SUPPORT SYSTEM ARCHITECTURE FOR ELDER CARE IN THAILAND

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Abstract—A major global healthcare challenge is being posed by the rapidly growing population of the elderly. Much of the care of the elderly in diverse societies is informal, delivered often by family members who are not trained medically. Nevertheless, such informal caregivers supply a vital service in providing dedicated and compassionate care whilst reducing, at the same time, the burden placed on medical professionals and public health systems. Caregiving tasks are frequently complex, so it is imperative to develop technology which can specifically assist informal caregivers. Existing support systems have indeed positively impacted the quality of care; however, their deployment in Thailand has been limited. In the present work, we propose an online support system for elderly care developed specifically for the Thai context. We describe the architecture and design of this system and how it can improve the effectiveness of caregivers and enhance the quality of the care process, as well as social interaction within the caregiver and patient community.

Keyword—support system, caregivers, elderly care, architecture, system design

I. INTRODUCTION

A drastic increase in the proportion of elderly people worldwide has been seen in recent decades, owing to lower fertility rates and an increase in lifespan. In 2010, the number of older people was 524 million out of a world population of 6.900 million; in 2050, it is forecasted to be 1.5 billion out of 9.7 billion [1]. In Thailand, for example, the number of people aged 60 or older has increased from 6.8% of the population (around 4 million people) in the year 1994 to 14.9% (around 10 million people) in 2014. This means that both the number and proportion of older people has doubled in this country in 20 years. In fact, it is predicted that the number of older people in Thailand will reach 20% (around 14 million people) by 2025, thus making it an aged society [2]. An aged society is defined by the United Nations (UN) to be a society in which 20 percent or more of its population is 60 years or older or one in which 14 percent or more of its population is 65 or older. Needs of the elderly, particularly, support so that they can lead productive and fulfilling lives, and medical care, both routine and emergency, in case of illnesses, are therefore, hugely important health issues for governments and societies across the world.

The Thai Government announced the 2nd National Plan for the Elderly (2002-2021) and it was revised in 2009. The cornerstones of the plan concern the establishment of security for old aged people and support by the family, community and the state. These consist of 1) empowered self-help 2) caring by the family 3) support by the community 4) social and state’s support [3].

Older people are often helped on a routine basis by informal caregivers, rather than healthcare professionals. Oftentimes such a caregiver is a family member with whom the older person resides. Informal caregivers, in fact, are a vital resource in filling the health needs of the elderly as they not only provide dedicated and compassionate care, but reduce, too, the burden on professionals and on the public healthcare system. Typically, too, the informal caregiver is a person in close proximity to the older person for
significant periods through the day, allowing him or her to monitor the patient frequently and tend to the patient’s daily needs. Such a caregiver is also often the first person to respond in case of a medical emergency. Unsurprisingly, therefore, the medical community not only encourages informal caregiving of the elderly but has come to rely on it as an intermediary between the patient and professional services [4].

Caregiving tasks are particularly complex and difficult for caregivers who are not medical professionals and have never trained in healthcare. Moreover, most informal caregivers have to perform household chores for the older person, as well as external activities such as shopping, in addition to routine medical tasks such as administering medications and incontinence support [5]. The burden of caring for an older person can severely impact the quality of the caregiver’s life resulting in such issues as social isolation, financial problems, psychological and physical exhaustion [6]. Consequently, informal caregivers need not only health information and training, but support in multiple forms, including social, emotional, financial and legal. [7].

Existing research shows that social support is a particularly important need for caregivers, in that they benefit from interacting with others who have had similar experiences [8]. Communication with others who have faced the same problem can lead to solutions in the caregiver’s own context, while the very activity of communicating with peers can reduce stress [9]. Accordingly, various systems to support caregivers have been developed which provide online communication services amongst caregivers and their family members [10],[11]. In Thailand, there exist online social networks providing general health information and online communities for people to seek and share health experiences and to post questions for medical professionals [12],[13]. However, in this country there is as yet no online support system or online community specifically for caregivers to the elderly.

Online networks can provide the basic infrastructure to support the needs of informal caregivers, ranging from social support to problem solving [11]. Nevertheless, online communication cannot meet all the requirements of a caregiver. To fill the gap, we would like to propose a comprehensive new online support system for elder care. For this work, we particularly target the community of informal caregivers who play the major role in elder care nowadays.

