Remote Assistance in Management of Diabetes Using Data Mining Concepts through Internet of Things

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Abstract-***This paper presents a new eHealth platform to provide multidimensional care approach for the treatment of diabetes using Health Monitoring Applications in Electronic devices. This architecture comprises the Internet of Things to a Web-centric paradigm through using existing Web standards to access the data from various sources. This includes capillary networks, each of which encompasses a set of health monitoring applications in a Electronic devices (Mobile phones or laptops) linked wirelessly (via the Internet) to a disease management hub. This provides a set of services for both patients and their caregivers to support the full continuum of the multidimensional care approach for diabetes. This is achieved through access interfaces and mechanism of handling service requests through a layered approach based on virtualization extension and automatic service delivery. It provides end-to-end functionality and acceptability between patients and caregivers and also done Mining Virtualizations. Which is achieved through some algorithms like association rule mining, Naive Bayesian rule, Linear Regression and Support Vector Machine (SVM). Those are help us to predict the future causes and for future study in order to provide awareness to Patients.***

Keywords-- ***Diabetes, eHealth, Internet of Things (IoT), multidimensional care, virtualization.***

I. INTRODUCTION

PREVALENCE of diabetes is increasing at an alarming rate worldwide. It is estimated that 415 million people have diabetes, every 6 s a person dies from diabetes with the accounts for 12% of the global healthcare expenditure [1]. As a result there has been an increased pressure on the available healthcare resources and patients diagnosed with diabetes require a more efficient and individualized disease management plan to prevent (or delay) progression and treatment costs of the short- and long-term complications of the disease.

Benefiting from technology advancements and cost reduction in wireless networks and Web technologies, numerous electronic/mobile health (e/mHealth) applications [2] [15] [17] have been increasingly reported in the literature. These applications offered various levels of user interaction intensity; ranging from general information, specific information targeting specific patients, to tailored user feedback information. Authors of these studies generally agree that ICT solutions are effective in diabetes management in terms of patient monitoring and technology-based decision support applications but further studies are still needed to assess the effectiveness of technology-based solutions with respect to long-term behavior change support in self-management, adherence and patient engagement with their health careers. In addition, most of these solutions are focused on the functionality, technological and mobility issues but not on behavioral changes and acceptability challenges of these applications. Continued improvement in diabetes self management and, in particular, type 1 diabetes mellitus (T1DM) in diabetic patients and adolescents therefore requires a multidimensional care approach that is not only focused on routine diabetes care activities but also on psychological and social dimensions.

The multidimensional care approach of diabetes has emerged in 2010 [13], when a multidisciplinary team combined psychological and social aspects with the traditional primary care of diabetes. Preliminary findings from a clinical trial showed a significant improvement in the blood sugar control in those who engaged in this care approach [3]. However, the requirement of engaging additional physicians is likely to be financially unsustainable in the current frugal economic climate in light of NHS staffing constraints. This is where the incorporation of eHealth technologies to facilitate the seamless and asynchronous interaction between the patients and their caregivers could potentially add a significant value by improving both efficiency and productivity of the care process, while providing a personalized and patient- centered experience. The Internet of Things (IoT) is a new concept associated with the future architecture of applications development in which the physical objects (POs) and virtual (or digital) objects (VOs) are interconnected through various means to enable new application and services [4]—[6] those are considered as components here. The VOs tend to be smarter representations of the POs through enriching their digital models by cognitive management functions and user information [15]. They also can have several attributes in common [8]. However, based on practical experimentation and prototyping, these objects can be categorized into three types: 1) activity-aware; 2) policy-aware; and 3) processaware objects. The key differences between these object-types Can be identified in terms of awareness, representation, and interaction [14][16][18].

The work presented in this paper suggests a next generation of eHealth platform driven by the requirements of the multidimensional care approach of diabetes and the IoT architectures. It suggests a novel technology support that integrates diverse diabetes care aspects, electronic device coaching, wireless technologies, and distributed intelligence in a single platform. Incorporation of health monitoring applications in diabetes management, which is not yet thoroughly explored in literature improves patient-career interactions over a distance and allows for a more efficient and cost-effective implementation of the multidimensional care approach. In the proposed application scenario, the platform is based on policy-aware IoT objects with the following design dimensions.

