An Integrated Framework for Social Contribution of Diabetes Self-care Management Application

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Abstract: Diabetes mellitus (DM) has becoming a critical health problem due to number of mortality. This disease will affect the entire life of diabetic with its biological, psychological and social effects. However, there is no known cure for this chronic disease. Diabetics can only reduce the complications that arise by taking certain measures such to keep the blood glucose levels as close to normal as possible. The goal to keep the blood glucose levels as close to normal requires the involvement of diabetics by diabetes self-care management (DSCM). However, successful treatment for diabetics is not only depending on patient's role in the care of their diabetes but also requires family support. This research proposes an integrated DSCM application which is enriched of social contribution feature since the DSCM application which accommodates the involvement of diabetics' family (social contribution) is still scarce. This proposed DSCM is aimed to allow family member of diabetics to encourage them to keep their blood glucose levels as close to normal and enabling the doctors to be actively involved in helping diabetics in managing their lifestyle.

1 INTRODUCTION

Diabetes mellitus (DM) has becoming a critical health problem due to number of mortality. In 2011, the International Diabetes Federation (IDF) claimed that every year 4 million people die of diabetes with an average of one person dying every 7 seconds (Alrahbi, 2014). It has been estimated that 382 million people in the world had DM, with more than 90% of them are type 2 diabetic (Thojampa, 2019). In addition, based on The World Health Organization report, the number of people with diabetes has risen from 108 million to 422 million in just 34 years. This number of is expected to increase to about 439 million in 2030, where 69% of this number is estimated to occur in developing countries (Shaw et al., 2010). Therefore in 2014, the World Health Organization (WHO) declared that diabetes is one of most serious disease and a costly health condition around the world(Association et al., 2014).

As a chronic disease, diabetics will experience various complications in their daily lives. This disease will affects the entire life of diabetic with its biological, psychological and social effects (Mankan et al., 2017). As an example, diabetics have a greater risk of cardiovascular disease, eye or kidney disease, and even reduced life expectancy compared to normal people. In terms of psychological problems, sufferers will experience a loss of life pleasure because they lose the confidence to live independently and become discouraged in living life. Furthermore, they have to maintain a planned care throughout their lives and receive professional help from time to time.

Unfortunately, to date, there is no cure for this chronic disease. Diabetics can only reduce the complications that arise by taking certain measures such to keep the blood glucose levels as close to normal as possible (Syaifuddin and Anbananthen, 2013). Effective control of diabetes depends on self- monitoring and self-care activities such as blood glucose monitoring, appropriate diet and nutrition, exercise regimen and medication administration strategies. Also, individuals have to keep track of their overall health record a holistic approach instead of only monitoring their blood glucose reading.

However, the goal to keep the blood glucose levels as close to normal cannot be achieved without involvement of patients in the management plan. This involvement occurs through diabetes self-care management (DSCM) with patients assuming an independent role in the care of their diabetes. In addition, successful treatment for diabetics is not only depend on patients role in the care of their diabetes but also requires family support a good relationship with the

diabetes care team, including open communication and easy access to care, is essential for success (Silverstein, 2014). This research proposes an integrated personal health record which allow family member of diabetics to contribute in order to keep the blood glucose levels of diabetics as normal as possible.

2 LITERATURE REVIEW

DSCM can be defined as implementing actual performance for self-care activities for those who suffer from diabetes to manage their condition (Gharaibeh et al., 2017). The main purposes of DSCM management is to the glucose levels as close to normal as possible by doing diet, performing physical activities, monitoring blood glucose level, using of medications, another self-care actions. The workings of DSCM is to modify health behaviour by making changes to the daily plan, if necessary, in accordance with the treatment regimen and completion of self-care activities such as following a regular diet and exercise plan, independent monitoring of blood glucose levels, and taking medication according to prescription (Khairnar et al., 2019).