Our goal, then, is to develop a comprehensive online support system for elder care in Thailand which is accessible to caregivers both via the web and mobile devices. In this article, we propose the system architecture and design that we plan on implementing. Our approach consisted of the following steps: (1) interview caregivers and analyze their requirements which determined a suite of functionalities to implement in order empower and assist the caregiver (2) design the platform and overall system architecture (3) design the functional components and interface.

In Section II we discuss the requirements analysis, while the system architecture is the topic of Section III. We discuss the system design in Section IV and conclude in Section V.

II. REQUIREMENT ANALYSIS

Design and develop an online support system for elder care in Thailand is the intention of this work. It is apparent that most caregivers to the elderly in Thailand are informal caregivers who are not professionally trained and, as a result of this, don’t have expert knowledge of caring for older people. Typically, such a person is a family member like a son, daughter or spouse who simply wants to care for a loved one [14]. So, our design focus is the user, in this case this would be the caregiver himself or herself. We conducted a series of in-depth interviews with fifteen caregivers in order to understand their responsibilities, problems and needs. Twelve of these interviewees were female and three male, all living in Bangkok or its suburbs, their average age being 41 years; moreover, the average age of the older person being cared for was 71 years and he or she is related to the caregiver by blood directly or through a marriage (e.g., daughter caring for father-in-law). Analyzing their responses led us to identify specific functionalities that could support their caregiving tasks.
A. Coaching
Coaching consists of providing online tools and assistants to improve the effectiveness of caregivers. Most caregivers have a full-time job, which means that they are burdened with both care and work responsibilities. As a result of this, problems with time management occur. One in particular being the scheduling of a routine, each day, which fills the demands of caregiving, work and their own personal lives. They are like to receive appropriate care recommendation for an older person such as what activities that they should provide and work best with his/her older person. Online help for caregivers in generating daily care plan will be provided by the coaching functionality of our system, including specific care recommendations, ensuring medication adherence and providing alerts.

B. Social Interaction
Emotional problems are critical to caregivers of the elderly. Stress can prove to be excessive when faced with difficult care issues or the patient is seriously ill. Caregivers in stressful situations, typically, desire to share their feelings. Explicitly, they would like other family members to understand and help support their caregiving burdens; this could even be done with as little as an encouraging message. In summary, caregivers need social interaction. Receiving emotional support and giving back the same to other caregivers is helped by social interaction with family members and friends [15]. Moreover, interaction allows them to share elderly care knowledge with peer caregivers. Thus, enabling online social interaction for the community of elder caregivers is an essential function of a support system.

C. Information Resource
In addition to the knowledge that they receive from social interaction, specialized information resources to do with elder care are a need for caregivers, particularly as caring for elders with chronic diseases requires access to health care information such as symptoms and treatment methods. Information about diet, emergency care and government services is equally as essential. Consequently, another main function of the online support is the system being an information resource.

III. SYSTEM ARCHITECTURE
The architectural framework of our proposed online support system for elder care is based upon general web application architectures, as shown in Fig. 1. It is made up of three layers consisting namely of the data layer, logic layer, and presentation layer. Described below are the functions of each layer.

![Fig 1: System Architecture of an Online Support System for elderly care.](image-url)
usage of strong encryption. Users will have basic permission to customize their resources such as who can join and view topics in their group. In addition to this, a log file manager will record activity and retrieval history of all users with a timestamp. This information will be used for better understanding of caregiver needs.

B. Logic Layer

The logic or application layer holds all the modules that provide the system’s functionality. This layer lies above the database layer, processes and controls all application modules which underlie the presentation layer.

Our online support system for elder care is currently proposed to consist of three core modules and nine sub-modules based on requirements analysis, but is flexible enough to add or adapt new modules in the future. We describe next the functioning of each core module and sub-module.

1) Coaching: The coaching module is an intelligent module which consists of three sub-modules: a) Daily care planner b) Care recommender and c) Reminder assistant.

a) Daily care planner

The daily care planner is a sub-module which processes input from a caregiver about the health status of the older person, older person’s preferences, caregiver’s personal data and care responsibilities, and then automatically generates a suitable daily care plan for the caregiver. Caregivers can perform caregiving tasks following the daily care plan or edit the daily care plan, thereby giving feedback to the system. Effectiveness in generating the caregiver’s daily care plan in the next cycle will be improved by the system using the feedback from the caregiver to learn his or her style.

b) Care recommender

Our care recommender sub-module will run based on a rule engine that we will develop. This sub-module will provide coaching in the form of personalized care recommendations. The care recommendation will also provide recommendations and motivational messages to users helping to move them further toward their goal of caring for an older person. This process will have two aspects as follow.

