Implementation of Contextual e-Healthcare System: A Prospective e-Service Supported by Context Aware Conceptual Framework and Image Processing Models

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Abstract: A novel contextual e-healthcare model is implemented based on earlier developed context aware conceptual framework that systematizes IoT infrastructure to obtain e-services based on context information leaving the current infrastructure unaffected. This suggested model merges the idea of image filtering models with communication system where firstly, a system will request and receive the service, a frontend to communicate with cloud service and lastly, convert the image filter equation into Simulink model. This model has created Simulink models to convert the mathematical equations of edge detection and FIFO which will reduce analysis time and user does not need to know any of programming languages. This system has digitized the digital image processing analysis system through web platform and responsive to all devices such as laptop, tab, cell phone, computer, etc. Proper health care is one of the elementary rights and the suggested framework model confirms the availability of services anywhere, anytime without being encircled by any boundary.

1 INTRODUCTION

The internet of things (IoT) can possibly be bounded in entire network structure based on unvarying and functional network protocols in which sensible and practical "objects" are assimilated in the communication network. „Things" can be defined as a physical object which is capable to communicate with each other and contribute to the development of the idea of e-services supported by context information gained from internet of things (Delphine Christin, et.al); The perception of IoT immensely fortifies the e-services especially the e-healthcare. Formation of a widespread IoT framework can help to establish ambient computing and ubiquitous intelligence through internetworking and sharing of resources among physical entities in dynamic and configurable networks (Ovidiu Vermesan, et.al).

E-health explains the healthcare exercise based on the shared application of communication technology and electronic information. The goal of e-health care is to advance the medical practice, healthcare improvement, global networking along with educational and research work away from the geographical boundary (Avinandan Mukherjee, et.al).

The suggested model is formed supported by the previously formed context aware conceptual IOT framework

(Theo Kanter, et.al, 2013) and ICTization framework (Arif Mahmud et.al, 2012) that prolongs the application of ICT infrastructure. This model will help to deliver a system to classify detailed collection of ICT infrastructural features to achieve a precise strategic placement from the business viewpoint. On the contrary, this concept will offer a collective framework with a goal to attain better context aware pervasive health care services (Shyamal Patel, et.al, 2012).

This method offers e-healthcare facilities by means of the current network structure along with modernization of image processing through web platform. The core infrastructure assists patients with filtering any image and performs as a communication media between them and analyzer. This new system

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can request and receive the services from cloud and can be responsive to all the internet connected devices, for example, cell phone, tab, computer etc.

As a prolongation of earlier works (Arif Mahmud, et.al, 2016), (Arif Mahmud et.al, 2012), (Arif Mahmud, et.al, 2014), (Theo Kanter, et.al, 2013), we have pointed out some research objectives identified below and can be simplified through our projected perceptions explained in the rest of the sections -

- The structure is needed to be supported through the mutual utilization of communication technology and electronic information.
- This system is required to be developed for the sake of educational and research activities.
- This method should have user friendly features and can filter images without prior knowledge in computer programming languages.
- The problem solving processes are needed to be faster and digitalized.
- The system is needed to be based on accessibility; users should have freedom to access and to use the services without any interruption.
- The roles of different entities or participants should be defined and divided in the proposed system

Probable application comprises constant health observing, disease syndrome investigation, regular health assessment, elderly monitoring, chronic disease observation etc (Shyamal Patel, et.al, 2012).

This paper is structured in the following way: section II explains the context aware conceptual IOT model; Section III defines the workflow of the proposed model; Section IV illustrates the implementation of our proposed context aware ubiquitous health care model; Section V demonstrates the prospect of this model and discussions are provided in section VI.

2 CONTEXT AWARE FRAMEWORK MODEL

The primary goal of this model is to investigate and define the smart activities of these smart devices through maintaining a dynamic communication among these devices. The suggested framework will support to systematize IoT infrastructure in order to obtain e-services based on context information where the current infrastructure will remain unchanged. The active association among these heterogeneous protocols and devices can help to achieve forthcoming ambient computing in which the utmost exploitation of cloud computing will be confirmed.

We have divided the total framework system into 4 layers to obtain context aware e-services out of raw data received from the internet of things as seen in fig.1. These 4 layers set up a universal framework that does not revise the existing network infrastructure but generate an interface among services and objects by means of network virtualization.

