ST-Rays: A Google Maps-based Geospatial Tool
to Cross-analyze Urban Services and Tax Payments

Alfio Costanzo

Department of Electrical, Electronics and Computer Engineering, University of Catania,
Viale Andrea Doria 6, Catania, 95125, Italy

Keywords: e- Government, e-Payment, e-Democracy.

Abstract: From the Public Administration point of view, the local tax payment is the basic condition to implement suitable urban services for the citizens. However, from the citizen point of view, control tools that measure the quality of the services offered at urban scale are also requested to verify the correlation between taxes and services. Therefore, tax control and payment facilitation methods should be implemented to increase the yield of the taxes, as well as transparency and accountability, but also deeper information on the status of the services should be given to plan possible service quality improvement. Aim of this paper is to show an e-government tool to inform the citizens, using a Google Maps interface, on how much to pay depending on her/his properties and use or to inform the public offices on the proper and timely actions to solicit the tax payment of citizens in arrears. Also, the tool supports statistical inquiries to visualize the payment degree for an area chosen by authorized users by issuing the name of the district or the road of interest, or by sketching the zone contours directly on the display. Also, the tool allows the user to visualize for the chosen area the offered services to assess how their tax is being spent and to express their feedback.

1 INTRODUCTION

From the Public Administration point of view, the local tax payment is the basic condition to implement suitable urban services for the citizens. However, from the citizen point of view, control tools that measure the quality of the services offered at urban scale are also requested to assess how their tax is being spent. Therefore, tax evasion control and payment facilitation methods should be carried out to increase the yield of the taxes, but also deeper information services should be implemented to inform citizens and public managers on the quality of the available public services, and possibly to plan their improvement.

In the paper we take into account the case in which tax payment at local level depends, as in Italy, on the correct proportioning of the tax amount to be paid with respect to the consistence and use of the taxed entities, e.g., the citizens' real estates. This computation is not so easy since it depends on the integration of many data that reside on the data stores of different departments of the Public Administration (PA), e.g., personal data residing on a Municipality Data Base (DB) should be linked to the cadastral data, i.e., data dealing with ownership, boundaries, and value of real property.

Let us note that several works are available in the literature dealing with geospatial data for land use management as well as for providing volunteered geographic information, e.g., (Coleman , 2009) and (Ganapati, 2011), whereas few solutions deal with the taxation, e.g., the projects named Elisa (Engineering, 2010) and K-Metropolis (Costanzo, 2012a) promoted by Italian Research Programs. The former approach is centralized, whereas the latter is distributed, but both these solutions are based on data integration technologies to transform data codification from proprietary formats to standard vocabularies, also called ontologies, e.g., (Faro, 2003) and (Zhai, 2008). A discussion on this theme is outside the scope of the paper and may be found in (Giordano, 2013).

Aim of this paper is to show a tool, called ST-Rays, able to visualize on Google Maps the tax payment status of the citizens so that they may be informed on how much to pay depending on their properties or to solicit the tax payment in arrears.

Statistical inquiries are supported by the tool to visualize the payment degree of an area chosen by

authorized users by giving the name of the district of interest, or by sketching the zone contours directly on the display. Also, the tool allows citizens and public managers to visualize for the chosen area the available services, e.g., the bus frequency, the number of students that can be hosted by the schools divided by the number of potential students resident in the selected area, the location of the containers for collecting waste. ST-Rays collects feedbacks from citizens to measure the offered service quality.

Sect.2 presents the architecture and the characteristics of the proposed tool by pointing out how it may be executed on either the urban server or the user mobiles to carry out timely control of the services quality and tax payment. Sect.3 illustrates the main use cases dealing with specific information on the due payments and with thematic maps about the available service status for a zone identified by name or by sketch.