1) *Awareness:* Understands to what extent the patients activities comply with their individual treatment plans.

2) *Representation:* Applies a set of rules on patients data streams and extracts useful summaries and health indicators such as blood glucose (BG) patterns, insulin bolus calculation, and patients' categorization depending on attributes of their health conditions.

3) *Interaction:* Uses accumulated data stored in the patient's electronic medical record to create reminders, warnings messages, and appropriate health advices when self management outcome deviates from pre-specified targets.

The remainder of this paper is organized as follows. Section II describes the distributed architecture of platform and its software design pattern. Section III describes the remote assistance components with there operations. Next, the main applications of the software/DMH interfaces and applications are described in Section IV. Aspects of the platform support to diabetes management, application interfaces and future assistance are presented and discussed in Section V along with some results obtained from a pilot clinical acceptability study. Finally, this paper is concluded in Section VI.

II. DISTRIBUTED ARCHITECTURE

The scenario adopted in this paper is an eHealth platform with remote accessibility and manageability of variety of applications. Network architecture of the platform encompasses two main components: 1) capillary networks and 2) a Web centric DMH for patients monitoring and disease management. The long-range connectivity between these components is performed through a wireless local area network (Wi-Fi) linked to an existing network infrastructure (the Internet) as illustrated in Fig. 1. Each capillary network comprises a set of health monitoring applications (BG monitor, blood pressure and pulse rate monitor, smartphone glucometer and weight scale) in Mobile phones [2].The Applications have to be installed in mobile phones, where the applications transfers collected data from patients to the healthcare through IoT, as illustrated.

Applications hub

Fig. 1. Abstract view of the proposed eHealth system.

The Electronic device and applications at each capillary network acts as a interface between the patient and his/her applications from one side and the DMH and caregivers from the other side.

The DMH provides a set of services that cover the full continuum of diabetes management for the patients and their caregivers.Application residing in the DMH are capable of interpreting events and activities with respect to predefined healthcare policies/ guidelines in terms of awareness, representation and interaction. For instance, these application understand to what extent the patient's activities comply with the treatment plan/guidelines, apply rules on patient's data streams to extract useful summaries, and use accumulated data in order to use it further and to create appropriate warning messages and advices to the corresponding patients and give Prescriptions with the help of applications.

A. Software Architecture

Software development of the main platform components (i.e., the Electronic device and DMH) is unified and logically divided into three main components: System, Database and Applications. The components are shown in Fig. 2 and are described briefly as follows.

1) System: Refers to the core classes, configurations and service libraries that provide a skeleton and a container for various applications at both the Electronic device and the DMH.

2) Database: Represents both local and centralized storage for the Electronic devices of the capillary networks and the DMH, respectively.

3) Applications: Refer to the modules that handle Applications related functionalities including human objects.

Design of all application modules at both the Electronic devices and the remote DMH are compliant with the model- view control (MVC) architectural pattern that provides a practical solution to separate the user Interface (view) from the data (model). In this pattern, the view interacts with model through the controller that mediates the input and convert it to commands for the model or view.

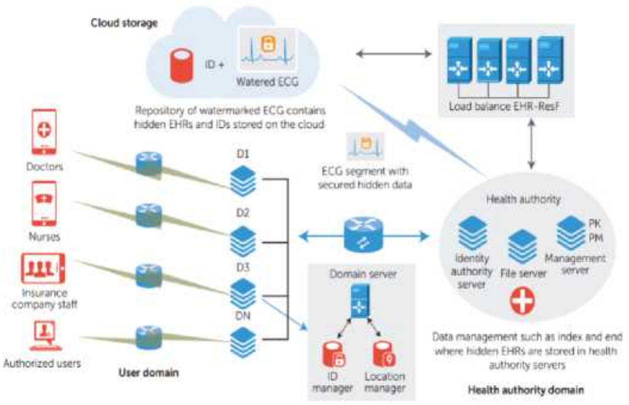

Fig. 2. Software architecture of the eHealth system.

