A Pervasive Health System Integrating Patient Monitoring, Status Logging and Social Sharing

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Abstract—In the current work, we present the design and development of a pervasive health system enabling self-management of chronic patients during their everyday activities. The proposed system integrates patient health monitoring, status logging for capturing various problems or symptoms met, and social sharing of the recorded information within the patient’s community, aiming to facilitate disease management. A prototype is implemented on a mobile device illustrating the feasibility and applicability of the presented work by adopting unobtrusive vital signs monitoring through a wearable multi-sensing device, a Service Oriented Architecture (SOA) for handling communication issues, and popular micro-blogging services. Furthermore, a study has been conducted with 16 hypertensive patients, in order to investigate the user acceptance, the usefulness, and the virtue of the proposed system. The results show that the system is welcome by the chronic patients who are especially willing to share healthcare information, and easy to learn and use, while its features have been overall regarded by the patients as helpful for their disease management and treatment.

Index Terms—Pervasive Computing, Self-management, Health Monitoring, Service-oriented Architecture, Social Networks, Micro-blogging

I. INTRODUCTION

Pervasive health systems concern the provision of healthcare services to anyone, anytime, and anywhere by removing locational, time and other restraints, while increasing both their coverage and quality [1]. Lately, a number of such systems and tools have been demonstrated, focusing particularly on health monitoring and information management by the patient himself/herself [2]. This notion of “self-management” has been associated with efficient disease management, enhancing the patient’s role and participation in healthcare services delivery [3]. The patients’ central role in the management of their health has been indicated by a number of educational programmes aiming to provide them with skills and knowledge, in order to cope with their diseases [4]. Especially, chronic patients may be benefited from self-management activities, in terms of understanding better their disease, enhancing their communication with their doctor, increasing their self-confidence, and so forth [5].

Chronic patients are engaged on a daily basis in the process of gathering and collecting their personal health information to manage their disease [6]. Such information can include objective elements, i.e., vital signs such as heart rate, temperature, blood pressure, and daily weight, as well as more subjective elements, i.e., various symptoms met during their daily activities, feelings, etc. The importance of daily management of this information by the patient himself/herself is illustrated in several clinical guidelines and recommendations [7]–[9]. Even though health systems such as the Personal Health Record (PHR) provide functionalities for health information management and status logging by the patients [10], their integration with pervasive health systems which employ vital sign monitoring is scarce due to various policy or technical issues related with data safety, interoperability, design concerns, cost, etc. [11], [12]. Moreover, social sharing, i.e., the ability of the patients to share within their networked community care-related information, is often neglected. This reduces the options for collaborative disease management, exchange of experiences/ideas, and emotional support [13].

In this regard, this work systematically elaborates on patient participation in pervasive health monitoring and disease management during daily activities, the preliminary idea of which has been presented in [14]. Specifically, a framework is illustrated for the construction of pervasive health systems, the novelty of which lies in the integration of three important features for efficient patient self-management, namely, health monitoring, status logging, and social sharing. The first involves continuous monitoring of the patient’s vital parameters via unobtrusive acquisition of sensor data through the deployment of commercially available sensing devices. Status logging refers to the subjective recording of health information by the patients themselves according to their observations and understanding. Social sharing of health data is perceived within formulated on-line communities consisting of patients, family or friends, and caregivers. According to the authors’ knowledge, there has not been designed, implemented and evaluated a pervasive health system elaborating on and addressing the integration of all the above-mentioned features.

The proposed system is particularly targeted at chronic...
patients who may wish to play a more active role in their disease management throughout their daily activities. It has been implemented using a mobile device and a wearable multisensing device for unobtrusive health monitoring, while a Service Oriented Architecture (SOA) [15] is adopted for handling communication issues. Popular micro-blogging services [16] – a form of micro-journalism for posting small pieces of content – are utilized, in order to demonstrate the social networking functionality.

The structure of the paper is as follows: Section II presents the main functionality of the proposed system, while section III illustrates the adopted system architecture. Our prototype implementation based on the adoption of mobile devices, sensors, and external social networks is presented in section IV. Section V presents the results from assessing various technical indicators that have been employed for system evaluation, along with the results of a user acceptance study we conducted. Finally, remarks, open issues, and conclusions are discussed in section VI.