2 ST-Rays MAIN FUNCTIONS

ST-Rays is currently a module of the K-Metropolis system (Costanzo, 2012b) aiming at supporting the e-governance of a metropolitan area as well as citizens mobility and logistics. Fig.1 points out how the tool interacts through the K-Metropolis functionalities with the relevant databases of PA, e.g., a) the cadaster DB dealing with ownership, boundaries, and value of real property, whose XML format is described in fig.2, and b) the municipal data archives. The K-Metropolis monitoring systems are not only used to support urban mobility and logistics, but also to collect geospatial data on the urban life such as pollution, waste collection and traffic congestion to measure the main urban services. In this architecture, the authorized end users (i.e., PA offices and citizens) may ask the ST-Rays resident on the Urban Server to check tax payments and the urban service status.

ST-Rays informs the users using JQMobile scripts (David, 2011) directed to their PCs or mobiles. The results may be displayed also by a software, consisting of Flash Builder scripts (Corlan 2009), resident on the mobiles that is able to collect the data entering into the mentioned XML databases directly without the server intervention.

In either the ST-Rays version implemented on the server or in the one resident on the mobile it is possible to visualize on a familiar interface based on Google Maps the situation of the payments and the status of the urban services.

This will allow the PA managers to have a better view on the tax payments and to do statistical studies

for selected areas, whereas the citizens may monitor their tax situation, as well as they may have a general view of the quality of the urban services with respect to the zones where they live.
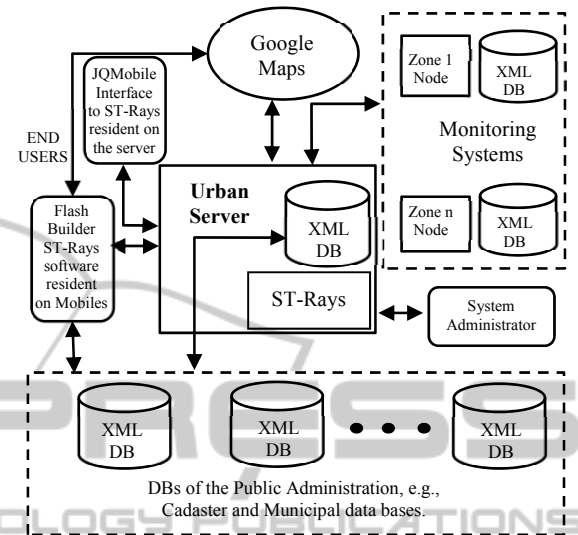

Figure 1: Architecture of the K-Metropolis system including the tool ST-Rays: relevant DBs, end users (on the left) and system administrator (on the right).

Figure 2: XML scheme of the database of the cadastre.

Also, the mobile version of ST-Rays allows the urban policemen to make inspections while they are walking, and the citizens to control the services offered as soon as they see some anomalies, e.g. the birth of an illegal waste dump. The citizens may also express their feedback about the quality of the available services using their mobiles so that the PA managers may avoid inconveniences and improve the overall service quality.

394

3 MAIN USE CASES

This section illustrates four main use cases: a) the Public Administration carrying out checks on the payments done from the citizens residing in a certain road or administrative zone, b) a citizen seeking the information characterizing his/her real estate taken from the cadastre, c) two queries by sketch to either check the tax payment and the status of the urban services and d) the statistical representation of the service quality of a given service for planning suitable actions to improve services.

Fig.3 shows the situation regarding the payment of taxes highlighting with a red marker the locations where there are people who have not yet made the payment and with a green marker, instead, those who have already done so. In this way one can have a territorial vision of tax evasion control.
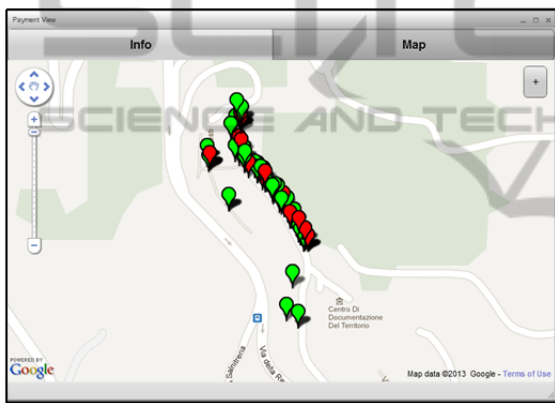

Figure 3: Detailed view of the payment status of the citizens residing in a certain urban zone.