Nowadays, DSCM is considered a critical part of diabetes management and has an important role in helping diabetics to control the glycaemic and prevent complications (Funnell, 2009). Furthermore, several research has shown that DSCM can improve the quality of life of diabetics and contributed in preventing and lessening the severity of complications (Lorig et al., 2009).

During the last five years, there are several researches that have been done to develop DSCM application. In 2014, an integrated model for cognitive behavioural therapy for DSCM was proposed (Alanzi et al., 2014). This proposed DSCM was intended to implemented cognitive behavioural therapy for diabetics by using smartphone technology. In 2016, another work for DSCM was performed by utilizing the digital engagement concept (Burford et al., 2016). This research attempted to empower the diabetics by inviting them to participate in various digital activities for the management of their health condition. The second work for DSCM research in 2016 was carried out by developing an application which is called by DiaHealth (Islam et al., 2016).

Based on the review of these several related works, it can be inferred that there are many e-health applications for diabetes management systems available, but most of these systems only focus on glucose measurement levels and have not accommodated the involvement of diabetics' family (social contribution).

Therefore, this research proposes an integrated personal health record which is enriched of social contribution feature. This feature is aimed to allow family member of diabetics to encourage them to keep their blood glucose levels as close to normal. Furthermore, this proposed DSCM is enabling the doctors to be actively involved in helping diabetics in managing their lifestyle.

3 SYSTEM REQUIREMENT

The DSCM application that is created is a web-based application because it tends to be more flexible. Web-based applications can be accessed through various devices and various operating systems such as via smartphones or tablets and others including smart watches. It doesn't matter whether users use Windows, Linux, iOS, Mac OS, Blackberry, Android or other devices; users can still use it only with a web browser. Users simply open a web browser (for example Firefox or Google Chrome) which then points that web browser to the DSCM application URL to use this DSCM application.

In addition, users can also access this application through all the devices they have without having to install it first on each of these devices. This of course will make it easier for users who tend to have multiple devices at once or change devices frequently. As for the website interface, DSCM application uses a bootstrap framework which is known as one of the best website front-end framework. By using this bootstrap framework, the DSCM application becomes more responsive and can adjust its appearance according to the devices that access it. However, to use this website-based application, users do not need hardware with strong specifications because all applications are placed on the server side rather than on the client side.

4 FEATURE OF PROPOSED DSCM APPLICATION

Based on literature study that has been conducted, this DSCM application is designed to have 5 main modules namely personal health record, knowledge base and extraction, intelligent suggestion, notification and reminder and social contribution.

As seen in the figure 2, the DSCM application is divided into two levels of users, namely the level of diabetics and social (family members and internists) who have different access rights. Diabetic Users will
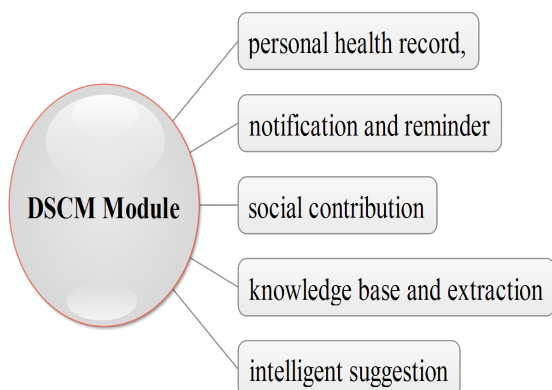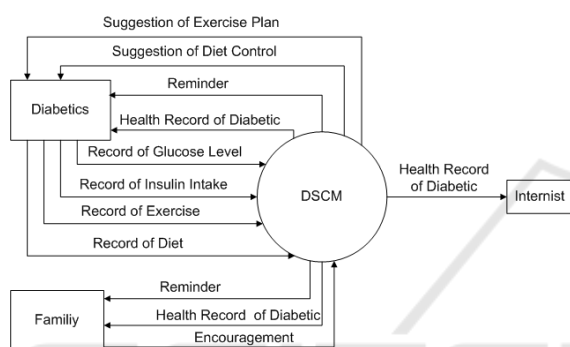
Figure 1: Module of Proposed DSCM