II. FUNCTIONALITY OVERVIEW

A. Patient Monitoring

Health parameters and vital signs, such as the heart rate, respiratory rate, skin temperature and activity, may be continuously monitored through the deployment of various on-body sensing devices. Due to the appeared information overwhelm, event-driven patterns which correspond to the configuration of personalized monitoring schemas can be initialized by the patient or the health professional [17], so as to filter the sensed data and generate appropriate alerts and feedback. For example, an alert of high heart rate may be reported as a result of an average heart rate value captured within a time-window that exceeds a specified threshold. In [18], we have presented a system incorporating configurable monitoring schemas as described above. In such a system, the vital sign measurements and alerts are forwarded to the Medical Center (constituting the system’s back-end) for disease or emergency management by the healthcare professionals. In the scope of this work, the vital signs and the respective generated alerts are considered as objective elements of patient information, due to their provenance.

B. Status Logging

Status logging is associated with the option given to the patients to log information concerning their disease as perceived by themselves through the proposed system. Thus, this information can be considered as subjective and corresponds to the following status descriptors:

- Problems/Symptoms: Patients can record various health problems or symptoms, occurring during their daily life. Examples of such subjective type of information include dizziness, chest pain, nausea, stress, etc.
- Activity: Activities such as shopping, driving, reading, working, exercising, resting, etc., characterized by their onset and end, may be recorded by the patient. These constitute an additional source of information which can play an important role in explaining the variation of the acquired signals through the patient monitoring, and identifying possible false alerts associated with the observed health status, also giving better insights into disease management during daily activities.

C. Social Sharing

Patients are able to share the diverse recorded elements of their personal health information through structured messages with their networked community, consisting of friends and relatives, caregivers, health professionals, and other patients. This information sharing enables the patients to obtain feedback or help (subject to their condition), receive emotional support, etc. The messages’ content is encapsulated in the status descriptors referred in sections II.A and II.B.

In a next step, patients can choose the exact receivers of the information from their networked community (e.g., specific persons or groups of persons), while they can also decide on the way of disseminating information, choosing between the spontaneous (user-proactive) and the event-driven mode (system-reactive), i.e., information is sent automatically whenever a condition associated with the status descriptors occurs (e.g., the patient recorded nausea, the time is between 08:00 and 10:00).

III. SYSTEM ARCHITECTURE

In Fig. 1, the overall system architecture is depicted. The communication flow concerns four diverse nodes, namely, the mobile device referred as Mobile Base Unit (MBU), the Sensors, the Back-end Platform, and the External Social Network Platform. The MBU is the system’s core part
consisting of 5 layers: a) the Personal Health Information Repository, b) the Personal Health Information Controller, c) the Social Networking Controller, d) the Communication Controller, and e) the User Interface. The MBU is connected wirelessly with the sensors and its Personal Health Information Controller handles the information reflecting the patient’s status. The Personal Health Information Repository is constructed based on the MBU’s built-in record management system, which is utilized in order to record the various conditions or problems met, along with the patient’s activities and alerts. All captured information is replicated to the back-end platform of the Medical Center offering the services, and acts as the MBU surrogate host. Moreover, since the typical mobile device can be still considered as a limited platform to deploy advanced data/information processing, health information persisted in the back-end infrastructure can enable the employment of sophisticated data analysis methods for pattern and trend discovery.

Communication between the MBU and the back-end platform is achieved via a set of communication interfaces defined and implemented according to the SOA paradigm, providing significant advantages compared to other architectures, such as interoperability and extensibility [15]. In particular, Simple Object Access Protocol (SOAP - http://www.w3.org/TR/soap/) messages over HTTP are transmitted from the MBU, after calling the pre-defined Web service operations related to health information management, e.g., getConditions(), getSituations(), etc., via communication stubs corresponding to the Web Service Description Language (WSDL - http://www.w3.org/TR/wSDL/) interface. The Communication Controller module is responsible for utilizing and controlling the entire client communication with the back-end infrastructure (as illustrated in the sequence diagram of Fig. 2), persisting also unsent information due to potential network unavailability for later transmission.

The MBU communicates with the External Social Network Platform via a SOAP/WSDL Application Programming Interface (API), or via a Representational State Transfer (REST) [19] API, as commonly provided by many existing social sharing platforms. These APIs provide a way for accessing and using externally the most typical functionalities provided by the platform, while providing also the necessary mechanisms for authentication and privacy via the adoption of protocols, e.g., OAuth (http://oauth.net/). Thus, the MBU may safely connect to the External Social Network Platform via the design and implementation of appropriate client methods incorporated in the Social Networking Controller module.

