Towards Social Inclusion of Elder People using Smart Systems

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Abstract. In the rapidly ageing world, evolving information and communication technologies are both welcomed as useful tools and also criticized as an important reason for social exclusion. This is because of the difficulty to retrieve required information and services from the volume of information and plethora of services available on the Web. So it is needed to develop Smart Systems that will provide required information that is easily accessible to elder people with varying capacities and resources. The central concern is to have Smart systems to foster active ageing by staying connected with events, people and getting timely, practical information to manage life and meet personal needs. This paper provides the design of a RESTful Smart System composed of different web services according to the requirement which will give assistance to the elder citizens in their daily life. To achieve a user friendly and easily accessible interface for the elder citizens the Hypermedia control defined in REST paradigm is also analyzed which provides the way to drive the users from one state to another through links.

1 Introduction

The challenges of ageing population growth, demographic change, urbanization and resource depletion mean that the world's great cities need to adapt to survive and thrive over the coming decades. As informed by WHO [2], the world is rapidly ageing: the number of people aged 60 and over as a proportion of the global population will double from 11% in 2006 to 22% by 2050. Due to the high cost and difficulty of maintaining and increasing the quality of elder people's life, ICT could play an important role to transform existing systems into smart systems to support people in their daily life.

We are moving towards urban superorganisms, where we can use ICT devices and unique human capabilities for the wellbeing of our society by collectively sharing real time information and taking actions accordingly [3]. Today's Smart cities are putting in place advanced technologies that aim to move people faster, save energy, connect people, and generally make all city services from healthcare to public safety more interactive and efficient. By connecting all the available services citizens are not only engaged and informed in the relationship between their activities, their neighborhoods, and the wider urban ecosystems, but are actively encouraged to see the city as something they can collectively tune up to become efficient, interactive,

engaging, adaptive and flexible, as opposed to the inflexible, mono-functional and monolithic structures of many 20th century cities.

In today's ICT world, the growing trend in software architecture is to build Web Services that are available as components in the distributed environment of the Internet. Therefore, applications are to be assembled from a set of appropriate Web services. Seamless composition of Web services has enormous potential in streamlining application integration even at personal level. The diversity of various Web Services or Web APIs makes difficult choosing the correct ones to fulfill the user needs. To Perform Service Integration we need to discover access, control and coordinate different services. It is impossible to make different Web Services to interoperate if there are no agreements or guidelines on how communication should happen. This problem can be solved by finding a common way of communicating between services. Service Integration also requires an appropriate way of discovering and selecting services where the discovery is the activity of locating a machine-processable description of a Web Service that meets certain functional criteria and selection is the activity of evaluating the discovered services in order to identify the ones that fulfill a set of nonfunctional properties requested by the actual user. Moreover, the coordination among the selected services and the functionality of the services to fulfill the user requirements are needed. From this discussion some questions arises:

a) How Composition of heterogeneous Web Services can be done?
b) How Composition of services can improve the quality of elder people's life and feel them socially included?
c) How Smart Systems can help to drive the user in an easy way?

In this paper, these questions have been analyzed to show how to compose the available Web APIs and Web Services to enhance the social inclusion of the ageing society. This can be done by providing the way to get real time information from heterogeneous sources like social networks, community sites etc. by Web Services and Web APIs. Existing Web Services, Web APIs and Social Networks have been considered in an example scenario. The aim is to enable Service composition by exploiting existing standard such as HTTP methods, URI templates, and Hypermedia control known as REST approach to support users in completing a task without knowing the system a priori.

Motivation behind this work is to provide a Smart System composed of different services according to the requirement which will give assistance to the elder citizens in their daily life. Due to the difficulty the elder people face in retrieving information from the heterogeneous sources of information available on the web, the rapidly evolving information and communication technologies are criticized as instruments of social exclusion. Regardless of the variety of communication choices and the volume of information available, the central concern is to have relevant information that is readily accessible to elder people with varying capacities and resources. Information materials and communication technologies should be adapted to suit diverse perceptual, intellectual and cultural needs. Staying connected with events and people and getting timely, practical information to manage life and meet personal needs is vital for active ageing. So it is needed to develop Smart Systems to foster active ageing. Also considering the Smart City concepts, the transportation systems need to

be improved to provide Web based transportation facilities where people can find their required information in an easy way. So there is an increasing interest in the role that information and communications technologies could play in transforming existing transportation systems into web enabled systems to support future smart cities. But to our best knowledge, as yet, few cities have fully grasped this idea.

