Citizen-oriented E-Complaint Service for Mobile Devices

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Abstract

The recent paradigm shift in the field of E-Governance towards a more residential oriented approach has led to a better governance by the municipalities. ICT as the base architecture is not only allowing top-down, but also bottom-up interaction between public authorities and citizens in a very efficient way. A central element of good governance is a E-Complaint system that allows citizen to report a spatial nuisance (ex.: littering, potholes, etc.) and where the local authority keeps the public up to date about addressing the problem. Such a transparent service is improving the effectiveness of municipal maintenance and direct communication with residents increases trust in those institutions. However, to gain a higher active participation future E-Grievance systems must be compliant with the 'Good Governance' principles and integrate all needs of the citizens. The service must be easy to access and use, transparent and not reliant on personal information (ex.: private account). The users are in control over their information that is shared with the municipality and the public. This study develops a lightweight web mobile application prototype of an E-Complaint system that is based on only open-source software and an OGC conform infrastructure. In order to not be reliant on personal information and still being able to guarantee the basic functionality of reporting and redressing complaints, the application is built upon publicly available and anonymous services.

Keywords: WebGIS, SDI, OGC, Local E-Governance, Smart City, Participation, web mobile application, municipal maintenance.

1   Introduction

In the last two decades many governments adopted E-Governance services to provide public services to their citizens in an effective and efficient way. Information and Communication Technologies (ICT) as the base of this architecture allow unidirectional and bidirectional communication with the citizen, whereby the latter plays an increasingly important role. Everyday interactions of citizens with the municipality, such as obtaining certificates, applying for a passport or reporting grievances, are nowadays mostly processed digitally. However, past E-government services were designed and implemented to meet the requirements of local governments. One was primarily concerned with the technical efficiency and scalability of services, while the needs of the citizens were not fully

considered, with the consequence that the usage of such applications was lower than expected (WEERAKKODY et al. 2016; ZHENG & MA 2021). Since 2010 and ongoing, there has been a paradigm shift in the scientific community of E-Governance towards a more citizen-oriented approach. This approach is expected to lead to better governance including a high effectiveness of local government and a high participation of local citizens. The implementation of a citizen-centric application requires the complete integration of the principles of good governance: Participation, Equity, Inclusiveness, Transparency, Responsiveness, Accountability, Effectiveness (HASSAN 2010).

In this research we will focus only on the E-Complaint service (for mobile devices) that allows citizen to report a spatial nuisance (ex.: littering) to the local government, whereupon the government has to respond and redress the complaint. This subservice of E-governance is particularly affected by the needs of citizens, as personal and location-based data is processed. The goal of this research is to realize a feasibility study of a full citizen-oriented E-complaint service that responds to the requirements of citizens. By doing this, an increase of participation and of efficiency of public services is expected. The designers of such a citizen-oriented service must consider digital divide, socio-economic factors, issues of privacy, security and transparency (KUNSTELJ et al. 2007). In concrete terms, the user interface must be as simple as possible, no prior (little) technical knowledge is required of the user, all steps of the service are explained in detail (e.g.: Why a specific information is necessary and how the data is been used?) and the user is in control of what he or she wants to share internally with the administration or publicly (CHEN 2010). The software architecture must guarantee all basic functionalities including reporting & redressal without the request of personal information (e.g.: contact information & GNSS). Only the complaint type, description and the location are mandatory. However, for additional or more convenient services personal information can be requested (e.g.: complaint update via mail notification, the use of GNSS, sending a picture, etc.). For further transparency, the service is based on open or free software and the source code will be available to the public.

For the realization of the feasibility study a prototype will be developed that fulfils the described requirements and which at the same time does not compromise the usage and satisfaction of such an application. A review regarding the usage and satisfaction, as well as a possible increase in participation and efficiency of public services can not be carried out. This would exceed the scope of this study. The aim is to develop a lightweight application that includes fundamental security measures. The prototype serves as a general showcase and is not built for a specific community (study area).

2   Material and Methods

2.1   E-Complaint Service based on Good Governance

A citizen-oriented application is based on the concept of 'Good Governance'. In general, 'Good Governance' is understood as "the responsible conduct of affairs and management of public resources" by the government, its citizens and the private sector (COUNCIL OF EUROPE 2008). Governance is thus not limited to the government but includes a variety of actors. It incorporates "the process of decision-making and the process by which decisions are implemented (or not implemented)" (UNESCAP 2009). It takes views of vulnerable

people (minorities) into account and responds to present and future needs of society. The concept is described by the following characteristics: Participation, Equity, Inclusiveness, Transparency, Responsiveness, Accountability and Effectiveness (HASSAN 2010).