Information conveyed by the user to micro-blogging services is realized by combining pre-defined tags (information labels) and optional status descriptors following the general format: #*Alert/Symptom <activity> <time>, where * denotes a mandatory term from a standard medical terminology system, and <> optional status descriptors from an application-specific vocabulary, e.g., #*Light-headedness while Shopping this Morning. The tags provide a convenient way to discover messages of interest in one’s social network. For example, the asterisk (*) character is used after the hash, in order to distinguish the medical terms related to symptoms/alerts provided within our system. Moreover, social analytics and processing may be supported and employed [20], due to the availability of this semi-structured information, without the need for applying complex natural language processing mechanisms. The user may browse/search messages within his/her group(s) of subscribers, making it easy to track messages of interest.

IV. IMPLEMENTATION

According to the functional and architectural specifications presented in sections II and III, respectively, a prototype system has been implemented using specific devices,
A prototype of the presented system has been implemented and tested on a Nokia N97 mini smartphone, in order to illustrate the feasibility of the proposed architecture. Java Micro Edition (Java ME) was the chosen development platform, which enabled us to implement and test the described functionality. Java ME provides high-level APIs dealing with the small memory footprint and the limited processing capabilities typically offered by mobile devices. More specifically, in regard with the MBU communication with the back-end, the Java Specification Request (JSR) 172 API was used, in order to provide the Web service functionality based on the SOAP/WSDL approach. In the back-end infrastructure, Apache Tomcat was used as application container and server, MySQL for data persistence, and Apache Axis as the underlying Web service engine based on SOAP.

B. Sensors & Communication Issues

For vital signs monitoring, the Zephyr BioHarness (http://www.zephyr-technology.com) physiology monitoring system was used. BioHarness is a wearable multi-sensing device incorporating various sensors on a strap, which is placed on the patient’s chest for continuous unobtrusive monitoring of the heart rate, activity, posture, respiration rate, and skin temperature. BioHarness provides Bluetooth communication capabilities and an API for the reception of the sensor measurements by the MBU. The MBU can then process the received data according to threshold configuration (Fig. 3(a)) and generate alerts related to the observed health status (Fig. 3(b)). The latter are persisted in the Personal Health Information Repository and visualized in a diary form along with other subjective elements perceived by the user through the User Interface (Fig. 3(c)).

The Bluetooth protocol native security mechanisms were used, in order to protect the sensor data from possible data tampering or hi-jacking. Therefore, a key-based pairing between the MBU and BioHarness is performed for their mutual authentication.

In order to ensure the high quality of the received sensor measurements, we have currently used the worn detection circuitry provided by BioHarness, to identify whether the user wears properly the garment or not, since this can be a common cause of faulty or inaccurate data.

C. Micro-blogging & Information Sharing

The proposed system’s social networking functionality is realized by utilizing external Web-based micro-blogging services offered by Twitter [21]. Twitter provides a platform based on a SOA architecture, as well as an open API facilitating the effective interoperation with the other components of the implemented system. Moreover, Twitter offers some interesting features, e.g., the easy discovery of messages of interest and the construction of user lists, constituting additional factors for its adoption in our implementation as an enabling technology for the social sharing part of the system. In this context, individuals are allowed to construct a public or semi-public profile and articulate social groups within which they share information. Typically, free-text messages (usually within the limit of 140-160 characters) are communicated to the subscribers and followers of the message author, optionally providing external links to additional information. In Twitter, a message may additionally be labeled with words followed after a hash, so as to ease the message search mechanisms.

In the current work, we have elaborated on the sharing of messages, which are constructed according to the described status descriptors. The resolution of the terms for symptoms/alerts (e.g., light-headedness, high heart rate, etc.) along with the associated activities (e.g., shopping, walking, etc.) is performed according to formal concepts derived from SNOMED-CT (Systematized Nomenclature of Medicine -
includes all the API calls. In order to protect the users’ privacy, a
after the conduction of various
the Twitter API calls lasted on
d with the libraries needed to expose the described functionality together
MBU is approximately 420KB. This siz
private Twitter list of people has been created with its
of m
serialize information from the XML
(http://kobjects.org/kxml/) was employed, in order to de
authentication purposes, while the kXML package
from/to the Twitter platform via GET and POST requests
and provides methods for both retrieving and submitting data
blogging functionality via the MBU. The API is HTTP
illustrated. The Twitter API (http://apiwiki.twitter.com/)
within a specified social group (e.g., other patients) is
cooperation with the patient, according to the disease/patient
context.
Finally, the selection of the particular social group
which was possible for 8
communication with the sensors was
which was used
middleware (a suite of tools and technologies for GUI
implementation), which was used for the UI development.