2.1 Connectivity Layer

This layer comprises all the physical objects involved in the framework model and the communication among them. Forthcoming internet mostly depends on the integration of these objects found in our surroundings and these devices will be specifically identifiable and manageable. This layer includes assigning of short range communication devices such as RFID tags, sensors, actuators, etc. and resource management verifies the accessibility of physical resources of these devices and networks participated in the basic infrastructure. These devices include very inadequate resources and resource management confirms the full utilization with slight overhead. It also permits distribution and sharing of information among many networks or in a single network separated into various domains.

2.2 Access Layer

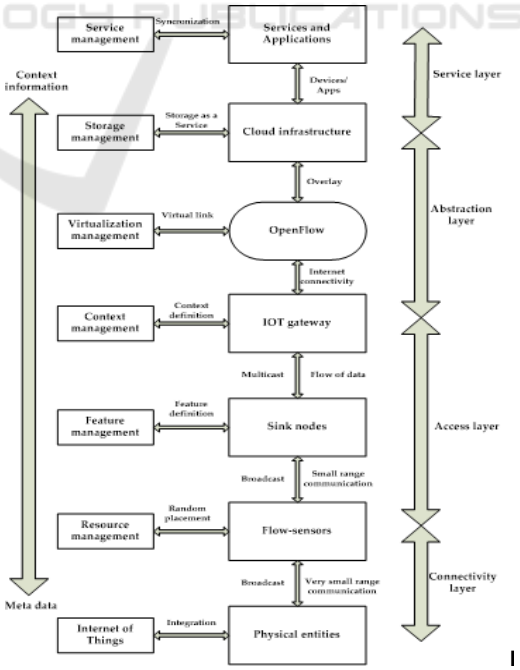

Fig1: Context aware conceptual IoT framework

Context data will reach to internet thru IoT gateway after capturing data by small range communication devices as raw data. Access layer contains topology classification, network origination, formation of network domains etc. This layer also comprises connection establishment, inter domain interaction, and transfer scheduling, data transmissions between sensors and IoT gateway.

Feature management comprises the feature_filter that receive only accepted context data and additional data will be rejected. Huge number of sensors maintains numerous amounts of features whereas only a trivial subset of features is useful in generating a context data.

Feature filter aids to lessen irrelevant data transfer, escalations the data transmission and diminish energy and unnecessary CPU utilization too. The number of features can be diverse based on the type of applications and context data.

2.3 Abstraction Layer

One of the most significant characteristics of OpenFlow is the addition of virtual layers with the present layers in which the established infrastructure will be left unchanged. The system can be considered as a fully a centralized system from physical layer standpoint whereas the sharing of services (flow visor can be used) can be maintained. A central system can observe, regulate all type of data traffics. It can assist to attain better reliability, band-width and routing which will comprise a improved quality of services.

Data are transmitted thru some neighbouring nodes in a multi-hopping state. Consequently, nodes which are close to access points accepts more load in comparable to distant nodes in a downstream consequence and due to inactivity of the vital nodes, the network might get collapsed. Virtual presence of these nodes can resolve the problem where virtual links can be created among networks through the negotiation of access points.

2.4 Service Layer

Storage management carries the concept about all kinds of unacquainted and imperative technologies that can make the system to be scalable and effective. This layer is not only responsible for data storage but also to ensure security. It also permits accessing data effectually; integrating data to augment service intelligences, and increases the storage effectiveness.

All business models can receive benefits out of cloud computing structure for instance, cost and flexibility of small business perspective and complete IT problems can be resolved for large organizations. It will enhance the support for companies, consumers, employees, distributor etc.

Service management links the needed services with administrative solutions and thus the new generation user services becomes simplified. These upcoming services are required to be unified and combined to meet the requirements of socio-economic challenges like environment scrutiny, security measurement, weather analysis, agriculture upgrading etc.

3 CONTEXT AWARE FRAMEWORK MODEL

The proposed model facilities ambient healthcare services based on previously proposed framework models. Five entities are included in the system as seen in figure 2 named as patient, merchants, home network, network operators and health care centers. The functionalities of these entities are provided in brief:

- Patients can utilize the home network to request and obtain the services and reply to third party for authentication purposes and desired services.
- The home network can be formed as a combination of smart devices such as laptop, cell phone, PDA etc. with internet connectivity.
- The Merchants works as a middle person to define and provide the desired services as asked by the patients. It will filter the images and send the results to health care centers. It can also communicate with banks to complete financial transactions.
- The network operators provide the network connectivity to handheld devices and govern the subscriber‟s identity.
- The health care service centers can be considered as the collection of hospitals, diagnostics centers along with specialized doctors, nurses and researchers. The centers can be distributed in different places and can share the information databases as required.