The rest of the paper discusses on integrating data from different sources which will be gathered by invoking different Web Services and APIs through standardized interfaces by the Smart System to fulfill its task. To investigate the issue, two scenarios have been discussed that differentiate between user control activities, where users are asked to invoke different types of services to fulfill a composite task, and a Smart System, where users invoke a single composite service without further interaction.

2 Motivation

To motivate our work, we refer to a real-world use case scenario that outlines challenges that are currently not fully addressed for the ageing society context at our best knowledge. Paper [121] shows how Web services can become smarter and deliver more complex functionality by gathering information from sensors and traditional services with minimal human intervention, using inter-linkage of sensor data with hypermedia controls. We follow a similar approach to address elder people needs. The aim is to provide a simple, flexible, and dynamic solution to improve the quality of elder people's life by addressing some challenges in transportation systems. The technical solution will exploit the REST architectural approach. We believe that the understanding of this scenario, related problems and proposed solution will show the research directions in designing the Smart Systems by composing heterogeneous Web Services and Web APIs.

2.1 Use Case Scenario

Let's consider two possible implementations of a scenario in which a user, let's say Mrs. Rossi, wants to go to a place near Piazza Duomo in Milan by public transport. She looks for route directions and other related information like access facilities or other alternative routes. In the first version, the user has to interact with different Web Services of different types, such as Web Services like ATM, community sites like grey-panthers, social networks like facebook etc. To get the realtime information some Web Services use sensors which has been also included in this scenario. In the second version, a Smart service with composite capabilities minimizes the user interaction by transferring the control from the user to the service. The control of the Smart System will be achieved by providing involved services with RESTful interfaces to make interaction and control similar to the one already in use on the Web and therefore already familiar to both users and developers.

Use Case Scenario with User Control. As depicted in Fig 1, first Mrs. Rossi searches information to go to a place near Piazza Duomo. She looks for the address in the Location API and invokes the ATM Web Service to get the information about the route direction and time schedule. As she has some knee problems she also wants to know whether there is an elevator in the subway station through which she has to reach her destination, and, most important, if the elevetor is working. But as the ATM service doesn't provide realtime complete information, she searches community sites like grey-panther or Facebook for real time information about routes, delays and elevators. If the station doesn't have a working elevator then the user needs to choose an alternative route by bus or tram.

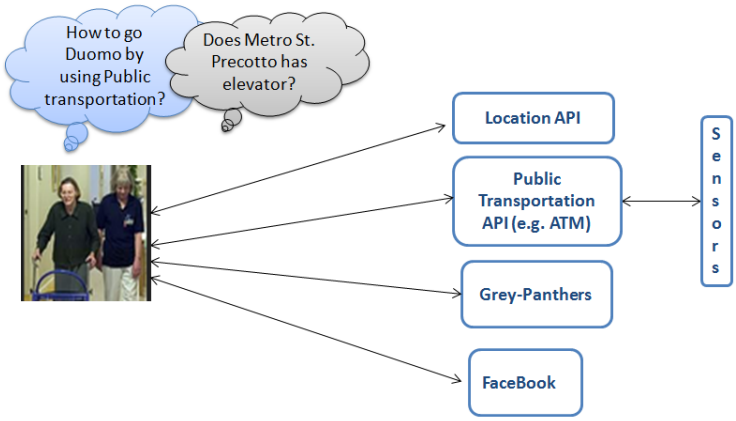

Fig 1: Use Case scenario with user control

Use Case Scenario Based on a Smart System. In this version, the scenario has been changed to minimize the user control to introduce *Smart Transportation System*. The user should be able to invoke a single smart service to collect all needed information to reach the destination. As shown in Fig 2, she invokes the *Smart Transportation System* that in turn interacts with the required services: (i) invokes the Location API to get the location of the address, (ii) invokes the ATM Service to get the route and time schedule, (iii) connects to social networks like Facebook to get real time information about delays and elevators informed by connected people. With this information she can decide which is the best route to follow to reach her destination. Furthermore, the *Smart Transportation System* updates these information in the grey-panthers' Facebook wall to share real time and reliable information helpful for the Elder people.