V. SYSTEM EVALUATION

A. Technical Evaluation

A technical evaluation of the system has been conducted concentrating on performance and energy consumption issues. Concerning performance, after the conduction of various experiments, Web service invocations from the MBU for communicating with the back-end infrastructure were found to last on average 1.45 sec until receipt of the response. In regard with social sharing, the Twitter API calls lasted on average 1.9 sec for message transmission to the social group. The downloading of the subscribers’ messages lasted on average 4.2 sec for 10 new messages with XML deserialization time included in the final result. System performance was found to be adequate in terms of responsiveness and task completion within tolerable time limits [24], although further tests are needed to exhaustively explore performance aspects.

An evaluation test has been also performed, in order to assess the power consumption and battery life of the proposed system in routine use. In particular, the deployed system has been used for 5 consecutive days. During this period, daily, continuous monitoring sessions took place, the duration of which was possible for 8 hours on average. In each session, the communication with the sensors was persistent, while the patient status was recorded 10 times for each session and

<table>
<thead>
<tr>
<th>Questions</th>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1) What is your education level?</td>
<td>Primary school (3) 19%</td>
</tr>
<tr>
<td>Q2) How familiar are you with the use of mobile phones beyond calls (e.g., SMS, applications, Internet)?</td>
<td>Very much (2) 12%</td>
</tr>
<tr>
<td>Q3) How familiar are you with the use of Internet and social networks (e.g., blogs, Twitter, Facebook, etc.)?</td>
<td>Very much (0) 0%</td>
</tr>
<tr>
<td>Q4) Would you record health-related information on a mobile phone for better disease management?</td>
<td>Yes (5) 31%</td>
</tr>
<tr>
<td>Q5) What do you find most important to record and monitor on a daily basis?</td>
<td>Vital signs (7) 44%</td>
</tr>
<tr>
<td>Q6) What do you find most important to share with others?</td>
<td>Vital signs (4) 25%</td>
</tr>
<tr>
<td>Q7) Would you like to get information on how other patients cope with their disease?</td>
<td>Certainly yes (4) 25%</td>
</tr>
<tr>
<td>Q8) Would you share information related to symptoms, vital signs, and activities with family or friends?</td>
<td>Certainly yes (14) 88%</td>
</tr>
<tr>
<td>Q9) Would you share information related to symptoms, vital signs, and activities with your doctor?</td>
<td>Certain yes (14) 88%</td>
</tr>
<tr>
<td>Q10) Which do you find the most useful feature in the service that was demonstrated to you?</td>
<td>Alert feedback (5) 31%</td>
</tr>
<tr>
<td>Q11) What did you like most in the demonstrated service?</td>
<td>Alert feedback (2) 12%</td>
</tr>
<tr>
<td>Q12) Do you think the service that was demonstrated to you can help you in disease management or treatment?</td>
<td>Certainly yes (9) 57%</td>
</tr>
<tr>
<td>Q13) Do you find the service that was demonstrated to you easy to learn and use?</td>
<td>Certainly yes (6) 38%</td>
</tr>
<tr>
<td>Q14) Do you understand the content of the service that was demonstrated to you?</td>
<td>Yes, all of it (7) 44%</td>
</tr>
</tbody>
</table>

Clinical Terms), which is commonly used in medical problem
lists [22], and accessed through the Unified Medical Language
System (UMLS) metathesaurus API [23]. In the scope of this
development, we selected an indicative list of terms which is,
in the general case, determined by the health professional in
cooperation with the patient, according to the disease/patient
context. Finally, the selection of the particular social group
responding to the recipients of the shared patient status
takes place.

In Fig. 3(d)-(f) the procedure for sharing health information
via micro-blogging according to the patient’s preferences
within a specified social group (e.g., other patients) is
illustrated. The Twitter API (http://apiwiki.twitter.com/)
relying on REST was used in order to demonstrate the micro-
blogging functionality via the MBU. The API is HTTP-based
and provides methods for both retrieving and submitting data
from/to the Twitter platform via GET and POST requests
respectively, e.g., Statuses/update, GET list members, etc. The
OAuth protocol was utilized for security reasons and
authentication purposes, while the kXML package
(http://kobjects.org/kxml/) was employed, in order to de-
serialize information from the XML-based response messages
of most API calls. In order to protect the users’ privacy, a
private Twitter list of people has been created with its
subscribers being the potential system’s users.