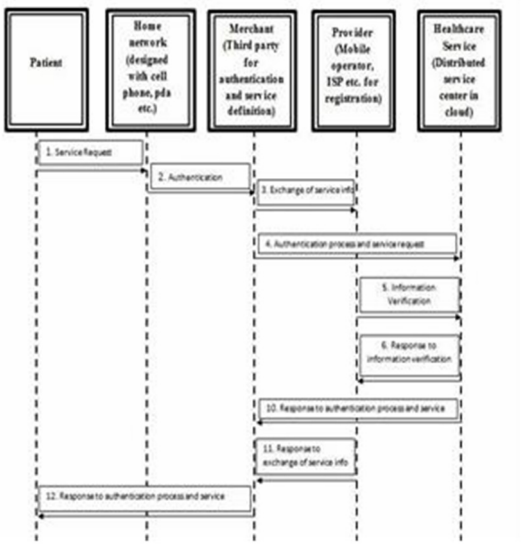

Fig 2: Proposed healthcare model workflow

- For instance, a patient can demand the service through the home network both manually or automatically. For automatic service, either sensor are used to capture the data for example patients heart bit, pulse rate, motion etc. or cameras can capture images intermittently and send the results to home network. On the contrary, patient can use the home network to request services manually.

- Home network guides the information to the merchant to verify the legitimacy of the user. The flow of data can be categorized in two types, such as mobile traffic and IP traffic as chosen by the patient. Consequently, the user can appeal the service both via mobile phones and emails.

- The procedure of sending and receiving services happened between user and provider in which the merchant plays the part of the merchant who becomes connected with both parties and approves authentication. The merchant has the vital role as explained in the previous paper. It can interact with banks to meet financial transactions. As for examples, when a subscriber needs to pay for any services and registrations, merchant will inform the bank to execute the transaction. At the completion of financial transaction by the bank, user and provider will be notified.

- In short, the healthcare centers maintain an interaction with merchant and network operators in order to confirm the validity of end user. After that the demanded services will be received by the end user via the third party.

4 IMPLEMENTATION AND RESULT

The following technologies and tools were used in proposed system:

- Apache server was used as web server
- PHP and CSS were used as web language and can be applied to HTML and XML.
- MATLAB, Simulink and Xilinx ISE were used for image analysis
- HTML5, Bootstrap were used for creating the interface and presenting the content in Web.

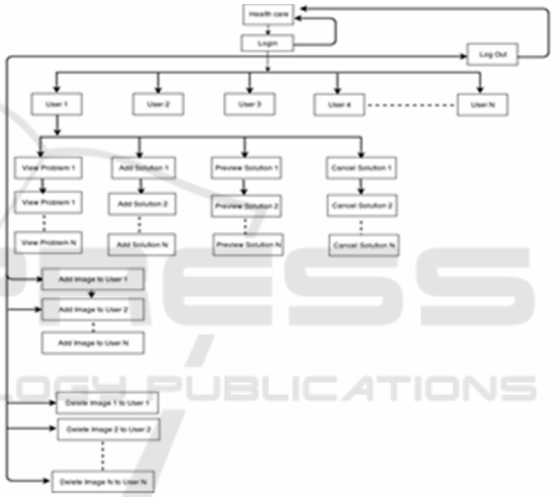

Fig 3: Administrative interfaces

This model provides administrative interface for the system administrator as shown in figure 3. some of important features of administrative application are Dashboard log in-out, Profile management using database, User management, image analysis (addition, view, examine, solution etc.), result display etc.

This model also provides a user interface which is intended for the system user with limited features can be seen in figure 4. Users can use those services after getting registered with username, email and password. Users can provide details information of the image with addition of images and can also receive the results.

We have used two filtering methodology, Edge detection and FIFO and converted their image processing equation into simulink model as shown in figure 6 and 5. This project creates block diagram for the image filter to replace the mathematical equation.

These models will be helpful for the third party to analysis any image without any prior knowledge on computer programming. Therefore, the processing time will be faster and becomes convenient to generate results.

Edge detection refers to the process of identifying and locating sharp discontinuities in an image. Hence, it is a vital step in image analysis and it is the key of solving many complex most image processing applications to obtain information from the frames as a precursor step to feature extraction and object segmentation. It has been used for object recognition, target tracking, segmentation, data compression, and image reconstruction.

