Scientific Journal Impact Factor (SJIF): 3.518
International Journal of Modern Trends in Engineering and Research
ISSN (ONLINE) : 2349 - 9745
ISSN (PRINT) : 2393 - 8161

Internet of Things based Tele-HealthCare System

Mohit Soni[1], Ayushi Srivastava [2] and Vaibhav Anand[3]
[1,2,3] Department Of Computer Science & Engineering, IIMT College Of Engineering

Abstract—This paper demonstrate the evolution of the traditional medical HealthCare System that can be boosted by the Internet of Things (IoT) paradigm which involve various ubiquitous devices or objects in form of actuators, sensors(environmental, wearable, and implanted) etc. connected to Internet with the purpose to smartly monitor , track the status of concerned object in digital Universe. This strengthens the Traditional HeathCare System by regulating user's health and activating remote assistance. Radio Frequency Identification (RFID) technology is now used with the common goal of extracting physical information about tagged objects and nearby environment through low-level processing of electromagnetic signals received and backscattered by the tags. It also provide part of the IoT physical layer for the personal healthcare in smart environments through low-cost, energy-autonomous, and disposable sensors.
Keywords—Internet of Things (IoT), RF identification (RFID), sensors, wearable sensors,AAL

I. INTRODUCTION

In early nineties, many change occurred in people's lifestyle mainly due to rise of affordable communication technologies. But from time to time, a new revolutionary variety of low cost, low power communication technologies are being developed to form a part of the human –centric networks, thus created 'Internet of Things (IOT)'.

Internet of Things is the concept that binds various ubiquitous physical sensing devices of digital universe with the Internet and is accessible and shared across platforms via Internet in order to boost by the recent adaptation of a variety of enabling wireless technologies such as Radio Frequency Identification(RFID) tags and embedded sensor and actuator nodes, the IoT has gradually stepped out of its dawn and is the next revolutionary technology in transforming the Internet into a partial concept of 'Utopia'.

Now a day, health care solutions can be provided by utilizing the current technologies, related Databases and formats to store information about the individual patient.

Many novel solutions are also being used to interconnect wearable sensors to the internet cloud. For example- An USB connected sensors belt is used to provide ECG (Electro Cardio Graphic) and respiratory signals. Many prototypes are introduced for the children care to enhance the psychiatric treatment using physiological & environmental readings. Internet of things is becoming an important frame work to support Telemedicine and health communication It also focuses on the importance of open standards for providing solutions for health applications.

For development of a complete basic health care networks with the internet, many mobile applications, websites are adopting the health care practices provided by clouds. To describe this, a 3 tier Tele-HealthCare Architecture is taken into consideration, in which the Tier 1 consists of a number of wireless medical sensor nodes and actuators, Tier 2 involves server applications running of PDAs or smartphone, Tier 3 includes the medical service servers distributed in the internet to provide most efficient and accurate health updates