The Internet of things (IoT) is a networking paradigm where interconnected, smart objects continuously generate data and transmute it over the Internet. Much of the IoT initiatives are geared towards manufacturing low-cost and energy efficient hardware for there objects, as well as communication technologies that provide objects interconnectivity.

However, the solutions to manage and utilize the massive volume of data produced by there objects are you to mature.

This logical division of the applications development improves interlayer operability, software reusability and maintainability across the platform [4]. It also enables the developers of IoT applications to develop various applications without the need to know low-level details of the platform.

B. Virtualization Extension

Virtualization of the POs is a key requirement for IoT infrastructure. It enables digital representation of objects and acts as an interpreter between the physical and the virtual layers of the platform. A layered object-virtualization approach [8], [20] is adapted in this paper to ensure interoperability and reusability of VOs. Virtualization process is out at the Mobile phones and the remote DMH to provide digital representation for all PO of the proposed platform.

1) Remote Assistance: The Remote Assistance for all realworld (or physical) objects in the associated capillary network(i.e., the patient, his/her medical sensors and Applications).The Electronic devices are to be used to communicate with the diabetes patients and professional caregivers in order to transfer the patients details to healthcare and get back to prescriptions to patients and stores the necessary data in the database(DMH). This enables efficient data exchange between different types of objects through specifying the data and its relationship among other objects. As a result, the Pos can be accessed through their VOs, which in turn act as translators between the digital and physical worlds.

The Electronic devices are to be used to communicate with the diabetic patients and professional caregivers in order to transfer the patient details to healthcarerer and get back prescriptions to patients and store nessosory data in database i.e., disease management hub.

2) *DMH's Virtualization:* The DMH virtualizes the remote components of different capillary networks as well as other user objects (i.e., caregivers and technical support staff) are virtualized at this stage. Unlike the Remote Assistance where each VO is constrained by the capability of the associated PO, more complex VOs called composite VOs (CVOs) are required at this stage to represent the case, where multiple VOs collaborate to accomplish a particular task. For example, the physician VO needs to collaborate with the medical sensor VOs to create and deliver a warning message/advice to the patient when the disease management outcome deviates from a pre-specified target. Semantic features of such a CVO describe its capabilities and relationships with other objects and thus help locating suitable objects that can respond to a certain service request.

3) Mining Virtualization: The collected patient records are to be stored in the Database i.e, Disease management hub. This data can be requested by the patient at any time and anywhere. So our application must be able to give the requested data to the patients and professional caregivers in the sametime.The patients can be sitting in the remote locations and server or database residing in the remote location but virtual mining can be done.

III. REMOTE ASSISTANCE COMPONENTS

Application modules of the Electronic device and application are devoted to handle all day-to-day interactions with the patient and his/her medical sensors from one side and the DMH from the other. An application manager, as shown in Fig. 3, performs execution, coordination and management of these modules. Except for the analysis management module that is developed using python language, all other modules are developed using C++ language. The specific roles performed by each of these application modules are described briefly as follows.

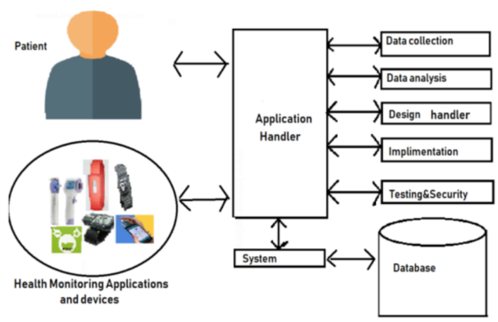

Fig. 3. Remote Assistance Components

A. Data Collection

Data collection is the process of gathering information from patient with the help of health monitoring devices or through health monitoring applications day by day. The data can be collected in various forms like text, images, scanned images, voice, video, graphics contents, medical prescriptions.