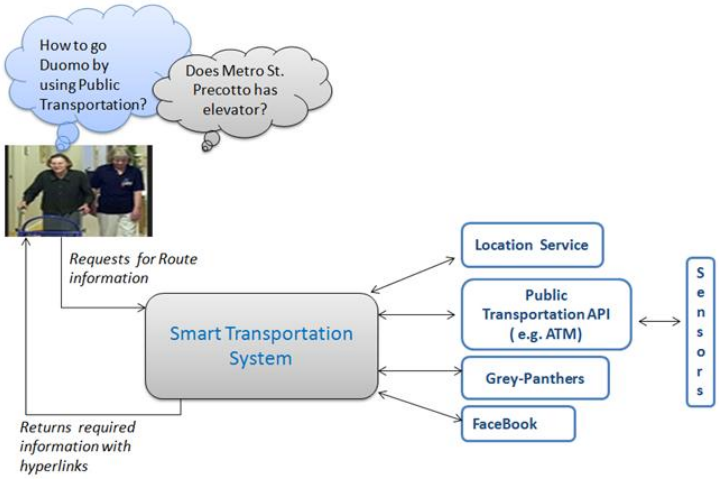

Fig 2: Use Case Scenario Based on a Smart System.

3 Technological aspects for Smart Transportation System

The need of global availability and sharing of huge amount of information through various kinds of heterogeneous devices and services has changed the reference scenario for the development of Web scale applications. The consequent growing complexity and increasing request of adaptive services has made manual management impractical. A possible answer toward smart systems is to make services self-manageable by achieving awareness of the target things' or the applications' physical environment or situations to respond proactively and intelligently. To tackle the problem from a technology point of view, a first effort should be the definition of a common protocol to foster automatic interoperability. The adoption of RESTful architecture could be the right answer by providing standard interfaces and hypermedia driven interactions to existing services. The major advantage is the use of HTTP methods that enable for the use of standard tolls to navigate, interact and compose services. These technological aspects have been analyzed to show how the *Transportation System* can become smarter and deliver more complex functionality by gathering information from heterogeneous services with minimal human intervention using hypermedia controls.

3.1 Common interface for services interaction: the RESTful approach

In order to increase the system interoperability, the *Smart Transportation System* has been designed according to the Resource-Oriented Architecture that is devoted to manage distributed, heterogeneous resources in which client applications interact directly with the resources, by following the REST principles [5]:

1. Resources should be identified properly using URIs, so that each resource is uniquely addressable.
2. Uniform interfaces should be provided through the use of a standard application-level protocol. In this way, the operations to be applied on resources are external and they have well known semantics [12].
3. Resources are manipulated through their representations, since clients and servers exchange self-descriptive messages with each another. A resource can have multiple representations that follow a standardized format or media type and can be negotiated with the Web server. Representations convey the state of the client's interaction within the application and contain hyperlinks that allow clients to discover other resources or change the state of the current resource.
4. Interactions are stateless since servers only record and manage the state of the resources they expose, i.e., client sessions are not maintained on the server. This increases the decoupling between client and server.
5. Hypermedia is the engine of application state, i.e., the application state is build following hyperlinks according to the navigation paradigm. Therefore, the application state is not known a priori, but it is built based on user navigation.

Further, data produced by the services has been exposed according to the Linked Data paradigm. Linked Data Design defines [1] the following rules for exposing structured data on the Web:

(i) use URIs to identify data as names,
(ii) use HTTP to look up those names,
(iii) provide useful information about URIs using standards, and
(iv) include links to other URIs, so that they can discover more things.

