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Combining personal diaries with territorial intelligence to empower diabetic patients ☆

Monica Sebillo [a], Genny Tortora [a], Maurizio Tucci [a], Giuliana Vitiello [a,*], Athula Ginige [b], Pasquale Di Giovanni [c]

[a] Department of Management and Information Technology, Università di Salerno, Italy
[b] School of Computing, Engineering & Math, University of Western Sydney, Australia
[c] School of Computer Science and Informatics, University College Dublin, Ireland

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ABSTRACT

Information is today recognized as a major source of benefit, for those who are able to properly create and manage it. With the advent of new computing, storing and networking technologies, transforming data into useful, 'marketable' information has become a major goal for companies, organizations and governments. The healthcare domain makes no exception. Governments and healthcare companies are paying increasing attention to patient-centered care and to its positive effects on business metrics, such as finances, quality, safety, satisfaction and market share. Appropriate information sharing and communication are then recognized to be one of the key factors for patient-centered care. In this paper, we propose an infrastructure for defining new processes to support a fruitful exchange of strategic information at the local level, which could encourage local dynamics and improve the relationships between ultimate users and the territory and vice versa. This is particularly relevant in the healthcare domain, so we have developed a mobile application to provide diabetic patients with personalized services based on a technology with a low level invasive impact, through the experimentation of new process models meant to share information and integrate software components. Such a special-purpose application is meant to improve care experience of diabetic patients while creating public value for services. This is achieved by a profitable combination of territorial knowledge with personal data and events available and processed on smartphones.

1. Introduction

1.1. Premise

The myriads of data available today may be profitably aggregated into information, and the resulting effective usage is critical to gain competitive advantages and address societal needs. In particular, information is today recognized as a major source of benefit, for those who are able to properly create and manage it by new computing, storing and networking technologies. Transforming data into useful, 'marketable' information has then become a

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* Corresponding author.
E-mail addresses: msebillo@unisa.it (M. Sebillo), tortora@unisa.it (G. Tortora), mtucci@unisa.it (M. Tucci), gvitiello@unisa.it (G. Vitiello), a.ginige@uws.edu.au (A. Ginige), pasquale.di-giovanni@ucdconnect.ie (P. Di Giovanni).

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major goal for companies, organizations and governments, which devote their investments towards the design of advanced solutions in several and significant domains, such as environment, healthcare, and renewable energies. In those domains, the user-centered approach to the development of tools exploiting shared information is becoming the focus of each initiative meant to better the quality of life. The healthcare domain is one of the fields that are greatly taking advantage of an appropriate information sharing and communication, recognized as key factors for patient-centered care. The term 'patient-centered care' is used to indicate healthcare that respects and satisfies the preferences, needs and values of patients. Governments and healthcare companies are paying increasing attention to patient-centered care and to its positive effects on business metrics, such as finances, quality, safety, satisfaction and market share. In this context, a well investigated field concerns the development of the so called *mobile health* solutions (*m-health*, for short) explicitly addressed to assist people who suffer from diseases that require a continuous monitoring during everyday activities, such as diabetes. In fact, with the continuous worldwide increase of diabetes spread, the need to massively include IT support and telemedicine systems during all the phases of diabetic care has become a compelling priority, both to improve self-management activities and to reduce the global healthcare costs.

The unique features of mobile devices and their operating systems may greatly support the development of innovative solutions. These represent distinctive features, usually not available on traditional personal computers, including the pervasiveness of smartphones, the growing number of sensors with which they can interact, and the capability of shared multimedia data. A concrete example of use of sensors-related information is represented by the context aware applications that provide users with new types of services and interfaces capable to adapt to the ongoing situations. Some statistics about the increasing number of mobile applications that take advantage of the data coming from such sensors to accomplish their main tasks can be found in [17].

1.2. Motivation

According to Dey, "context is any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves" [8]. The increasing number of sensors available on a mobile device facilitates the development of context-aware, user-adaptive solutions. By combining user-entered data with the information generated by the myriad of sensors available on a modern smartphone, it is currently possible to develop useful solutions on behalf of ultimate users. However, so far, the geographic reference of data has not been properly exploited by the majority of existing solutions, although that is a characteristic available in almost any type of data retrieved from a modern mobile device. As a matter of fact, existing systems do not yet consider the surrounding context as an active source of information, that is, they limit the capability of a spatially enabled territory to elementary and autonomous functions. On the contrary, it is widely recognized that acquiring information from a territory and integrating it with data produced by users and public organizations may significantly enhance the strategic planning and the involved processes. Then, probing or making sense of all the information that could be potentially in hand to users is a challenging task [6].

The awareness of such a limitation has stimulated researchers to investigate how territorial communities could be involved in the design of information systems for obtaining a better understanding of data they produce and use. The collective intelligence of a community, indeed, can play a primary role in the development of new strategies that can dramatically improve several aspects (social, economic, etc.) of a given territory and offer mutually related new services. By this mind-changing, also the environment neighboring a local community of targeted users becomes a valuable source of additional information through the creation of new types of connections among users and among users, domain experts, and provided facilities, thus improving the organization of services, simplifying access to resources and reducing barriers to services. However, in order to realize such a transformation, a supporting infrastructure is necessary that acts as an underlying common layer for new types of applications.

1.3. Contribution

The goal of the research we are carrying out is to define methods and techniques for handling the multidisciplinary complexity of data coming from a spatially enabled territory. In particular, we investigate new ways to exchange strategic information at the local level, through processes that encourage local dynamics and improve the relationships between ultimate users and the territory.

The results presented here fall in the healthcare domain, and are meant to provide patients with personalized services based on a technology with a low level invasive impact, through the experimentation of new process models meant to share information and integrate software components. We also aim to extend the impact of those results in order to address the challenges of territory sustainable development, encouraging mutualisation and cooperative exploitation of information between individuals and communities. This goal can be achieved by a profitable combination of territorial knowledge with personal data and events organized through a software infrastructure conceived for the development of special-purpose applications meant to improve users' experience while creating public value for services. In order to design and develop such a platform, the factors of primary importance that should be taken into account are the need of a shared communication protocol among all the involved entities, extensibility (i.e., the ability to add new features without affecting the existing components), and the opportunity to hide the format differences of data coming from heterogeneous data sources.

The experimentation we are conducting concerns an environment neighboring a local community of diabetic patients. We are developing new types of connections