechanism for smart cities.

Social network analysis view social relationships in terms of network theory, consisting of nodes (representing individual actors within the network) and ties (which represent relationships between the individuals, such as friendships, chat, hyperlinks, and other responses). These networks are often depicted in a social network diagram, where nodes are represented as points and ties are represented as lines.

The strength of social ties between individual parties of social network, the evolution of social network over time, trends and content are visualized in different kinds of diagrams and graphs using key metrics, calculated by specific algorithms.

IV. SYNOPCITY VIRTUAL CITY HUB 3D MODEL

SynopCity Virtual HUB 3D Model is application where Members create a community of citizens and commonly develop 3D model of virtual city. Data will have a geographic component with definition of location related to local GPS parameters of Model.

Model Orientation and search in Model is based on a visual recognition of reference objects, user's experience from real world life and norms and traditions, behavioral standards and unwritten rules that govern how we and when we gather.



Fig. 3: Application showing geotags (Agency9)

Virtual City HUB 3D Model is designed to explore human behavior inside a Social Cyber Physical System (S-CPS). S-CPS is complex of applications connected inside one hybrid

system designed to develop a virtual city in 3D format by members of SynopCity Social Network (SSN).

Data from virtual city development process will be analyzed. Results of this experiment will be used to improve design processes of re-formatting and re-shaping existing cities and new smart urban developments.

Data of this Virtual HUB Model and spatial flow indicators are tagged with an information generated in relation to original geographic information system (Fig. 3).

SynopCity 2D Map is application used as a visual aid guide – plan of Virtual City HUB 3D Model. Map will be an orientation tool exposing Entry Points (EP) – designated gateways into a 3D Model and other interest points and use of land (Fig. 4).

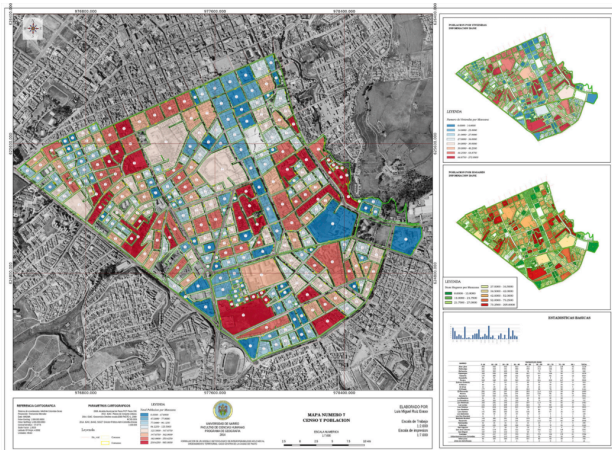


Fig. 4: Sample of map created with QGIS Open Source Geographic Information System (GIS) licensed under the GNU General Public License (<https://www.flickr.com/photos/131735363@N06/16934676110/in/pool-2244553@N22>)

Development of Virtual City HUB 3D Model will be controlled by Regulation Plan - Building Code, and development Rules and Regulations. Land for development will be distributed to future owners by administrator based on attractiveness of location and in relation to activities on other land in neighborhood.

Each User of Virtual City Model have assigned a status of Citizenship:

- Model Administrators (Rules and Regulation makers)
- Shareholders
- Policy makers - elected by Permanent Residents
- Citizens with a status of Permanent Resident
- Citizens with a status of Temporary Resident
- Citizens with a status of Business Representative
- Visitor (restricted functionality and rights)

Citizen's status is based on activities and amount of ownership of Model's asset. Citizens with different status have particular set of right.

Individuals or groups of individuals are permitted to conduct a business processes inside a Virtual Model or manage a business outside of Virtual Model (Fig. 5).

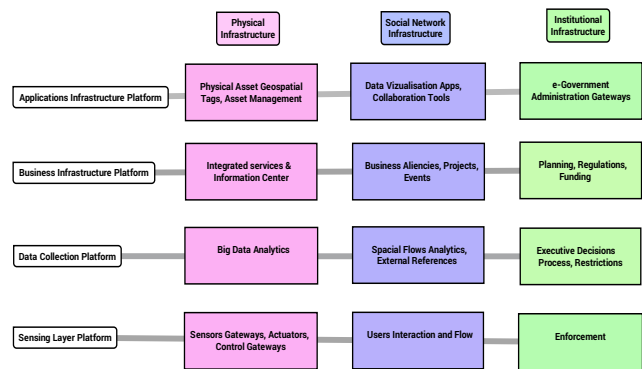


Fig. 5: Four Platforms of SynopCity Virtual City HUB

Each transaction is monitored and documented by Model Administrator System. Model will have its own payment system using digital crypto-currency allowing users provide direct transaction without an intermediary. The regular currency can be used instead through physical world banking system.

V. SYNOCITY VR/SR CITY MODEL CLONES

VR/SR City Model Clones (SC-CLONES) are 3D Models of real place in physical world developed in virtual space (Clones) presented through Virtual or Simulated Reality interface.

Data from sensors and actuators placed in physical city will be visualized in Model.

SC-CLONES is a part of SynopCity HUB application simulating development already built in real world or virtual model of future development at the location described by GPS coordinates.

Information and processes in tis part of model can be enhanced by using overlaid set of nearly real life information, using augmented reality interface.

The purpose of this part of SynopCity Model is to create a distance access to particular places in world. This is done by use of Virtual and Simulated Reality visual interface and visualization of processes generated in a real world using data gathered by sensors and actuators.

VI. SYNOCITY APPLICATIONS

Applications (Apps) are connected to other parts of SVH. These Apps are built as integrated part of SVH system or connected through APIs and other gateways.

Specific Apps are created to form interest groups - communities inside a virtual world [3]. Those groups can conduct many activities inside cyber model world. They also can manage physical asset located in real world using Cyber Physical System Networks.

Physical models of Virtual City HUB 3D Model and VR/SR City Clones Model could be printed using 3D printing technology as a visualization tool with a possibility to use augmented reality to showcase real time processes inside both type of SVH models.

VII. CONCLUSION

The presented SynopCity HUB is a new type of a Social - Cyber Physical System (S-CPS) Model where actors – registered members of social network are developers of a virtual model of City based on rules and regulative simulated processes of urban development in physical world.

Within citizen engagement, participation and co-design methods, a commonly reported challenge is related to bridging and actually translating professional and technical jargon into a language that can be easily understood and that people can connect to their daily lives and problems.

Data produced within SynopCity HUB both – virtual and physical – are going to be analyzed, visualized and used for more research, education, learning and smart city managing processes [8].

The further evolution of the urban development process using Cyber Physical System (CPS) augmented with Social layer (S-CPS) will be the subject of future research [9] within Smart City area.

VIII. REFERENCES

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