In the scenario of composing different services where most of the web services do not follow the REST approach or missing some of the REST principles, it should be addressed that they compromise the interoperability of services and do not facilitate computer-to-computer interactions. Another issue to be addressed is that composition of services involves different web services working with heterogeneous protocols. For example some services communicate through SOAP message where the HTTP methods are used as transport protocol while the application protocol is domain specific and the operations invoked by the user lay on the message envelope. Such communication pattern tunnels all the requests to a single URI that identifies an endpoint. HTTP GET and POST are the most-in-use methods but their semantics are not maintained, i.e. GET is used to invoke operations on server side that modify resources state, and therefore, it is not possible to optimize the network traffic by using caching mechanisms. In some cases the form-based Web services are used where the user interacts with different URIs via an html form, using again GET or POST possibly with a different semantics: URIs encapsulate server-side information, like operation names and parameters, revealing implementation details to the user. Such an approach enforces the coupling between the client and the server: if the server implementation changes, then the old URIs become invalid (operation and/or

[1] http://www.w3.org/DesignIssues/LinkedData.html

parameter names may change). Moreover, using Location service does not provide hypermedia-driven interactions since resources representation does not contain hypermedia controls and the user advances to the next state using some out-of-band information.

The Smart system is expected to be seamlessly adapting, in a fully autonomic way, to different operational conditions to fulfill the user requirements. Autonomous actions need to be performed by enabled devices, sensors and/or services with different levels of capabilities. The Smart Transportation System needs to access and control services that use different technologies in the communication which make interactions and integrations troublesome. This problem can be addressed by employing a common architectural style for implementing the involved interfaces. We propose to adopt the REST approach because interoperability is fostered by the use of standard technologies, the stateless RESTful interactions support scalability, and hypermedia controls reduce coupling between components by driving clients' interaction. Moreover, REST principles provide the opportunity to reuse and generalize the component interfaces, reduce interaction latency, enforce security, and encapsulate legacy systems by using intermediary components.

3.2 Hypermedia driven interactions

By employing a RESTful interface to the involved services it is possible to provide hypermedia driven interactions. REST approach uses HTTP as a way of communication between the services and the client-service interactions that are done using HTTP methods. For example to hire a car service the user can follow the actions like:

- Invokes the service for retrieving information about car hiring using GET;
- Requests for a booking by POSTing a request;
- Updates or cancels the booking by using PATCH/DELETE;
- Retrieves booking information, to know the status by using GET.

Use of HTTP methods and the multiple representations provides a way to drive users from one state to the next state without knowing the system a priori. For example, while the request from the client side is made for the information about car hiring using GET, the service provides the available information and also the links for booking in the representation. Then the client can select the booking option to reserve the car in a specific date and time. This request is made by using POST method and upon reception of the request, the services creates a booking request resource, decides whether the booking will be accepted, rejected or pending, and sends the HTTP response to the client. Upon successful creation of the resource, the response status code is 201 Created, and the Location header identifies its URI. The representation provides the links for updating, canceling or getting the information about booking by using PATCH, DELETE and GET respectively. Similar HTTP requests are used for actions to fulfill the user needs in the invocation of other services.

4 Related Work

In today's world the expectations of users are increasing towards connectivity and social inclusion by the emerging of social-media-based services, like Facebook and iTunes, that has been addressed as the evolving service in [18], that is user-centered, responsive, real-time, flexible, local and global, pervasive, location-based, platform-based, and so on. We exploit this idea of using social media based services to foster social inclusion.