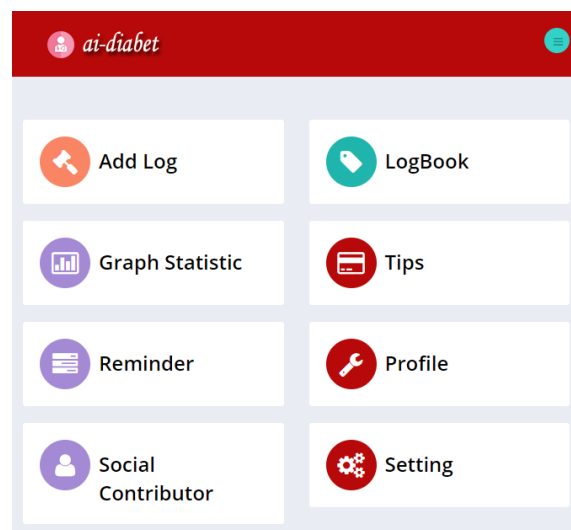Figure 2: Context Diagram of Proposed DSCM

Figure 3: Homescreen of Proposed DSCM

DSCM application will give suggestion to diabetics regarding physical activity and a better and appropriate diet in order to maintain their blood sugar levels as close to normal. All data that has been inputted by the diabetic user will be displayed by this DSCM application on the health profile display page so that the related users, diabetics and family members of the internist, can monitor the patient's health condition real time.
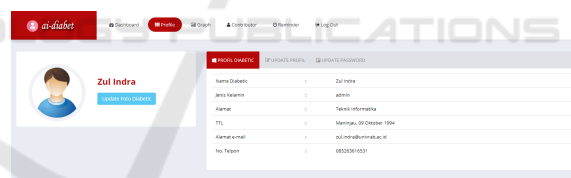
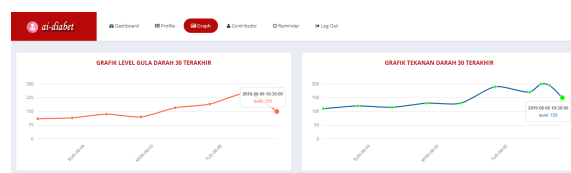

Figure 4: Profile of Diabetic

Figure 5: Graph Representation for Glucose and Blood Pressure Level

be given the right to access the blood sugar level data input features, input insulin data, input exercise data and obtain a profile of their health records. In addition they will also be given a notification to remind them to routinely check (input) blood sugar level data, diet advice and also advice on physical activity. For social level user, they will be given access to the health profile of diabetics, get notifications from the system and provide encouragement so that diabetics can manage their lifestyle. Moreover by using this DSCM, it is expected the internist can get a health picture of the patient real time and provide better treatment.

4.1 Personal Health Record

In this proposed DSCM application, the Personal Health Record Module consists of two main parts, namely data input section and the health profile of diabetics section. There are several data which is inputted by users into personal health records such as blood sugar levels, insulin intake, exercise activities and diet activities. All these records of data will be processed by the Knowledge Base and Extraction module and then delivered to diabetics in the form of suggestions.

4.2 Knowledge Base and Extraction

This module has a task to process raw data which are inputted by users where concepts of data mining and machine learning are utilized in this module. So that the presence of the Knowledge Base and

Extraction module makes this DSCM application become smarter as this DSCM will adjust itself, in terms of giving advice and notifications, according to the health profile of each user. For example, based on the results of the blood sugar level record the DSCM application will look at the blood sugar level trend of diabetics then analyse the causes of elevated or decreased blood sugar levels.

The results of this analysis will be displayed and can be accessed by the user in personal health record module. In addition, the results of this analysis will be further processed in the intelligent suggestion module to be able to provide more suitable treatments related to diet, physical activity and so on.