Our model supports all edge detections techniques such as Sobel, Prewitt, Roberts and Canny. The functionalities of these blocks are explained below:

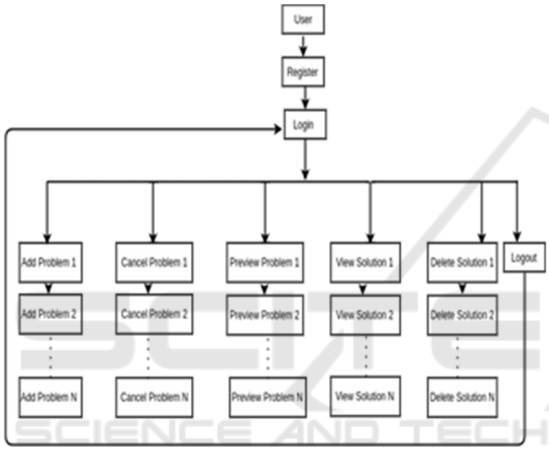

Fig4: User interface

- Image from file: This block takes input from computer in form of jpeg, png for filtering.
- Color space conversion: This block helps to convert the true color image RGB to the gray scale intensity image. This block converts RGB images to gray scale by eliminating the hue and saturation while retaining the luminance.
- Edge detection: This block helps to detect the boundaries of image using Sobel, Prewitt, Roberts and Canny method.
- Input: This block convert‟s true color image RGB to the gray scale intensity image.
- Processed image: This block helps to find the final result of filtered image.

On the other hand, FIFO is used to buffer temporarily the pixels data for later usage. The FIFO size is proportional to the length of filters and input data width. With this method, image will be slightly blurred. The primary effect of blur image is to reduce contrast, noise and also to increase visibility of small object or in detail.

In addition, this method helps to find the actual shape of any object out of any unclear image. The functionalities of are given in brief.

- Signal form workspace: Output signal samples are obtained from the MATLAB workspace at successive sample times. A signal matrix is interpreted as having one channel per column. Signal columns may be buffered into frames by specifying a number of samples per frame greater than 1.
- An M x N x P signal array creates M x N matrices at successive sample times. The samples per frame must be equal to 1 for three-dimensional signal arrays.

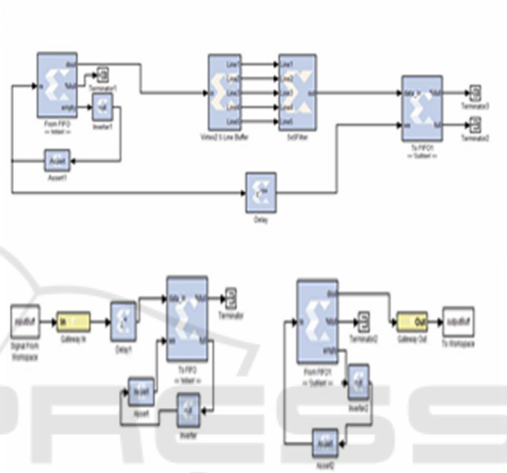

Fig 5: FIFO Simulink model

- Gateway In: Converts Simulink integer, single, double and fix point to Xilinx fix point or floating point data type.
- To FIFO: First-in-first out (FIFO) block writes FIFO data to shared memory storage.
- From FIFO: First-in-first out (FIFO) block that reads FIFO data to shared memory storage.
- Vertex 2 5 Line Buffer: The block buffers a sequential stream of pixels to construct 5 lines of output. Each line is delayed by N samples, where N is the length of the line. Line 1 is delayed 4*N samples, each of the following lines are delay by N fewer samples, and line 5 is a copy of the input.
- 5*5 Filter: The Xilinx 5x5 Filter reference block is implemented using 5 n-tap MAC FIR Filters. Nine different 2-D filters have been provided to filter gray scale images.