The final size of the prototype application hosted in the
MBU is approximately 420KB. This size includes all the
libraries needed to expose the described functionality together
with the J2ME Polish (http://www.enough.de/products/j2me-
polish/) middleware (a suite of tools and technologies for GUI
implementation), which was used for the UI development.
shared (through Twitter) via a 3.5G network connection. After each session, a full battery charge was required for both the MBU (1200 mAh, 3.7 V, 4.4 Wh) and the BioHarness device (230 mAh, 3.5-4.2 V, 850 mWh). Our experimentation with a power consumption profiling tool for mobile applications, namely, the Nokia Energy Profiler (http://www.developer.nokia.com/Resources/Tools_and_downloads/Other/Nokia_Energy_Profiler/), illustrated that the system consumes on average 1.45 W when persistent communication with the sensors takes place against 0.73 W when not, while maximum consumption was 3.70 W vs. 2.10 W, respectively. This highlights the need for adopting optimization methods, as presented in [25], in order to minimize the Bluetooth duty cycle.

B. User Evaluation

In order to evaluate the overall concept with targeted users, a series of focus group sessions took place at the outpatient Pathology Clinic of the Ippokrateio General Hospital of Thessaloniki, where the system was presented to hypertensive patients and their response was assessed (Table I). The focus group consisted of 16 patients, 5 male and 11 female, with mean age 47.125±10.43. According to our inclusion criteria, the subjects of the survey were chronic patients (i.e., hypertensive), regular users of a mobile phone, and less than 70 years old. The sessions took place while the patients visited the relevant outpatient Clinic for scheduled check-ups.

The patients were firstly asked, if they would like to participate in an anonymous study aiming to assess the value of pervasive health services for self-management. Upon their acceptance, the rationale of the self-management concept was explained, along with the potential positive outcomes that could eventually come out for better disease management and treatment. The patients were then demonstrated and tried the prototype (Fig. 4) and its basic features (i.e., health monitoring through wearable sensors and alert generation, patient status logging, and social sharing within a networked community).

In the following, the patients answered a questionnaire consisting of 24 questions that involved: a) patient demographics, such as age, gender, disease, years since diagnosis, etc., b) educational level and familiarization with technologies (i.e., the Internet, social networks, and mobile phones), c) attitude towards monitoring and sharing personal health information, d) evaluation of the presented application and its use, and e) open questions for spontaneous feedback. Table I depicts the elaborated questionnaire, excluding demographics-related and open questions, along with the obtained answers. In the following, the most important findings are presented and discussed.

Overall the study showed that the presented prototype was considered as both useful and understandable. With respect to the patients’ will for recording health and personal information on a mobile phone (Q4), there was an equal frequency among three options, i.e., a positive, a conditional, and a negative option. This may suggest that, for those who are not completely negative with the idea, it is a valid option to offer contextualization and personal adaptation as regards to the conditions for recording information. Answers to Q5 suggest that, although patients are familiar with the importance of vital sign recordings, other pieces of information are also highlighted, and a possible fine-tuning based on personal preferences might be an option.

Concerning health information sharing with family and friends (Q8), 88% answered “Certainly yes”, and “12%” answered “Yes sometimes”, with no negative answer, showing that patients are willing to share personal health information with their relatives. The percentages were the same as concerns sharing information with the health professionals (Q9). These two elements show a positive attitude towards sharing information. The answers concerning the content of what should be shared seem to diverge (Q6), and so are the preferences for receiving information shared by other patients (Q7). Therefore, conclusions on the safe side are: a) sharing information is regarded positively, and b) health professionals, friends/family, and other patients are regarded as different groups and the sharing attitude with each one is distinct.

With respect to the relation between the answers delivered, after mapping the answers for each question to a numerical scale, a linear correlation coefficient (CC) was calculated for the pairs of answers, and the most important findings were: a) CC = -0.6235 between education level (Q1) and will to share information with family/friends (Q8), b) CC = 0.6441 between the will to record information on the mobile phone (Q4) and the opinion that the presented application is easy to use (Q13); answers may be associated with technological literacy (Q2, Q3), c) CC = 0.6571 between the will to share information (Q8) and interest in receiving shared information (Q7); a potential behavioral characteristic that might require further analysis, d) CC = 0.8172 between the opinions that the demonstrated application is both useful (Q12) and easy to learn (Q13), e) CC = 0.6263 between the opinions that the presented application is helpful (Q12) and its content is understandable (Q14), and f) CC = 0.6391 between the opinions that the presented application is easy to learn (Q13) and its content is understandable (Q14).
VI. DISCUSSION