B. Data Analysis

Data analysis is the process analysing the data collected from the patients. It checks whether the data collected from the patients are valid or not. Then it will form some division in order to process the information.

C. Design Handler

Design is the process of make a complete structure for the storing the collected data and gives the necessary prescriptions to the patients with the help of Internet of Things by the healthcare to prevent short and long term complications of diseases.

D. Implementation

The designed modules will be implemented by java languages using NETBEANS software and HTML.

E. Testing

The implemented modules are to be tested before constructing the whole application. With the help of this we can easily identify the errors and complications.Those are all can be solved easily in the miner stages.

F. Security

The security for the application by the means of providing a unique Id and password to the patients. By using this patients communicate with doctors and Doctors gives the prescriptions to the patients.

G. Database

It is an abstraction for a local device database that provides simple functions to all database tables to insert, delete, update, and select data. The database is used to store interaction data temporarily. Interaction data refers to all information gathered either from patient's medical sensors in devices or verbally and the information retrieved from the health portal, such as dialogues and treatment plan thresholds.

IV. SOFTWARE/DMH ARCHITECTURE AND APPLICATIONS

A. DMH Architecture

Service requests of the physical-layer electronic devices and human users of the platform are handled by various applications hosted by the DMH. The DMH is accessed through two different interfaces for human and device objects.

1) Human-Object Interface: It provides access interface for different human objects (i.e., physicians, nurses, dieticians, Informal care givers, and patients) through Web browsers. This of interface supports accessibility of system users depending on preassigned role and access permissions granted to each user. The request/response sessions between the users and the DMH are processed securely through utilizing secure HTTP (HTTPS) protocol that provides the necessary authentication and thus security of the exchanged data are protected.

2)Device-Object Interface: Unlike the human-object interface, the HTTPS is not available for the device objects. Instead, the unsecure HTTP can be utilized to process the request/response sessions between the physical-layer electronic devices and the DMH. In the proposed platform, the electronic device exchange data with the DMH through periodic data synchronization between local databases of the device and the central database hosted by the DMH. No HTTP requests are expected from the DMH end; thus the device is protected from external access.

B. DMH Applications

Human and device objects of the physical layer can access applications of the DMH through a access interface Mechanism. As explained earlier, the software architecture of this hub follows the MVC pattern in which the controller and view of all applications are represented by a core functionality module called service request manager, as shown in Fig. 4. The controller handles all business logic processes, including virtualization of components, interactions between applications, and performs all tasks relevant to service creation and management. It also acts as a coordinator between the models and views for nonasynchronous JavaScript and XML (AJAX) requests (i.e., first page loading) of the browser-based interface. All subsequent AJAX requests are handled by the access interface. This saves processing time, minimizes page-loading time, and thus improves the user-machine interactivity. The view is a set of HTML templates that are used to monitor patients' health profiles in various tabular and graphical charts. The model is created for each object entity registered in the central database and used to provide

CRUD (create, read, update, and delete) functionality to active entities. Before describing the service request manager, the main DMH applications are described briefly as follows.

Data mining task can be divided into 2 major categories like,

1) Predictive Tasks: Use some attributes to predict unknown future values of other attributes. Means the collected patient information's will be help us to predict the future diseases will be caused to diabetic patient. This future prediction can be achieved through application in server side. That will be achieved through classification, regration, and deviation detection subclasses.

2) Descriptive Tasks: Find a human interpretable pattern that describes the data. Means first we must collect the patient information's from the electronic devices through some application then we can able to describe the diabetic patient health easily with the help of pretested data. That includes association discovery and clustering.

The Internet of things (IoT) is a networking paradigm where interconnected, smart objects continuously generate data and transmute it over the Internet. It move towards manufacturing low-cost and energy efficient hardware for there objects, as well as communication technologies that provide objects interconnectivity.

Each embedded systems like softwares, physical devices, electronics connectivity which enables these objects to connect and exchange data. and each thing is uniquely identifiable through its embedded computing systems but its able to interoperate within the existing internet infrastructure and also it help us to transfer the data from patients to professional healthcarer though the internet in the form of dataset.