- Matching: match caregivers with peers caring for older persons who have similar profiles, caregiver characteristics, and goals. After that the system will then urge users to support and encourage those they are matched with.
- Recommendation: recommending services and caregiver activities, based on the older person’s profile and caregiver’s history both in the database and log file, to lead toward caregiving goals.

c) Reminder assistant

From a daily care plan which includes each period of time in which important caregiving activities take place, such as the time for taking medication of older person, the system will automatically generate an alert message to remind user of tasks both on the website and mobile phone as shown in Fig. 6.

This task is complex because we will match the data of both care recipients and the caregiver. Therefore, we propose to create a rule engine as the platform. The rule engine will define the algorithm to generate the daily care routine; the rules will not be static but evolve based on user feedback.

2) Social interaction: This module is planned to enhance social interaction amongst caregivers, as well as provide emotional support. This module is essentially a social network and, indeed, nowadays there exist many ready-to-use social networks such as Facebook. However, we cannot fully control external social networks, which also may not extend all desirable functionalities, especially privacy [11]. Our system will provide online spaces to caregivers to communicate with their peers, the content of their exchanges possible containing sensitive data which should be handled on an internal platform [11].

For these reasons, we decided to develop our own social network platform to underlie the social interaction module. Solutions for developing social networks are provided by many organizations. For example, Elgg is open source software for creating social network platform which was voted best social
network engine in 2008 [16]. In this work, we decided to use Elgg because its open source, free and easy to include in the proposed system [11].

The main concept we have in mind for social interaction is to allow caregivers to create their own online social groups and communicate with their peers, as shown in Fig 2. Caregivers can also create private groups for communication with their family members and friends. They can manage the group activities and determine functionalities for each group. For example, caregivers can create discussion topics such as how to encourage elders to exercise and invite other users to respond. Moreover, caregivers can communicate with other caregivers to share knowledge, discuss and exchange experiences.

A proposed message feature of our social network platform is a service which would be used to allow caregivers to exchange private messages both synchronously and asynchronously.

3) Information resources: we have the intention to provide information resources, particularly a thorough knowledge base backed with reliable references. This information will support caregiving tasks and caregiver needs. The proposed information will fall mainly into three groups as follow:

- Health care information such as signs, symptoms and treatment for each disease, dietary information, physical activities information and etc.
- Emergency protection information such as emergency call numbers, list of hospitals and etc.
- Government service information such as social welfare, free training and etc.

Furthermore, we shall provide the search mechanism to allow users to search the knowledge base and fill their information needs efficiently.

C. Presentation Layer

This layer provides a user-friendly graphical interface for caregivers and authorized users to access all system functions implemented in the logic layer. The presentation layer can run inside web browser as well as on mobile devices. A part of our design process will be to analyze user preferences for creating the graphical interface of the mobile client. Users can invoke the coaching module both in a web browser and on a mobile device.

IV. SYSTEM DESIGN

A. Functional Components

In this context, after having proposed the core and sub-module for understanding the main abilities of the system, we will then propose functional components as shown in Table I. These components show the detail of system abilities that enable users interact with the system in each component. This will allow for the understanding of the scope of the system as well as use for the design interface in the next step.

<table>
<thead>
<tr>
<th>Functional Components</th>
<th>Description</th>
<th>User Procedures</th>
</tr>
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</table>
| Account Manager       | Basic of security module for user authenticating. | • Register account  
|                       |             | • Account setting  
|                       |             | • Cancel account |
| Profile Management    | Important components for caregivers to record and manage their personal profile and elder’s profile. Users have to record this information before use the system. | •Create Caregiver’s Profile (e.g. personal, health status and)  
|                       |             | •Create Caregiver’s responsibilities (Housework, caring)  
|                       |             | •Create care recipients profile/Older profile (e.g. personal, health status and)  
|                       |             | •Management all profile |

Further reading on the system design and implementation can be found in [11].
Health Assessment

This component is designed to evaluate an older person’s ability, physical health and caregiver’s mental health. The assessment result can initially identify an elder’s health problem so that suitable care activities can be prepared.

- Geriatric assessment (Activities of Daily Living [17], Instrumental Activities of Daily Living [18], Physical Health Problem)
- Caregiver’s mental health assessment [19]
- Update health status
- Management assessment result (Cancel, Share, set authorization)

Daily care plan

A complex component that has to create an intelligent rule engine which generates a daily care plan based on relevant information from profile, health assessment and care activities.