4.3 Intelligent Suggestion

As explained in the knowledge base and extraction module, this developed DSCM application will intelligently provide advice according to the health profile of each diabetic. Thus the advice which is delivered will be more in accordance. For example, based on the results of the analysis that has been carried out in the knowledge base and extraction, users will get advice about physical activity and diet control that is more in line with their habits in order to make it easier for them to keep their blood sugar levels normal.
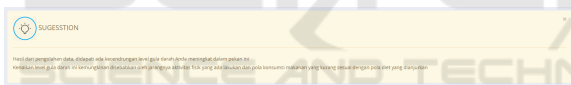

Figure 6: Sample of Intelligent Suggestion

4.4 Notification and Reminder

This module is an important module in the DSCM application that has the task of giving reminders to users. Patients will be reminded to record their health data such as their blood sugar level and regular physical activity. Due to diabetics are tend to forget or lazy to record their health data because they consider this troublesome. This module will routinely check whether the patient has recorded their health data. If diabetics have not yet recorded the data, the DSCM application through this module will send notifications to users in order to remind diabetics to immediately record their health data.

4.5 Social Contribution

As explained earlier, another factor in the success of treating diabetics is the contribution of family members. This module is intended to be a medium for
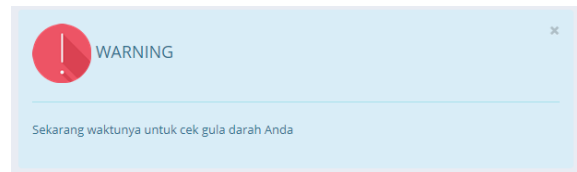

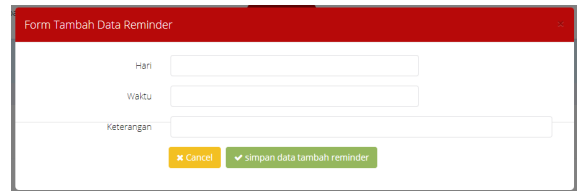Figure 7: Sample of Intelligent Suggestion
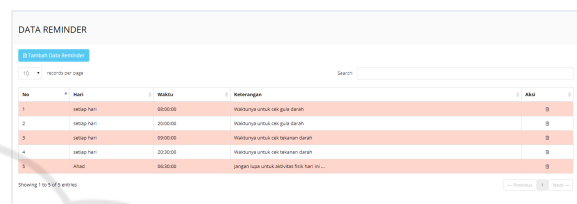

Figure 8: Adding of Reminder Notification

Figure 9: Reminder Data

family members and doctors to be actively involved in helping diabetics in managing their lifestyle. Through this module, they can easily monitor the health conditions of diabetic real time and encourage them to be able to regulate their lifestyle such as reminding them to check their blood sugar levels, follow a healthy diet, and do physical activities and so on.
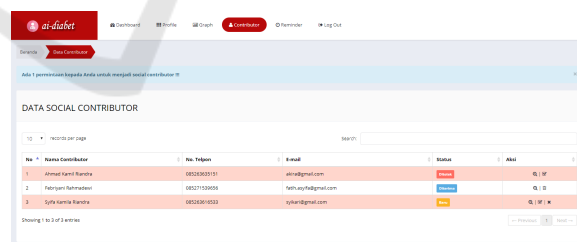

Figure 10: List of Social Contributor

5 CONCLUSIONS

Successful treatment for diabetics is not only depend on patients role in the care of their diabetes but also requires family support to encourage them to keep the blood glucose levels of diabetics as normal as possible. This research proposes an integrated DSCM application which allow family member of diabetics to

Figure 11: Form of Social Contributor Registration

Figure 12: Approval for Social Contributor

encourage them to manage their lifestyle and enabling the doctors to be actively involved in helping diabetics real time. This research is still in the initial stages in terms of identifying what modules are needed in the development of DSCM applications. Further research needs to be carried out to find out how much the influence of proposed DSCM application in order to ease the treatment of diabetics.

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