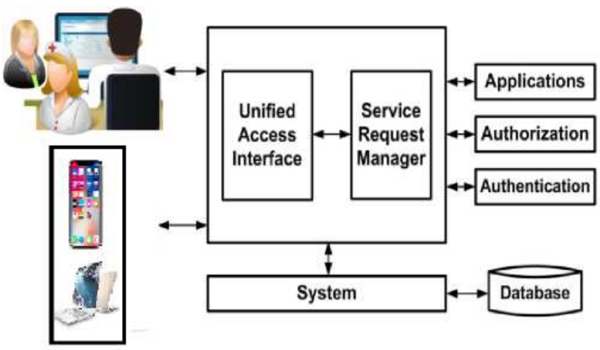

Fig. 4. Software architecture of the DMH.

1) Adding Patient Details: In this module user register with their domain for their authorized access. Register with his face recognition and location registration where they access the egg data. Here they enter their profile details and store location and face for login into the system. This is patient details are adding to the server or main controller through registration form filling with adding to the server. When the details are match, then only the person is authenticated and after the person is view some reports & other information's.

2) Finding Patient Status & Follow-Up: We have to extract the data based on status and follow up patient. Status patient are the people who caused by diabetes in long year which based on dataset attributes. Follow up Patient are the people who caused either diabetes at starting stage or not. Status Patient reports are stored automatically because we have to find the high risk patient report for future purpose. Here we finding critical with overall patients medical details with diseases based splitting specifically areas as wards.

3) Association Rule Mining: Here we are using the best classification part of algorithm as machine learning for association rule mining to be used. After finding the result of support and confidence to mining the report based on support count. Finding overall counting with measurement the data for patient testing results and extract the resulting item set from overall item set. And then we extract the diabetes report based on item set who are satisfy the condition and affected by symptoms.

4) Finding Behaviour: Relative Patient Coverage (RPC) can be extract from the status & follow up patient report who are caused by relative symptoms and affected by diabetes. Here finding critical patients list details with calculated the false positive value and then extract the diabetes report based on false positive result. Then finally we present a disease using symptoms based finding patient critical status reports and coverage details stored. Again finally some testing criteria using us will finding the given patient is normal or abnormal.

5) Health authority: This server verify the location of the user domain Also it verify the face recognition and verification. It process ECG segment with secure hidden data from health authority to user. In this module select ECG image of the patient in the system and store in the cloud. It verifies the authentication of the user in the system by using Domain server. Also it maintains Data management such as index and end where hidden EHRs are stored in health authority servers.

6) Data extraction and embedding: In this module the health authority is fully secure and responsible for generating security parameters. We use lossy steganography, the data doesn't increase in size because each bit of the original data is replaced by another bit of the hidden data.

7) Medical Report: Reporting is one of the main process for showing all specifically or critical patient's details to be visible for data pages is called reporting. Medical report for finding critical patients & it's our diseases information's to be retrieved.

V. APPLICATION INTERACTION AND

FURTHER ASSISTANCE

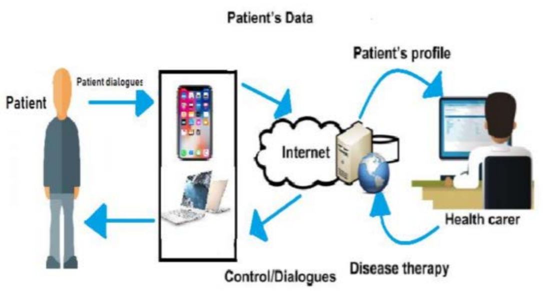

Fig.5 Care cycle and scenarios of system support to diabetes care.