- Record care activities (Medical record, time to take medicine, details, doctor’s appointment)
- Receive and access daily care plan
- Update and edit daily care plan health status
- Share daily care plan
- Send feedback to the system

Reminder

Reminder is received at the time of each care activity from the daily care plan and sends a message to caregivers

- Receive reminder message for important activities (medication time, doctor’s appointment and etc.)
- Send feedback to the system

Care Recommendation

Providing services that both match users and recommend which have to use rule engine to generate the result. Matched

- Set goal for caring for an older person. (e.g. for an older person to lose weight). Time periods can be input into the settings in

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<tbody>
<tr>
<td>Forum</td>
<td>Including: knowledge sharing, exchange care experience, exchange of advice, question and answer and etc.</td>
<td>• Create a forum • Join/Respond to other forums • Invites other users to respond on a forum • Management of his/her forum</td>
</tr>
<tr>
<td>Message</td>
<td>Internal messaging system that allows users to send messages both private and public to other users.</td>
<td>• Create Chat group • Sending messages within the system to other users.</td>
</tr>
<tr>
<td>Access and searching Information resources</td>
<td>The information resources which are classified and can be searched for</td>
<td>• Access information • Search information • Rating information • Share information</td>
</tr>
</tbody>
</table>

TABLE I (Cont.)

<table>
<thead>
<tr>
<th>Functional Components</th>
<th>Description</th>
<th>User Procedures</th>
</tr>
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<tbody>
<tr>
<td>Private Social Group</td>
<td>Allowed caregivers to create their own online social group by providing basic social network functionalities to support online interaction.</td>
<td>• Create private social group • Add friends to group • Accept / Reject friends invite • Instant Chat • Comment/Like/Post • Assign social activities in group (event/notifications)</td>
</tr>
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</table>
B. Interface

For the design and development of an online support system for elderly care, the User Interface Design (UID) can be used for the representation of the program [20]. Creating a well-designed user interface of the system both on web applications and mobile is a very challenging, important and influential part of the system [21]. Our design focuses on usability which means ease of use and that it is entirely suitable for anyone to use. Therefore, the design principles are emphasized in the user-friendly design throughout the system design and development. For this work, we proposed some main interfaces that make it easy to understand the overview of our system. Figure 3 displays the home screen after user login. Main functional components are displayed very coherently, which is easy to see. The system has shown the notification which is processed from user history in order to remind users to update information or motivate user interaction with the system. Users can select the functional components that they need like profile management, as shown in Fig. 4.

The profile management screen contains many sections which allow users to record and manage their profile and elder’s profile. The design is emphasized at data classification in a way that is easy to understand and use. The screen section includes the user’s personal data, care responsibilities, elder’s personal data and elder’s hobbies and interests. Additionally, the system has recommendations for people who it believes should be your new friends. This is done by analyzing data of each user for finding similarity between users such as caring elders with similar characteristics, then offers a recommendation to each user.

After users record and manage their profile and their care recipients profile, they have to provide a geriatric health assessment for the record and evaluate the health status of their elderly. The system can then generate a daily care plan automatically which is suitable for each user and their care recipient via a mobile phone. The daily care plan is generated through proposed suitable times of day that the elder functions best and is most convenient for caregivers. Furthermore, the system has matched caregiver preference, elder preference and elder health status for the proposed suitable daily care plan. Users can add, edit and share the daily care plan and also send feedback to the system which will allow it to improve the effectiveness of daily care plan generation next time, as shown in Fig. 5.
Figure 6 shows the example of the care reminder functional component with the example being medication time for an elderly care via a mobile phone. This function receives data from a daily care plan and then generates an alert message to remind users that they must carry out care activities, such as administering medication at a certain time. Users can set specifications as to which care activities they want to receive alert messages about from the system. Moreover, the system provides call functions which automatically call their elderly care patient or views and records the details of medication.

V. CONCLUSIONS

In this paper, we present the architecture and design for an elder care support system to operate in Thailand. The system will be accessible both via the web and mobile devices. We are currently in an early stage of development. The functional modules proposed in this work offer a suite of functionalities of possible interest to developers of healthcare support systems in general. Ancillary technology developed for our system, such as a customized social networking platform, could be used in other settings as well.

VI. REFERENCES


