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Context-aware Healthcare System based on IoT – Smart Home Caregivers System (SHCS)

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***Abstract*— the Context-aware system provides real time information between patients and caregivers by using Internet of Things technology. In this paper we propose a Smart Home Caregivers System (SHCS) is able to collect the real-time patient respiratory rate, oxygen leakage information, normal and abnormal conditions of the patients can be monitor via MQ6 sensor. The sensed data can be delivered to Base Station (BS) where monitored by the caregivers through laptop or app. It can be done either by wire or remote users via REST web services.**

Keywords*— *Context-aware, Internet of Things, Health care, Smart Home Caregivers System (SHCS), Representational State Transfer (REST),

I. INTRODUCTION

Monitoring patient health conditions is most important for patient's safety and health. Nowadays, caregivers not being with patients, so it causes a big issue. Besides console, unsafe situation can be detected like gas leakage (O2, CO, CH4) [17]. We already know that the degree of context aware in user application. Nowadays smart phones come along with many no of tools so it can be sense the user object or environment (such as location, activity, energy etc,.) and produce the results according to the user object. For example a smart phone can adjust the screen brightness based on the lighting around us by using lighting sensor in mobile. Likewise many other sensors are used in smart phones. Then when we are using laptop, screen goes dim if not accessing the system. So this sensor can be applied to context aware application.

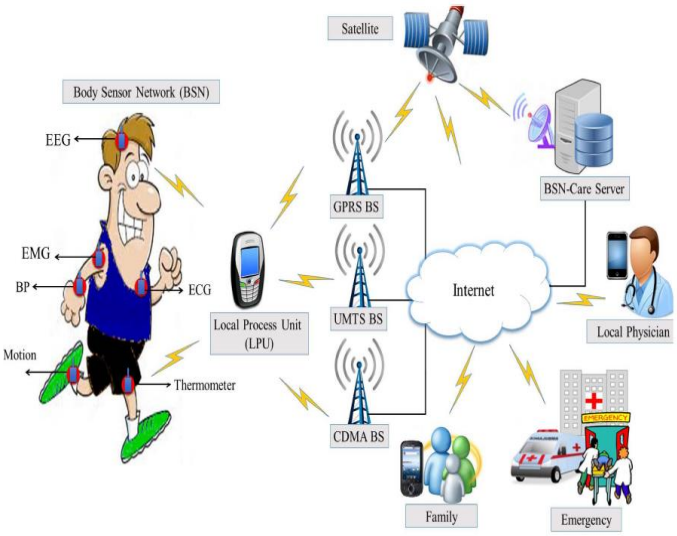
Internet of things is internetworking of physical devices building, vehicles, and other items which can be embedded with sensors, electronics and network connectivity that enable the object to collect and exchange data.

The IoT is to change the manner we live and work. The type of disorder is evident in the healthcare section. Nowadays healthcare technology changed in many ways. In healthcare application a patient can fix the appointments without need a doctor call or in receptionist. A doctor can carry the patient or with them anywhere with the help of apps on their mobile. The patients can take more intention in their own health will being. Likewise a home monitoring systems allows patients and doctors to keep contact of and personnel health care when doctor not available to prevent unnecessary cost with physician. In many hospitals the IoT technology used, like smart beds which can sense the bed and adjust according to the patient position and pressure which is provide better support without help of nurse. Also IoT can help healthcare in home environment so many patient don't take their medicine in right time so the IoT (smart medication) automatically upload, inform to doctor if patient not having their medicine in right time. It's suitable for patients those who are in critical position.

II. LITERATURE SURVEY

Shih-Hao discussed about context aware (ImHS) Interactive m-Health System which is offered two way communications between caregivers and patients in real time. Through MQTT protocol, the ImHS will automatically notify the patient's caregivers and also ImHS can receive the patient's health status in real time and context aware information [1]. In this paper a patient can be monitored using collection of wireless sensor nodes. It described privacy and security issues in healthcare application by using BSN technology and it is not to embed strong security services. The secure IoT-based modern healthcare system using BSN is showed in Fig. 1. [2].