A. Components Interactions

The platform is driven by the technology support needs of an emerging multidimensional care approach for diabetes. As explained in Section IV, the developed platform offers various technology support means for this care approach, including remote patient monitoring, decision support, and long-term behavioural change support through delivery of various patient empowerment modules. There are numerous useful models on behaviour change, of these; the information- motivation-strategy model is the most outstanding [26]. Different strategies were also suggested in [23] and [24] for patients' empowerment through improving engagement with their caregivers to help them cope with challenges of diabetes management in everyday life. This platform offers the tools necessary to fulfill this need over a distance and thus avoiding the place and time restrictions of the face-to-face clinic visits. The new care cycle scenarios of platform support to diabetes management are shown in Fig. 5 and the relevant interactions between different objects are summarized in Table I.

TABLE I
INTERACTIONS OF PLATFORM COMPONENTS

Interaction	Description
Health monitoring applications/Electronic device	Collection of BG, blood pressure. Pulse rate, and body weight measurements.
Patient/Electronic device	Collection of carbohydrates intake, basal and quick-acting insulin boluses, physical exercise level, illness conditions (if any), well-being and patients views /messages to healthcare.
Electronic device/DMH	Pre-process and upload the collected data to the remote health portal server.
DMH Server/Electronic devices/Patient	Real-time system-generated feedback to the patients (maintain health record, relavent compared graphs about day to day information's).
Caregiver/DMH Server	Periodic review of patients health profile, adjust therapy plan, build/assign dialogues for patients education and long-term behavioural change.
DMH Server/Caregiver	Notification for patients with poor disease management performance.
DMH Server/Electronic devices/Patient	Periodic caregivers feedback to the patient(new/amended therapy plan, education/motivation Dialogues, well-being assessment, and health advices).

TABLE I

INTERACTIONS OF PLATFORM COMPONENTS

B. Service Management

The main functionality of the DMH is performed by application, each of which has a specific authorization level. All applications follow a similar design pattern such that they can be accessed using a unified interface. Management of services are dependent on: 1) type of the requesting object (i.e., device or human user); 2) user profile (i.e., patient, caregiver, support staff, etc.); and 3) context of the service request (i.e., internally or externally initiated).

For example, some service creation requests are initiated internally by the DMH when the outcome of the disease management process deviates from prespecified targets. Once these parameters are identified, the related models are invoked to grant access to the central database. The main units involved in handling a service request are explained with the aid of Fig. 6, as follows.

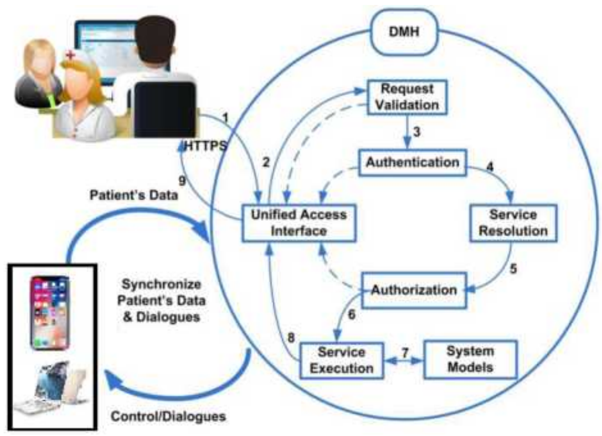

Fig. 6. Service management.

1) Application Access Interface: It represents an entry point for all service requests coming from the physical-layer objects. It unifies the access mechanism to DMH applications and thus it further improves security, software reusability and maintenance of the platform and the DMH in particular.

2) Request Validation: It validates incoming requests depending on attributes of the requested service.

3) Authentication: It authenticates incoming requests using HTTPS session/cookies or the access keys that are provided as part of the request payload.

4) Service Resolution: It creates an instance of the requested service and passes it to the authorization unit along with the request payload.

5) Authorization: It ensures that the authenticated object(user or device) is authorized to access the requested service.

6) Service Execution: It invokes the requested service logic, and sends back the request's payload to the service access interface.

The data flow between these units can be summarized as follows: upon receiving a certain request, the service access Interface sends it to a request validation unit. If it is found to be a valid request, it proceeds to an authentication module; Otherwise, if the request is found to be invalid, it is dropped and the service access interface is notified to reject the request. Next, depending on the source of the request, the authentication unit either uses an HTTPS session-based for browser based requests (user clients) or a key-based authentication for nonbrowser-based requests (i.e., device clients).