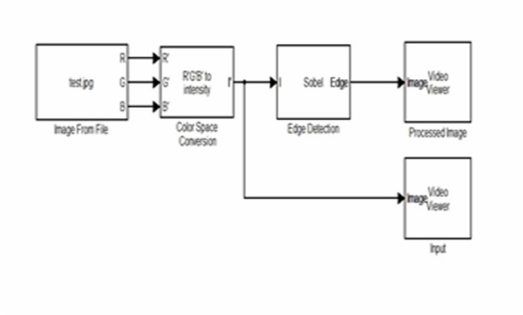

Fig 6: Edge detection Simulink model

A new context aware real time e-service based on present network service system has been proposed in our paper. This system merges the idea of image filtering with communication system. On the way three tasks have been finished. Firstly, a system will request and receive the service, a frontend to communicate with cloud service and lastly, convert the image filter equation into Simulink model. Therefore, all these tasks has been checked and analyzed for the system. For converting image filter equation into Simulink model worked with two methodologies, Edge detection and FIFO. This system digitized the digital image processing analysis system through web platform, which is directly connected to web. Using this system users can easily analysis the image without any interruption. It will be faster because it will reduce analysis time and user does not need

to know any kind of programming language. This system will be digitized by the combined use of electronic information and communication technology. A user can easily upload their image problem into system and get result from this system. This system is responsive to all devices like laptop, tab, cell phone, computer, etc. System can ensure validity of user can be the same or different person based on functionality.

Some of the significant solutions as expected from this model are provided below:

The proposed system is capable of accomplishing the approval level through maintaining user friendly features and vital support and services for registration and electronic payment system.

The system supports accessibility; subscriber has the liberty to access and consume the facilities. Importantly the system will not be surrounded by any borderline.

The system maintains reusability which is a significant part to incorporate the healthcare service system with present system. User has the liberty to choose the processing partner for example, bank, third party, network operators as required.

Users have access to m-commerce applications through their hand held devices in real time without the support of any external devices which allows users to verify the service validity.

Third party assessments the customer identification before delivering any services that turns the system reliable.

The user can carry the hand held device and obtain the service anywhere within a network coverage arena that verifies the concept of mobility.

5 DISCUSSION

Our goal is to develop a real time e-healthcare service system based on present network system. In this system, we have used several tools and techniques that make it efficient one and can be outlined with five entities as proposed in our previous paper, development of Simulink blocks to convert the mathematical equations of image processing and a frontend to communicate with cloud service and to make user friendly. This model is efficient in logical partition of physical objects placement, formation of virtual links among distinct, network domains and collaborate in multiple applications without the support of any central management system.

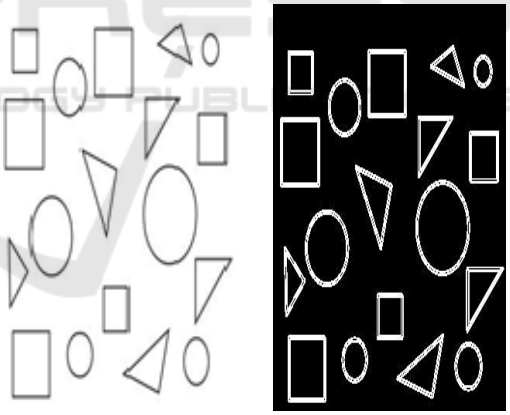

Fig 7: Input and output using edge detection mode

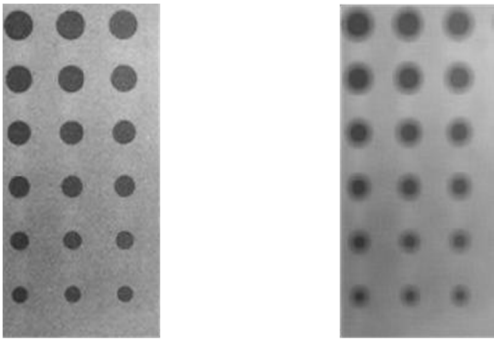

Fig 8: Input and output using FIFO model

Context awareness plays a remarkable role in accomplishing e-services and ubiquitous computing as well as it permits interpreting of various contexts received from environments. The obvious IoT segmentation and certain standard permit various manufacturers and system vendors to collaborate the activities and large scale expansion to be fully operational.

Healthcare services are one of the most substantial concerns in human life. The utilization of computerized tools and information increases along with our demands. However, these improvements are not sufficient to support new technologies for the sophisticated machines in modern health care services. As a consequence, the proposed model will contribute to the development of secure and trustworthy system.

To conclude, we have projected a novel contextual e-healthcare system as an example of the e-services and it confirms accomplishing the requirements, purposes and issues being maintained by the earlier developed framework models. Further, it is expected that the model will play a noteworthy role in e-commerce which will become a huge success in terms of upgrading of e-health care system.

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