The public office can check in detail the payment situation of an individual building, as shown in fig.4 where all the relevant information of the citizens resident on that building under check are displayed.
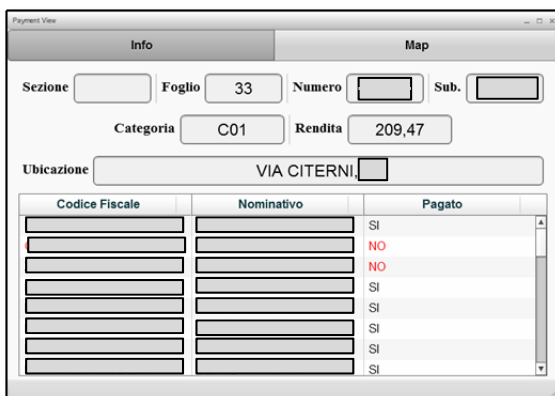

Figure 4: Detailed view of a local tax payment of the citizens resident in a given building.

The data shown in fig.4 have been obtained by linking the cadaster information to the related Google Maps addresses. This linking allows each individual citizen to control their tax payments, calculated on the basis of their cadaster situation.

The mentioned check may be carried out by using the query by sketch technology. For example, fig.5 illustrates how the software resident on the mobile may support a search by sketch to facilitate the monitoring of the areas that share some urban functions although they don't belong to the same administrative zone.
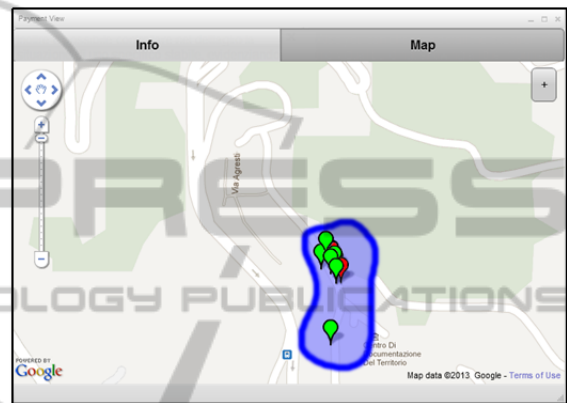

Figure 5: Search by sketch to monitor the payments situation of an area freely chosen by the user.

From the citizen point of view, it is important not only to report any abnormal event or to transmit their feedback but also to know if all the services offered in the area of their interest are functioning correctly.

For this reason, the tool allows the citizens and the district administrators to have a general vision on the service status by visualizing on their mobiles all the service units of a certain service typology, e.g., the schools of a district, featured by red, yellow and green icons (see fig.6). In this way it is quite immediate to recognize the situations that require a specific intervention (red icons), the ones that should be taken in serious account (yellow icons), and the ones that are featured by positive feedbacks (green icons).

Finally, at urban level, the tool offers the thematic representation for each service to find differences on how the chosen urban service is provided in the districts of the city (see fig.7). In particular, the thematic map point out the average score of the separate waste collection clustered by colors: good (green), sufficient (yellow), insufficient (red).
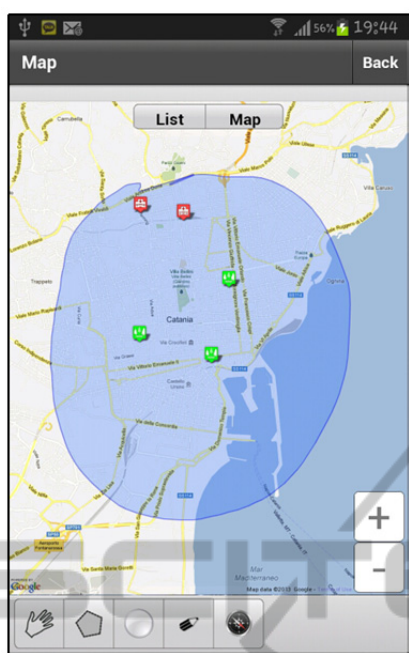
Figure 6: Status of the schools in a given area clustered by colors: good (green), sufficient (yellow), insufficient (red).
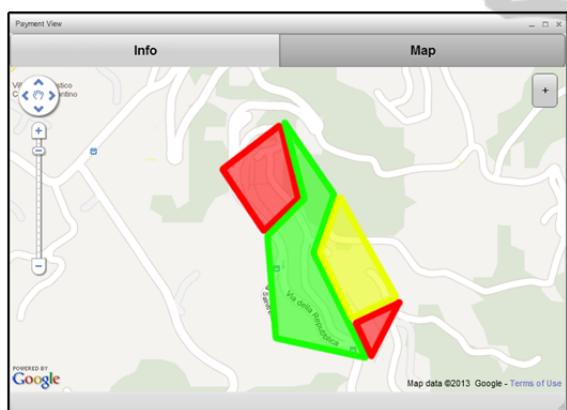