If the authentication was unsuccessful, the service access interface is notified to reject the request. Otherwise, the request is passed to the service resolution unit, which instantiates the requested service and passes it to the authorization unit along with the payload. Next, the authorization unit grants the authenticated user access to the requested service. Authorized access will then be forwarded to the service execution unit that first passes the payload to the requested service object, invokes the requested service, and then sends back the execution results to the requester via the service access interface.

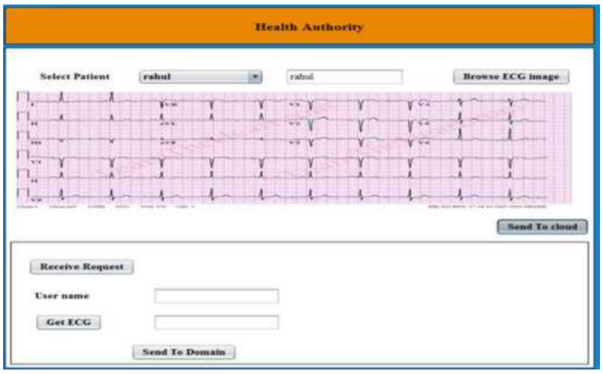

Fig. 7 Sample screenshot of the DMH Dashboard

VI. Results and Discussion

Numerous test scenarios have been carried out to assess data quality (DQ) with data representations and end-to-end functionality and a seamless, secure and accurate data exchange has been demonstrated between different layers of the platform. In this section, some key aspects of the developed eHealth platform are presented and discussed.

A. Patient Monitoring

A sample screenshot for the DMH dashboard that provides a single-page summary for patient's health profile is depicted in Fig. 7. It also provides access links to all key platform applications, such as treatment plan, dialogue wizard, diabetes diary, BG patterns, and other applications, as illustrated. The primary design goals, which included the automaticity of remote data collection, monitoring of patients data, and maintaining continuous interactivity between the patients and their health carers have been accomplished. It was also demonstrated that the platform understands to what extent the patients comply with their individual treatment plans. DMH's ability to extract various BG patterns and generate appropriate feedback to patients when their health conditions deviate from specified targets has also been demonstrated successfully.

B. Patient-Application/Remote Assistance Interaction

Patient-electronic device dialogues support patients' empowerment and motivation toward healthy lifestyle and improved BG control. These dialogues are created by specialist clinicians and saved into a dialogue library at the DMH that is made accessible to all caregivers. The dialogues in this library can be assigned to patients as required, depending on their individual needs to support the disease management process.

once assigned by the physician, the dialogue is automatically sent to the robot at home which in turn performs the specified interaction with the patient. For example, the electronic device reports any changes made in the treatment and the identified BG patterns over a certain period of time. Next, the dialogue may proceed to collect patient's information/messages relevant to diabetes management. During the dialogue execution, the electronic devices with applications may also communicate with the DMH server to exchange data/messages between the local and remote database. Example of the patient-Application/Remote Assistance interaction setup is shown in Fig. 8.

C. Data Representation

Data representation is the process of representation of data in the various forms like text,image,video,voice,scanned image, graphics contents, medical prescriptions like wise. It can be done in both the side like patients and DMH. It also help us to compare two or more dataset and gives the result.

1) Text Data: The electronic device will accept the data in the form of text from patients then that will transfer to healthcare. Before that text will be encrypted in client side and it will decrypted in healthcare side. That text may be a content of the one day patient record.

2) Image Data: Patients can also be send the report images collected from nearer doctors. That images can be send into the for professional caregivers in order to take better prescriptions and stores the nessosory data in database.

3) Video Data: The patients records or live video can also be send to professional health givers in the form of videos. Then based on that the remote doctors help to the doctors who are near to particular patients.

4) Scanned Image Data: Scanned images are to be send to DMH and professional caregivers .That will be in form of X- ray, Scanning reports etc..