The idea of good governance is that all members of society, regardless of race, class, religion, age, gender or sexual orientation can participate in the decision-making process. Everyone should have the same opportunity to be heard, in particular the most vulnerable people. This entails the principles of participation, equity and inclusiveness. The principle of transparency means that policy-making and the enforcement of policies must be in accordance with rules and regulations. Further, information concerning the decision must be provided freely and understandable to the public. Responsiveness deals with the processing of requests or provision of services to stakeholders within a reasonable timeframe. Effectiveness refers to how governments are responding to the needs of citizens while making best use of their resources available. Finally, accountability is holding decision-makers responsible for their actions (COUNCIL OF EUROPE 2008; UNESCAP 2009).

By applying those principles to E-Governance and in specific to our E-Complaint service, local governments are hoping to increase the participation and the efficiency of public services (ex.: complaint handling). By participating, citizens are able to express their dissatisfaction about communal services (ex.: street maintenance) and make the local government accountable for it. Also, the responsiveness of a municipality to redress a complaint can be checked via a E-Complaint service and the local government can be made accountable for not responding in an appropriate time-frame. This transparent, easy-accessible and open procedure of complaint redressal where the citizen can see the routing how a complaint is redressed helps to strengthen the relationship between public authorities and citizens. It increases trust in those institutions, which in turn increases participation. For the local government, complaints are an important source of feedback and lead to a new awareness as well as possible improvements in organizational arrangements (HASSAN 2010).

These principles are not limited to the conceptual level but are also considered in the technical implementation of an E-Complaint service. Integrating a fully inclusive participation is challenging. Digital divide within society leads to the exclusion of people that are not connected or digitally illiterate. In particular, people with a low socio-economic status, higher age, less education, of female gender and from minority groups are affected (Hassan). To keep the impact as small as possible, the application has a low usage barrier. It is easily accessible and intuitive to operate. The user interface is kept as simple as possible, so that no prior or little technical knowledge is required. In order to gain participation, privacy and trust must be safeguarded. An anonymous and publicly available (no restriction) complaint reporting service achieves this by relinquishing personal data. Further, there is the possibility to create secured private complaints which are only shared with the municipality. The users are in control of their information. Most input fields are optional. Only three are mandatory to ensure the operation of the service (type, description and location of the complaint). Transparency is obtained by using open-source technology and publishing the source code under open-source license. Furthermore, information is provided about the service itself. Info boxes are implemented with additional information on why specific input fields are required and what happens with the data after its submission (KUNSTELJ et al. 2007; CHEN 2010; HASSAN 2010).

2.2   Software Architecture of E-Complaint Service

The implementation of a bi-directional citizen-centric E-Grievance system allowing complaint reporting by the citizen and complaint redressal by the municipality requires a complex architecture to ensure all functionalities (see fig. 1). Due to time restrictions such a prototype was not realizable and was therefore limited to the reporting ability (uni-directional system, see fig. 2). To guarantee the transparency pillar of good governance the application is developed based on open-source technology and will be itself distributed under an open-source licence.

Figure 1: Bi-directional Interaction Flow of E-Complaint Service

The prototype is built as a mobile web application consisting of four interfaces[1] hosted by a node webserver. The first interface is a general overview web page allowing users to access the different services. This encompasses a 'report complaint' interface and two 'access complaint' interfaces whereas one gives access to private and the other to public complaints. To enable those services multiple client-server interactions are required in form of OGC conform 'Web Feature Services' (WFS) allowing citizens to send and access spatial data (their complaints) to/from the municipality server. For our prototype, the WFS infrastructure is provided by a GeoServer and PostGIS database. On the frontend side, the mapping library 'leaflet' is used to locate and visualize the complaints of citizens. Existing mobile frameworks (ex.: jQuery Mobile) were left out due to (potential) incompatibility and dependency issues with leaflet and therefore a new framework was built from scratch.