To show more focused, on-demand use of Web APIs, driven by functionality and social parameters, paper [22] describes how the Web API description format RESTdesc that captures functionality in an elegant way can be extended to include social parameters. It indicates the role these parameters can play in generating functional compositions that fulfill specified quality attributes and how descriptions can be personalized by exploring a user's social graph. As we are keeping in mind to pick up the right API and We Services while composing, inclusion of these social parameters are useful to fulfill the user needs. In [1], the authors focus on service composition in pervasive systems. They propose ranking services based on context-related criteria so that the selection is based on the service matching score with the composition features. This mechanism needs to address critical aspects like the heterogeneity of interfaces and data models mismatches. In [11], the authors describe the selection of services that match user preferences by collecting and evaluating services' descriptions. RESTful interactions can be integrated into such mechanism to facilitate the descriptions discovery and the services selection, and to enable pervasive systems make use of the selection process. Such solution minimizes the number of services and avoids unsuitable services in pervasive systems since it involves only the services that meet the user requirements.

In the domain of SOAP/WSDL services, messages are exchanged between endpoints of published applications by using the Web as a universal transport medium. In this way, the applications interact through the Web but remain "outside" of the Web. In addition, SOAP is the single standardized message format in this approach and messages are exchanged in both directions by using only one HTTP verb (POST). In the literature, there are several papers that compare the SOAP and the REST approaches (e.g., [12]). We have used the REST approach that reduces the limitations of SOAP by taking the advantage of adopting full semantics of HTTP verbs to expose operations where applications become part of the Web, making it a universal medium for publishing globally accessible information.

In [3], an approach investigates the use of the REST architectural style for providing the functionality of sensors in pervasive systems. It emphasizes the abstraction of data and services as resources, services interoperation via self-describing data and services orchestration with loosely typed components. In [14], the DIGIHOME platform has been developed to deal with the heterogeneity, mobility and adaptation issues in smart homes where devices have advanced computational capabilities to improve the user satisfaction, but the heterogeneity of protocols used constrains the integration of these devices into a larger monitoring system. The platform provides software connectors for devices accessed by a variant of protocols such as ZigBee, SOAP and CAN, while HTTP is the communication protocol for the

detection of adaptation situations and the handling of events. In [6], the authors explore REST as a mean to build a "universal" API for web-enabled smart things. They give emphasis on the decoupling of services from their representation and the negotiation mechanisms for the representation format, and they propose AtomPub to enable push interactions with sensors, and gateways that abstract communication with non Web-enabled devices behind a RESTful API. Although [14][6] use HTTP according to the REST principles, they do not make explicit how services with conventional interfaces are mapped to a RESTful API. But in this paper, the concept to use REST approach has been explicitly defined and hypermedia controls for hypermedia driven interactions with the service has been explored.

5 Social inclusion by Smart Transportation System

There are several Web Services and APIs available to fulfill user needs by providing real-time information or experiences of people. We propose the approach to compose available Web Services and APIs in the context of Mobility to provide a *Smart Transportation System* that fosters social inclusion. In the process of Service Composition one of the important steps is to choose the right APIs. If two APIs are offering same functionality then some other factors such as non functional properties or social parameters are becoming decisive factors to pick the right one from the plethora of Web Services and APIs available on the Web. Quality attributes such as performance and ease-of-use exists within a social context which should be taken into account creating personalized mashups and Service Composition [22]. Though this paper is not focusing on Service discovery and selection criteria considering non-functional or social parameters but keeping in mind these factors in the process of service composition. Rather it concentrates on employing a common interaction style in the process of composing required Web Services and APIs that pave the path towards the Smart Systems that will fulfill the user needs and help them to actively participate in the social events. Since our goal is to exploit the number of Web Services and APIs already available on the Web, we discuss the inclusion of some of them in the next paragraphs.

5.1 ATM Mobile API

To involve the people of a city in different activities it is important to provide Smart Systems that facilitates the service and information required by the user. People travelling in Milan are getting the facilities provided by Azienda Trasporti Milanesi (ATM) that also offers a Web API to provide route in map, time schedule and other information related to transportation around Milan city. The related services include Radiobus, an on-call minibus service; Guidami car sharing and BikeMi bike sharing services etc. There is a mobile application of this service to guide the users while they are travelling which is very much helpful for the users to move around. This City Service can be considered as an example of a Web Service API which can be combined with other services to provide required information for fulfilling the

regular activities especially for elder people in their daily life and also the new travelers will be benefited.