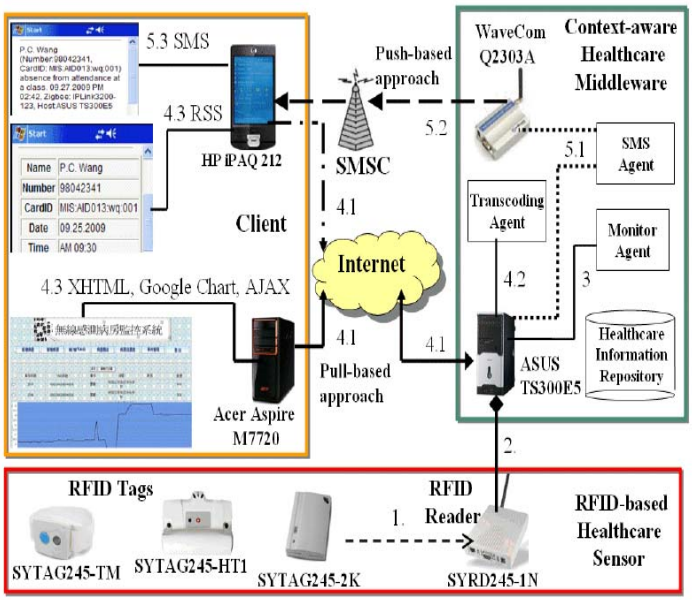
Fig. 1. Secure IoT-based modern healthcare system using BSN.



Shankari Battacharyya et al., presents monitoring & reporting

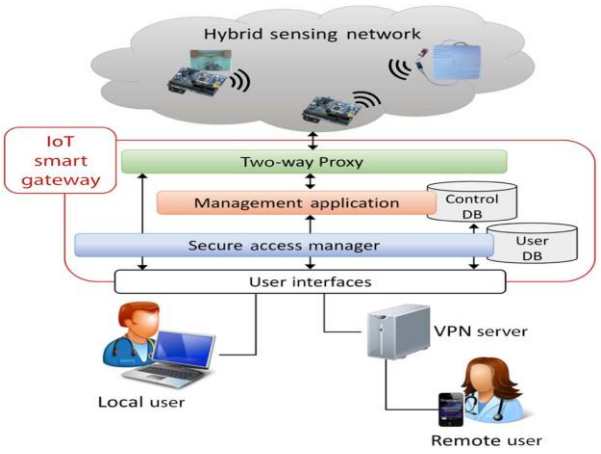
the health care issues of a patients suffering from brain tumor. It is used to build an abstract framework for Context aware applications. They suggest the future enhancement, the individual one who want to live independently, the system can allow sensor for monitoring their safe [3]. In this paper they proposed RFID based context aware healthcare system (RCHS) to enhance the classic healthcare system based on the wireless communication architecture. Advantages of RCHS are used to reusability of healthcare information based on the web 2.0 technology. They mentioned future work to investigate how to integrate semantic web into Context aware health care system. In Fig 2 the flow oriented RCHS architecture is represented [4].

Fig. 2. The flow-oriented RCHS architecture.



This paper the author proposed Smart Health System (SHS) architecture for monitoring and tracking of patients automatically. Inside, the clinic and medical study institutes has monitored by using biomedical devices. They proposed the technology SHS is used to collect environmental conditions & patient's physiological parameter and hybrid sensing network (HSN). Merits and implementation of this paper is ultra-low-power, data HSN transmission supported by zero-power RFID. COAP, 6LoWPAN, and REST have been used for UHF RFID, Gen 2, WSN and smart mobile technology. In Fig 3 the author represented smart healthcare system for patients' physiological parameters [5]. CHEN Xican et al., surveys advance in IoT-based healthcare technologies and reviews the up to date network architectures/platforms, applications, and industrial trends in IoT-based health care solutions. It's analyzes distinct IoT security and privacy features, including security requirements, threat models, and attack taxonomies. It presents eHealth and IoT policies and regulations [6].

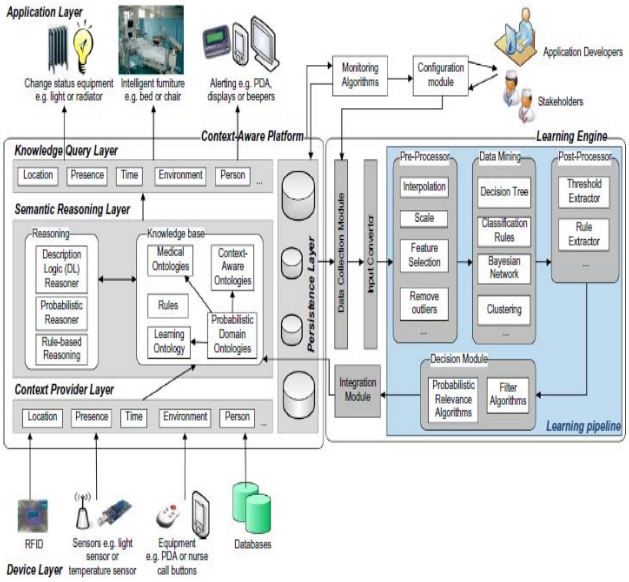
Fig. 3. Overview of the SHS architecture.