The 'report complaint' interface is the core component of the citizen-oriented application and is composed of a map and a form. It allows for the anonymous reporting of a complaint to the local government. No personal account needs to be created and no personal information (ex.: contact) transmitted for using the application. The users are in control of the information shared with the municipality and eventually with society. This means that apart from three input fields all fields are optional, and that the user can decide whether the complaint is shared publicly (public complaint) or only with the municipality (private complaint) (see tab. 1). Only the complaint location, type and description are required for

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[1] Web pages with different functionalities that are interlinked with each other.

the application to work. Optional fields are the upload of a picture, mail, date and time. Those fields can make the redressal process more efficient (identify the complaint, contact the citizen for more information, etc.) and inform the citizen about the status of his/her redressal via mail. To ensure the transparency, the service is providing users with essential information in form of info boxes on why an input field is required and what happens with the data after being transmitted.

Table 1: Overview Input Fields of Reporting Interface

Input field	Properties	Data type
Complaint location	mandatory	Point (coordinate)
Complaint type	mandatory	String (enumeration[2])
Complaint description	mandatory	String (textbox of 300 characters)
Picture	optional	PNG/JPEG
Mail	optional	String
Private/Public status	optional	String
Date & TIME	optional	Date & Time

A specific input field is the complaint location. It is determined as a marker on the map (leaflet) and represents, thus, a point coordinate. To increase the user friendliness of the app, the determination of the location is not done by clicking on the map, but by dragging and dropping the map. A further option is to activate the GNSS to facilitate the localization[3]. This geolocation feature is implemented with the help of a third party leaflet plugin called 'leaflet-locatecontrol' by 'domoritz' (MORITZ 2018). It is optional on purpose to meet the citizen's need of privacy.

When the complaint is filled, it is sent as an XML form (HTTP request: POST) to the GeoServer via a 'Web Feature Service-Transactional' (WFS-T) and stored in the database. Before sending the form, the application is checking for filled fields and creates dynamically an according XML form. The used WFS-T must be publicly available without any restriction for guaranteeing the required anonymous access. This causes a risk that data could be changed or deleted, and private complaints could be accessed. Therefore, the

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[2] The input field 'Complaint type' has predefined categories helping the municipality to increase the redressal process by sending grouped complaints to the responsible departments. For the prototype the categories whereas following: 'Litter and Trash', 'Street and Park Damage', 'Vehicle and Parking', 'Lights', 'Illegal Graffiti', 'Trees' & 'General/Others'.

[3] The geolocation feature is only available for HTTPS. Since the prototype application is running on a HTTP server this feature is disabled.

database has one table connected with the WFS-T that is storing the data temporarily. When a complaint is inserted into this table, a trigger is fired off to insert the identical complaint into a second unconnected table and then to delete the same insert of the first table. Since the transfer of a picture via a WFS-T is not intended, a file storage system is put in place on the node server that organizes the uploaded pictures. Before sending the image, a unique 10-digits ID is randomly generated for renaming the picture and avoiding duplication in the file storage system. A unique ID is also generated in case of a private complaint (12-digits).

After a successful complaint submission, the 'reporting interface' automatically generates a web page showing the status of the submission (picture and WFS-T) and in the case of a private complaint the ID to the user. This referenced ID must be kept by the user for accessing the private complaint later and is ideally stored on the smartphone (ex.: 'Note' app). Further, a notification is sent via e-mail to the municipality including the complaint ID[4]. For this reason, the node server is extended with 'nodemailer', a node module for sending e-mails.

The 'public complaint' interface provides users with all publicly available complaints on an interactive map (leaflet) by requesting this data (HTTP request: 'GET') from a publicly available WFS (GeoServer) and the file storage system (picture). The complaints are represented as markers and more information (type, description, date & picture) can be displayed by a clickable pop-up. For receiving the public complaints, the WFS is pointing at a view of the second database table. This view generates a subset based on a private complaint ID filter where the ID is null.

The 'private complaint' interface allows for requesting one private complaint at a time via a private complaint ID and visualizes the complaint like the previous interface on a map. However, it does not have a direct connection to a WFS. For security reasons, a proxy server is implemented on the node server that receives the private complaint ID from the interface (HTTP request: 'POST') and then in turn makes a by the ID filtered 'GetFeature' request to a protected WFS[5]. This WFS is linked with another view containing the private complaints[6]. If a correct ID is found, the information is sent back to the user.

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[4] A notification extension of sending complaint's status to citizens has not been realized, but it is a key extension for future work to increase user satisfaction.

[5] The protected/private WFS is secured by an account authentification. The proxy server knows all relevant authentification information and therefore can access the WFS (GeoServer account).