5.2 Moovit API : an step towards the Smart Transportation System

There are some APIs available that provides the collective information and also updates the real time information on the social networks. As an example the name of an exciting API "moovit" [7] can be mentioned that is revolutionizing the experience of the public transport users by providing real time (up-to-the-minute) information generated by people sharing their experiences about what's going on further up to the route. By providing real time information and service it takes the hassle and uncertainty out of public transport. It provides information about route based on all public transport methods available, jammed and delayed routes, available seats, arriving buses and trains on the live map and detailed point-to-point directions. People can also get real time updates such as arrival time notification, or get off at the next station alerts and easily share the route and communicate with friends along the way.

By riding the public transport vehicle with this app open during the trip the user can anonymously share its location and speed. The user can also choose to actively contribute relevant reports such as overcrowding on the bus, an accident that causes delays or an inaccurate station location on the map. By sharing these information, the user can join together with the community to create the best real time public transport data and extract much more from the existing public transport infrastructure. As "moovit" is recognized as a user-generated platform, the real time information gets better as more people use it and share their information. This implies the use of *Smart Transportation Systems* in emerging social inclusion.

5.3 Social media based Services: a Way for social Inclusion

To enhance the social relationship among people one of the important way is to share information like interests, activities, backgrounds, or real-life connections. In today's modernized world where most of the people are habituated to use Internet as their medium of interactions, Social media based services like Facebook or Twitter facilitates social inclusion by sharing their common interests. Online community services are sometimes considered as a social network service like Grey-Panthers[2] for Elder people where people can share information on its Facebook or Twitter page. Being engaged in the same community people can understand the problems that other people face and emphasis on sharing real time information that are helpful for the community. These media based services pave the path towards social inclusion by providing related information that are more reliable to them for accomplishing their daily activities.

[2] http://www.grey-panthers.it/

Smart devices and social apps are becoming a part of everyday life that open up new and more efficient ways of social interactions. To enhance this issue the personalized web services composed of different services including social components are becoming a popular aspect. To provide an easy way for the clients without programming skill (e.g. elder people) to interact with the Smart System the client side interaction should be more user-friendly. It is possible by employing the RESTful interface through which the user easily moves from one link to another to complete their desired tasks. In this case they even do not need to know about the system a priori. Moreover, to compose the Web Services and APIs there should be an easy way to include different services to make a personalized or user driven System.

By composing the above discussed services and other services according to the requirement, it is possible to build a Smart Transportation System. To maximize the usefulness to the elder people, the proposed system provides a simple user interface with easy to learn and less functions to remember functionalities. As the proposed approach emphasizes to minimize the user interactions, the user does not have to interact with several Web Services to complete his task. While the user makes the request, the Smart System interacts with required Web Services and gives the results to the user and also provides the links to go further. Thus the user interaction with the Smart Transportation System is simple and the user does not need to know about the functionalities of all the involved Web Services. This proposed approach is useful for extending their activities in the society. Moreover, by sharing their experience with other people and participating in the community they are achieving the sense of social inclusion.

6 Conclusions

In this paper a step towards the social inclusion of Elder people has been made by defining a *Smart Transportation System* with minimum human interaction. The REST architectural style has been discussed to define the common interaction style between heterogeneous services by providing RESTful interfaces. This proposal shows how it is possible to design a system which fulfills the user needs by composing required services and getting real time information through media based services (e.g. social networks). In the ageing society context where an easy and user friendly interactions need to be considered, this approach helps elder people to participate in the social activities by getting related real time information and sharing their experiences through a simple user interface with hypermedia links to complete their required task. The future plan is to continue in the effort of extending the adoption of REST and Linked Data paradigms to foster the integration of Internet of Things, Internet of Services, and Internet of People by developing a common and interoperable platform on the existing Web infrastructure. Furthermore, we want to develop a Smart System composed of different services including social apps based on this proposal and validate it by getting feedback from elder people.

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