[5]. Leandro Y. Mano et al., represented the patients are treated in-home, mainly the elderly people treated as in- home patients through IOT infrastructure. Patient images and emotional detection both can support elderly people and patients which are contained by a home by using home health care context. To enhance the medical treatment they are used Health Smart Homes (HSH). As future research in this area they plan to use classification algorithm for facial expression [7]. This paper reviews recent advances in radar sensor design for low-power healthcare, indoor real-time positioning and other applications of IoT. To improve the accuracy, detection performance, power consumption and detection range for that they used radar front end architecture and digital processing methods. This paper reviews the radar sensor for IoT, especially low- cost, low- power, high accuracy indoor positioning and healthcare monitoring sensors. As future research in this area, there are challenges and opportunities for low-power, low-cost sensor for IoT and mobile healthcare [8]. In this paper says that the elderly people those who are not taking the medicine at the right time they are suffering from dementia. They described the technology is home health care which is used for remainder to take the medicine in scheduled time, monitoring and update the new medicine by prescriber through web [9]. Alexandre santos discussed about a secure IoT architecture for ubiquitous Ambient Assisted Living framework to be used by mobile health application. They used the RFID technology with IOT for patient's monitoring and control the object. To reduce the cost and safety of patients care need to increases by the development of RFID technology. In future the architecture can be tested to include health facilities. Elderly people also tested by the objects so it can enhance the secure validation and encrypted communication [10]. In this article, the author's proposed healthcare internet of things for end-to-end security system. Healthcare IoT systems have to offer responses and real time notifications and about the patient's condition. Then monitor

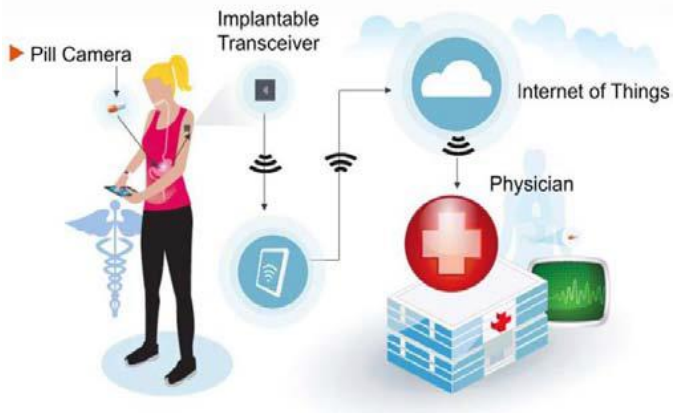
patient activities and signs which they ensure the safety of patients. It has used a novel architecture as suitable paradigm to the requirements [11]. Femke described about a self learning, probabilistic ontology base architecture which allows context aware application can asopt the behavior at run time. The pipeline architecture of the framework was presented and use case also presented to demonstrate the framework. They used nurse call system (NCS) algorithm for automatically get the call when the patients are in not well or emergency case. To evaluate the correctness and performance of the proposed framework they used nurse call system by the reason is SIRS (Systemic Inflammatory Response Syndrome). In Fig 4 says that the general architecture of the framework [12].

Fig. 4. General architecture of the self-learning, context-aware framework.



Nathalie Bricon-Souf et al., Focused on, to identify strength and weakness of context aware in healthcare and they proposed a framework to analyze and characterize of the context in different exes also then identified drawbacks or difficulties of this paper [13]. Shobanbabu described a smart healthcare service by using sensors and actuators to monitoring and tracking in patient and their medicine. securely get the patient health data from various sensors they used complex algorithm to analyze the data and share to through wireless connectivity with professional those who need suitable health recommendations. Patient can be monitored by transceiver via the internet of things [14]. Tuan Analyzed IoT based (Analog front end to end user (AFE)) architecture and implementation for healthcare. It provide cost effective and easily analyze the real time health data and monitor. The health data can be transmitted via 6 LoWPAN which is used for quality overall cost in healthcare. As future research additional layers will be added in the 6LoWPAN for increasing efficiency and security. Data filtering and compression algorithm is used for battery saving and network bandwidth [15].

Fig. 5. Remote patient monitoring

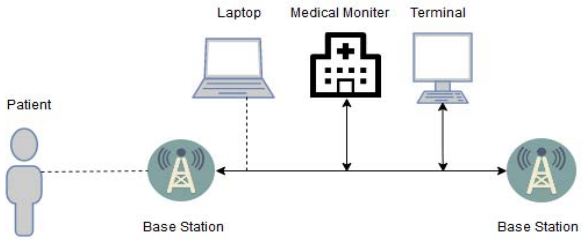


To analyze and collect the context data, pervasive and ubiquitous computing has played a main role [18].