[6] The view uses a private complaint ID filter where the ID is not null.
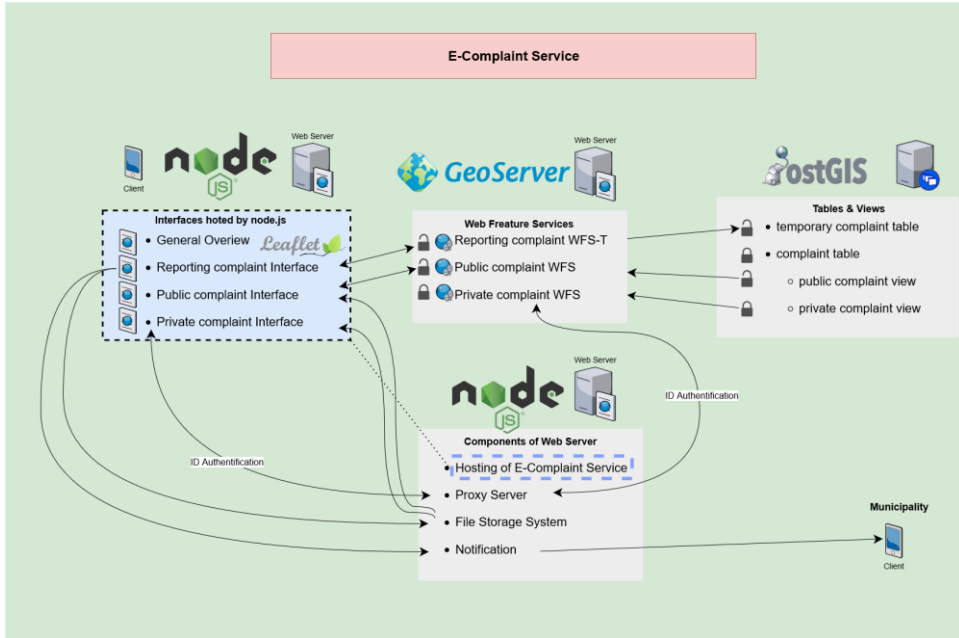
Figure 2: Software Architecture of E-Complaint-Service

3 Results

The prototype development of a citizen-oriented mobile E-Complaint service could be implemented for the most part. All interfaces/services for the citizen have been realized, whereas those for the municipality were cancelled due to time constraints. However, by limiting ourselves to the citizen side of the application the goal of the feasibility study could be reached. We were able to build a citizen-oriented complaint service as a web application based on open-source technology that allows reporting of (spatial) complaints (e.g.: pollution, etc.). The architecture and the user interface respond to the needs of the citizens. This incorporates privacy, security, transparency, control over information and usability. The prototype can be accessed with the QR-code of figure 3.

Figure 3: QR-Code with Access to E-Complaint Service

Privacy is guaranteed in multiple ways. First, all services (reporting & accessing complaints) are working anonymously. No personal information or account is required to use those services. Second, the reporting complaint service enables private complaints that

are only shared between the municipality and the submitting user. Third, the usage of geolocation as a help for locating the complaint is not the default option.

Closely related to privacy is the control over information. Citizens can decide what they want to share with the municipality and the public. Besides the location, type, description of the complaint, all other fields (date/time, upload of picture & mail) are optional. If the user decides to share more information with the municipality, it increases the efficiency of the redressal procedure of the complaint. For example, by sharing date & time and a picture of a complaint the local government can identify the complaint faster. The indication of a mail address allows for further enquiry, when a complaint cannot be identified or more information is required to redress it.

Transparency is achieved by using open-source technology and providing the software under open-source license. Thus, users have full insight into the software and can check on their own how the system works. Furthermore, the application aims to inform users why certain input fields are necessary and what happens to the data after it has been transferred. Therefore, info boxes about data policy are integrated in the reporting interface.

The usability of a citizen-oriented application is characterized by a simple, easy-to-use application, so that as many citizens as possible can operate it. No or little technical knowledge is required to use the app. This is an attempt to overcome digital divide in society and guarantee equity and participation to all members of society. Further, the web application must be built user and smartphone friendly, so that the usage is satisfying. Hence, a general overview has been created serving as a service hub. The styling is explicitly adapted to typical smartphone formats (ex.: dynamic adjustment of the font, optimal button size, etc.). The localization of the complaint is done by moving the map with a centred marker instead of moving/pointing the marker. The last convenience is the integration of the geolocation feature allowing a very fast localization of the complaint.