Figure 7: Thematic maps of the average score of the waste collection clustered by colors.

4 CONCLUSIONS

A tool has been illustrated to allow the PA offices and the citizens to carry out controls using a Google Maps based interface about local tax payments and the status of the urban services with the main aim of reducing the payment arrears and to improve the quality of the urban services. Although the tax payment is a sensitive issue, it is more and more joined to the theme of the quality of the urban services, as suggested by the proposed ST-Rays

approach inspired by e-democracy schemes that balance duties and rights. For this reason, ST-Rays belongs to the class of the novel e-services offered to the citizens to widen, as envisaged in (Faro, 2011), the services offered from the urban information system that, until now, are mainly devoted to mobility and logistics assistance.

From the technical point of view, the main advantage of ST-Rays is the one of responding to the user requests by accessing directly the remote DBs where the relevant data reside, i.e., cadaster and municipal databases. Also, the mobile version of ST-Rays allows citizens and policemen to be always informed on urban taxation and service status using any type of mobile. A version based on Quantum GIS is also under development to study the taxation software as a module of a more general urban GIS (Giordano, 2013). A comparison of the Google Maps and Quantum GIS based versions as well as the evaluation of the user interface is for further study.

REFERENCES

Corlan M., Flash Platform Tooling: Flash Builder, Adobe, 2009

Coleman D., Georgiadou Y., Labonte J., Volunteered Geographic Information: the nature and motivation of produsers, *International Journal of Spatial Data Infrastructures Research*, Vol.4, 2009

Costanzo A., Faro A., Giordano D., Venticinque M., Wi-City: A federated architecture of metropolitan databases to support mobile users in real time, *International Conference on Computer and Information Science, ICCIS 2012 - A Conference of World Engineering, Science and Technology Congress, ESTCON* , 2012

Costanzo A., Faro A., Giordano D., Wi-City: living, deciding and planning using mobiles in Intelligent Cities, *3rd International Conference on Pervasive and Embedded Computing and Communication Systems, PECCS 2013, Barcelona,* INSTICC, 2013

David M., Developing Websites with jQueryMobile, Focal, 2011

Faro, A., Giordano D., Musarra, A., Ontology Based Mobility Information Systems. Proc. of *IEEE International Conference on Systems, Man and Cybernetics,* SMC03, Vol.5, 4288-4293, 2003

Faro A., Giordano D., Spampinato C., Integrating location tracking, traffic monitoring and semantics in a layered ITS architecture, *IET Intelligent Transport Systems*, (3), pages 197-206, 2011

Ganapati S., Uses of Public Participation Geographic Information Systems Applications in E-Government, *Public Administration Review* Vol.71(3), May/June 2011

Giordano D., Torre A., Samperi C., Alessi S., Faro A., An Ontology based Approach to Join E-Government Data in a GIS framework: a Case Study, IEEE 4th International Conference on Software Engineering and Service Science, ICSESS, 2013

Engineering Tributi: Il progetto Elisa. http://www.tributi. eng.it/ blog/progetto-elisa/, 2010

Zhai, J., Jiang, J., Yu, Y. and Li, J.: Ontology-based Integrated Information Platform for Digital City, *IEEE Proc. of Wireless Communications, Networking and Mobile Comp.,* WiCOM '08, 2008