III. PROPOSED WORK

Consider a case of two sensors, in case one; we have a sensor used when the oxygen is leaked. Here the sensor senses the leakage and stops it. In case two, when we have normal and abnormal breathing, If in case of abnormal breathing the sensor needs to be turn ON thereby saving the patient. In case where the patient has normal breathing, the sensor senses the normal breathing and the oxygen supply needs to be turned off.

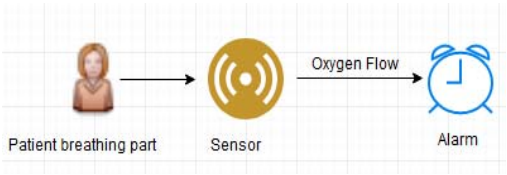
Fig. 6. Network architecture for patient monitoring



Here we are integrating three components context, healthcare and IoT. The care givers know the situation of the patient through their app which is integrated through the internet by the sensors and is monitored 24x7. The context information is based on breathing. We use high quality sensors and highly sensitive respiratory devices. We use sensor solutions for respiratory devices. It is based on highly Reliable Flow and Pressure Sensors for Respiratory Devices. Consider the case of respiratory illness where a person finds difficulty

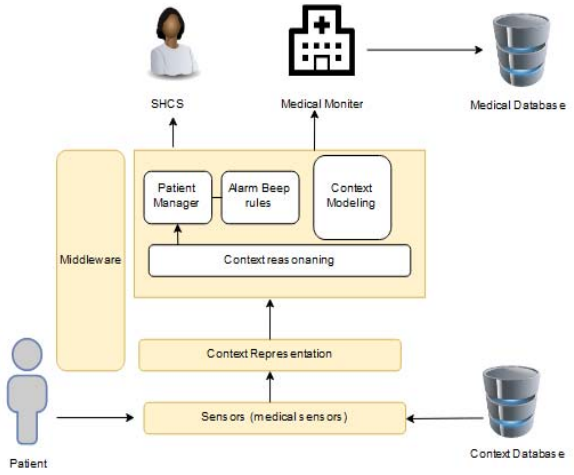
in breathing. Hence breathing here is the context. The breathing rate can be slow or fast or normal. If the breathing rate is fast, immediate connection to the oxygen supply is needed. If the breathing rate is slow, also we need immediate connection to the oxygen supply. Both these criteria are sensed by the smart sensors. And the third case where we have normal breathing; we need to disconnect the oxygen supply based on the third sensor. Also we have a sensor used when the oxygen is leaked. Here the sensor senses the leakage and stops it.

Fig. 7. Sensor with wireless module



In Fig. 6 the wireless sensor is used to detect the leakage of gas in the sensing part. If oxygen is leaked, normal and abnormal conditions is detected the sensor will detect and give the notification alarm to the caregivers. Then the caregivers can tack care of the patients because always SHCS not being with patients.

Fig. 8. Smart Home Caregiver System Architecture



Patient details can be monitor by the smart home caregiver system through the base station, then also monitored by the doctors here its mentioned as medical monitor. In case of emergency situation the medical monitor is used get the health information about the patient. In Fig. 7 from the context database, the sensor can collect the context data for representation, to predict the results we are using context reasoning. Patient manager can collect the patient information like respiratory rate, oxygen leak, normal and abnormal breathing, the care giver can collect all data via the base station and medical monitor too, from the medical monitoring it would be stored in the medical database for patient future reference. Here middleware act as a connection between context database and smart home caregiver system.

TABLE I. EXAMPLE OF RESPIORATORY RATE

S. No	Ranges of respiratory rate		
	Repository Rate	*Condition*	*Response*
1	RR between 12-20	Normal	No issues
2	RR Below 12	Abnormal	Inform Local Doctor
3	RR Above 20	Abnormal	Emergency

IV. CONCLUSION

In this paper, we proposed about respiratory rate of patients those who are all affected by breathing difficulty. Our research is focused on Smart Home Caregiver System (SHCS) based on IoT. Context awareness creates contexts to the defined troubles and translates to the caregivers. SHCS is collecting the real-time patient respiratory rate, oxygen leakage information, normal and abnormal conditions of the patients, it should monitor via MQ6 sensor. The sensed data can be delivered to Base Station (BS) where monitored by the caregivers through laptop or app. It can be done either by wire or remote users via REST web services.

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