Due to the openness of the application (public/anonymous reporting ability & public complaint access), the security aspects mainly concern the protection against data manipulation and content verification. Also, the protection of the private complaint is an important task. To prevent data manipulation, the data is transferred to a private table after its submission (reporting interface) and are only accessible via WFSs that are linked with views. To secure the private complaint access, a 12 digits code is generated during the reporting that is required as authentification when accessing the private complaint interface. This code is only visible to the user and sent in the body element of a HTTP(S) request to the server. In case of an actual implementation of the prototype, the communication must be done with HTTPS for decoding the information. In general, the application's principle of not using any personal data, helps to minimize potential damage in case of data theft. A content verification must be put in place because the reporting and accessing is based on anonymity. For avoiding misuse of the service, each municipality requires an employee that verifies the data.

4   Discussion

The feasibility study of a citizen-oriented E-Complaint prototype service could be realized. The prototype only includes the reporting and the visualization ability of complaints. However, it covers all citizen accessible services and, hence, all needs of the citizens. The missing redressal ability of the app would only be available for employees of a municipality. Consequently, the visualization of the complaint is not covering the redressal status. A future extension would add the missing municipality interface. This would be a separate web application protected by an account authentification. The interface would use a fourth (private) WFS that is connected to the main table in the database. It would have the ability to insert or update data in the database for example updating the status of a complaint, adding a redressal description, or adding a picture to a specific complaint. Another feature would be a notification of the citizen via mail when the complaint is redressed (under the premise that a mail address is given).

Although all requirements of the citizens (privacy, security, transparency, control over information and usability; see chapter 3) are covered, problems and improvements still exist. Citizens can only participate when they have access to internet and understand the local language. Therefore, a multilingual app could overcome the language barrier. The problem with internet access is insolvable because E-Governance is based on this technology. If we have a time-limited access to internet, a hybrid application running locally on a smartphone, which is able to catch the complaint information offline and to submit it after reconnecting to a network, might be a solution. Nevertheless, a risk of exclusion remains. The anonymous reporting ability helps lowering the participation barrier, but it is on the other side more susceptible to misuse. Much deliberate misinformation of complaints risks to slow the redressal process down as a whole. It requires at least one person to check for data quality. In terms of security, the current security concept of generating randomly 12 digits to secure private complaints entails a (very low) risk of duplication. The file storage system is a weak point when it comes to protection of private complaint's pictures. Pictures can be accessed if someone knows the right filename. An account-based authentification system for private complaint would increase data protection and would make the storage of a private complaint ID obsolete. However, this requires a more complex software architecture and some sort of verification in form of a e-mail address. Storing picture in databases as blobs could solve the picture security problem. Last, the usability can be improved by adding additional features or redesigning the software architecture. A search bar could be added to the reporting interface for locating a complaint via an address. Also, a system could be put in place that gives all private complaints of a citizen back and not only one at a time. For avoiding the manual storing of the private complaint ID on the phone, a native app or a hybrid app ('WebView') can be built that runs locally and thus can store it automatically on the device.

In general, further research should be sought in the field of citizen-oriented E-governance services. The potential and impact of such an app remains unclear. It would be interesting to know which groups of society are using the app or if the usage of such an application is satisfying and increases the acceptance/adoption of it. It must also be checked whether authorities are more responsive to certain groups in society or areas of the municipality.

5   Conclusion and Outlook

This feasibility study shows that a full citizen-oriented E-Complaint service fulfilling all requirements of citizens can be technically implemented. The development of the reporting and access complaints interfaces incorporates the principles of 'Good Governance' and the derived needs of citizens. Aspects of privacy, security, transparency, control of information and usability have been considered and implemented. The service has a low usage barrier and guarantees transparency by publishing the source code to the public. The graphical user interface is simple, is easy to use and provides the user with additional information on data requirements and policy. Users are in control of the information shared with the municipality and the public. To ensure privacy the application relinquish on personal information. Instead, it is built upon publicly available and anonymous services which guarantees all basic functionalities of the E-Complaint service (reporting & redressal of complaints).

However, the desired effects of a citizen-oriented E-Governance service – increase of usage, trust in public authorities and efficiency of public services – remain uncertain. Further research is needed on the impact of such applications. Furthermore, an actual assessment is required to check whether the technical implementations correspond to the fulfilment of the actual needs. Information regarding the satisfaction of such a service does not exist.

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