5) Voice Data: The health monitoring applications can

also be able of accepting the voice command from patients or supportive hands in the clients side. Then that will be transfer into the healthcare through internet.

6) Graphics contents: The virtual graphic pictures are to be created according to the patients details then that can transfer to DMH in order provide the prescriptions to patients in sufficient manner.

7) Medical prescription: The previous in take of prescriptions can also be send to health carer in the text form or images forms. Through that the health carer can gives the further prescriptions to patients who are suffering from diabetes.

D. Acceptability

A pilot clinical acceptability study was conducted with the aim of exploring how young or old diabetics and their caregivers receive the proposed platform. This paper also aimed to determine how the patients feel the device, as a new medical device, may contribute to their care, and how they respond to the advices and education provided by the electronic device in order to use the medical devices for detecting the diabetes and monitor and manages the diabetes. This paper also investigated how the robot serves as a communication device between patients and health care professionals. A total of 22 patients equally divided between males and females (8-15 years old) with T1DM and seven clinicians (four diabetes consultants, a nurse, a dietician, and a diabetes technician) participated in this paper. Acceptability of the platform was measured in terms of the following four specific services (s1 -s4) that were considered of interest to both the patients and their caregivers.

The obtained results showed a relatively high acceptability level, as shown in Fig. 9. These results as well as the positive comments received from the patients and their parents have been promising. A wider and more detailed study of the feasibility and acceptability of the platform are recently reported by Al-Taee *et al.* [22], [27]. unlike other existing e/m-Health platforms, which are mostly focusing on mobility and remote patient monitoring, design and architecture of the proposed platform is driven by several key emergent healthcare requirements and technology developments.

1) It supports multidimensional care approach that integrates social and psychological care with the traditional primary care of diabetes in a single platform without imposing financial burden on the NHS budget.

2) It responds to the growing need to conduct social and behavioural studies to address adaptability challenges of diabetics with their health carers and families.

3) It is based on the IoT architecture that can addresses the challenges of developing the next generation of a personalized delivery of healthcare services and potentially reshape some of the current healthcare delivery systems and relevant services. Developing such an innovative platform is expected to dramatically improve diabetes care through: 1) supporting long-term behavioural change from unhealthy to healthy lifestyles; 2) delivery of cost-effective healthcare services over a distance; and more importantly 3) improving BG control in diabetic patients and young adult.

VII. CONCLUSION

A fully functional IoT-based eHealth platform that incorporates the Health Monitoring Applications assistance in diabetes management in patients has been designed and developed successfully. This is achieved through an intelligent, adaptable and reconfigurable process of participatory design in which patients are heavily involved in creating their personalized health profile, follow-up and treatment plans. The developed platform facilitates a continuous but loosely coupled connectivity between patients and their caregivers over a distance and thus improving patients' engagement with their caregivers and minimize the cost, time, and effort of the traditional periodic clinic visits. This will also contribute to long-term behavioural change from unhealthy to healthy lifestyles.

The end-to-end functionality and DQ with data representation of the developed platform were tested through a pilot clinical acceptability study. The suggested architecture and applications can also be considered a blueprint for developing a generic eHealth platform for management of various chronic diseases other than diabetes. This platform is therefore remains open for further technical improvements and clinical studies. In particular, the virtualization approach and semantic representation of Components that tackles the heterogeneity challenge of the platform can be further improved through enhancing the cognitive capabilities of the VOs. This approach can be adopted to realize a more flexible patient-Medical devices with applications data exchange between them . Further clinical studies are also required to assess the impact of the proposed technology on the quality- of-life of patients diabetics. The implemented mechanisms for DQ can also be further improved by using an advanced patient-profile matching through probabilistic algorithms, as needed.

VIII. FUTURE ENHANCEMENT

This paper is mainly focused on ehealth application in multidimensional care. This approach can be adopted to realise a more flexible patient-medical components communication through applications. This system mainly concentrated on mobility and security factors with respect to an web centric approach. This application can also be used for different purpose and also can be done with different dataset. There is a huge way to use this idea for any suitable application.

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