The recent advances in pervasive computing technologies have provided the basis for the design and development of several personal health systems and services, the majority of which rely on the adoption of biomedical sensors and networking/communication technologies. Specifically, the progress in micro-nano technologies enabled the availability of various types of biomedical sensors, e.g., portable, wearable, implantable, embedded in the patient’s environment, etc., that can be effectively used to record patient parameters, signals, and contextual information, and communicate this information to other devices or systems. Typical applications of personal health systems include remote monitoring for chronic disease management, wellness and lifestyle management, and ambient-assisted living (AAL) for the elderly/impaired to name a few.

Although significant progress has been achieved lately in the field of personal health systems, there are still several open issues and challenges that have to be addressed. It is evident that the role of the patient in healthcare will have to be further elaborated as an active, mobile, and empowered participant, so as to achieve the appropriate patient motivation and involvement [3]. In this regard, new patient-driven paradigms for healthcare have been introduced, considering the patient in the center of the consumption of healthcare services [2, 10, 13]. The penetration of mobile technologies in everyday life enables the introduction of the required tools and services that may pervasively support the realization of this objective.

The above challenges constituted the motivation underlying the current work. Overall, this paper proposed an approach towards chronic patients’ self-management based on a pervasive health system encapsulating services to support patients in health information management and sharing. In particular, we elaborated on both objective and subjective elements of information concerning the patient, acquired via a wearable monitoring system and self-reporting by the patient himself/herself, respectively. An additional objective of this work was to enable controlled sharing of the obtained information with caregivers/family members of the patient by taking advantage of the social networking paradigm. The ultimate goal of the proposed approach is to further enhance the patient’s personal role in healthcare information management and promote collaborative healthcare.

It is evident that the presented system is primarily targeting at patients willing to play a more active role in managing their disease. To this end, we identified functional specifications and defined a system architecture for realizing such a system. At the current stage, our prototype implementation constitutes a technical proof-of-concept concerning the feasibility and applicability of the proposed approach. It is important to remark that our development was based on existing, affordable/accessible solutions, i.e., a smartphone, a commercially available multi-sensing wearable device, and a widespread social networking platform, all selected as enabling technologies according to our design specifications. Our aim was to highlight that the conducted research may be easily transferred to actual use, eliminating barriers such as cost and digital literacy (as highlighted by the user group that participated in the evaluation study), which are quite common factors eliminating technology uptake.

On the other hand, this prototype experimentation highlighted technical challenges that need to be faced, such as the restraint introduced due to extensive power consumption when persistent communication between the MBU and the sensors takes place. Although the 8-hour autonomy may be considered adequate for a 1-day personal use, supporting 24-hour continuous use would be necessary in many applications, e.g., in case of emergency scenarios, requiring optimization in communication protocols as well as hardware advancements. The integration of the health information sharing through networked communities into the system was also appreciated by the users. Nevertheless, privacy policies, such as role-based permissions, concerning personal health data protection need to be further explored [26], while a social networking platform dedicated to healthcare purposes and ensuring healthcare data safety in the light of protection laws would be necessary for adopting this kind of systems.

Overall, a longitudinal evaluation of the presented system in real conditions is necessary to assess technical robustness, user acceptance, as well as the extent of its contribution in patient self-management. The user acceptance study that was conducted illustrated that this kind of systems is welcome by chronic patients. Patients are willing to share their health information with their relatives, doctors and other patients, especially if this may enhance their quality of life and increase their safety. Evidently, the presented analysis is limited by the number of subjects interviewed. Aiming to thoroughly assess the potential and virtue of the proposed approach, field studies are necessary to be conducted. Such studies shall systematically explore the usage and added value introduced by the proposed system in terms of quality of life, patient safety, and user acceptance. Upon availability of a greater number of subjects, it could be considered statistically safe to elaborate on patient profiling and generation of profile clusters that may share a common attitude towards the proposed approach. Moreover, our future work involves the further development of methodologies for handling contextual data, behavioral monitoring based on user-to-system interactions, and appropriate methods for the collaborative filtering of information and discovery of patterns. In particular, we aim to investigate ways for inferring activity information [27], rather than requiring from the user to provide this information.

In conclusion, the presented research constitutes a paradigm for accomplishing effective and user-accepted patient self-management through an integrative approach, elaborating on both objective and subjective information capturing and its sharing, that can be deployed using existing technologies.

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REFERENCES


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