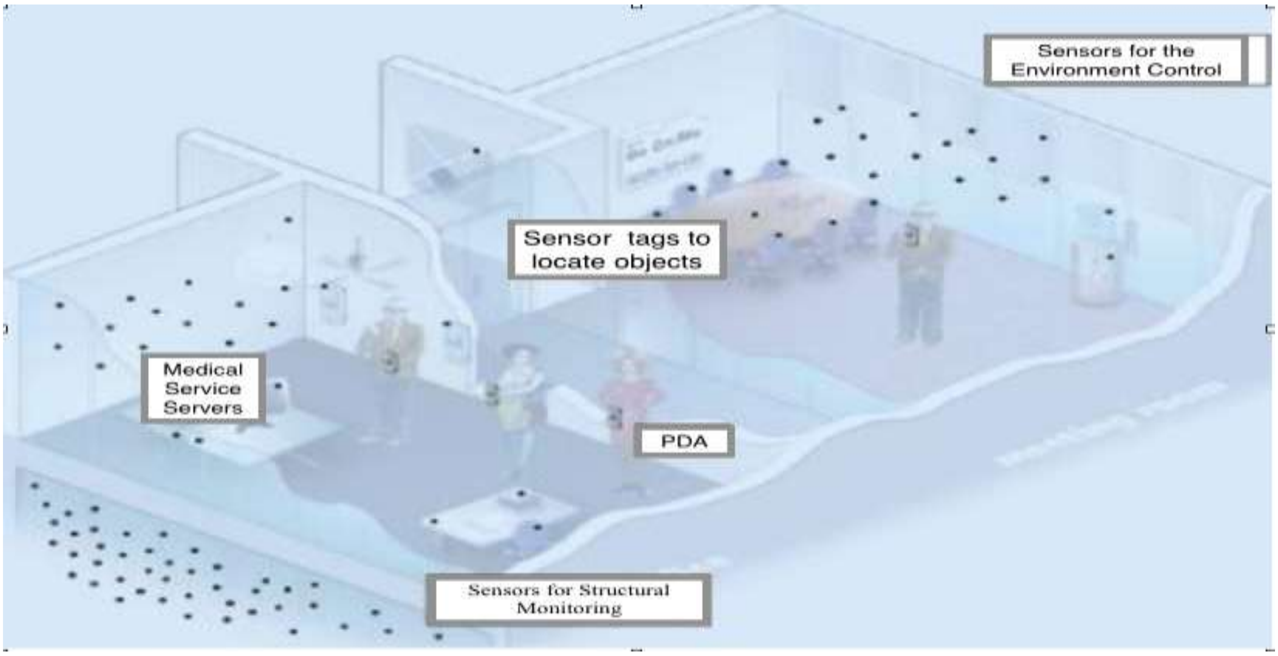

fig 1(a) Representation of 3-Tier Tele-HealthCare architecture

II. SCENARIO AND REQUIREMENTS

The IoT can be exploited to realise and support the remote assistance. For example Fig. 2(b), an old woman suffers from diabetes, has a wireless device who measures blood sugar and tell when it will reach a critical position. This device monitors continuously health condition like breathing rate & heartbeat. This is a part of body sensors system .She takes certain amount of sweet dish, after some time his blood sugar starts increasing and goes beyond the normal. The wireless identifiable device senses and sends a message to his phone which is equipped with built in Internet of Things communicators that allow communicate with wireless network interface(WNI).The phone smartly reminds for remedies by using an appropriate algorithms. She adopts the prescribed suggestion. In case of any emergency, a person with the help of IoT communication can alert the emergency centre to send an ambulance. When reach at hospital, all medical data is made available and so IoT technologies save much time of physician.

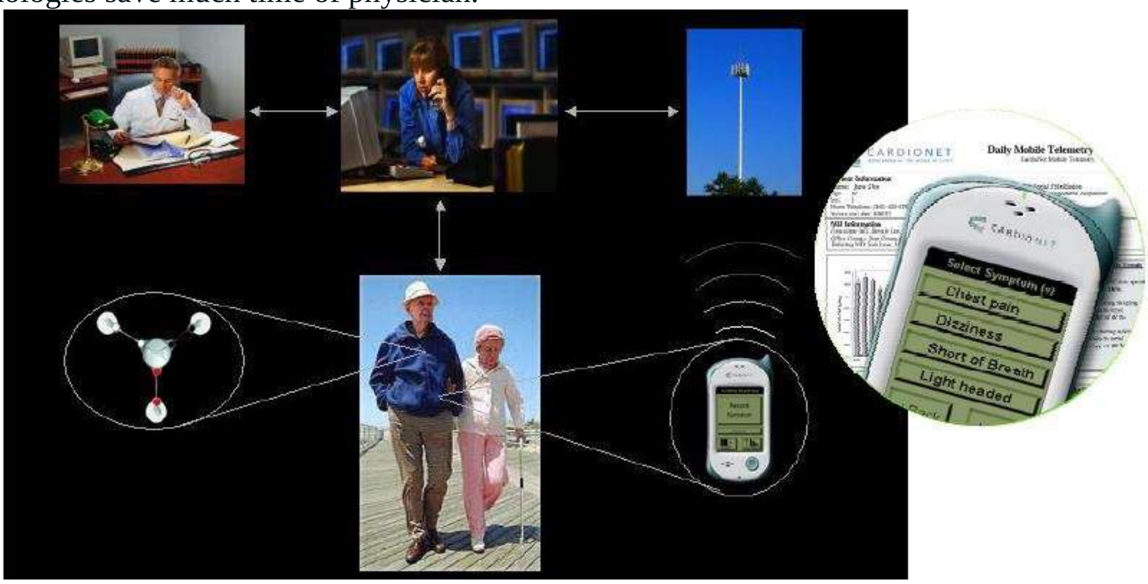

Fig.2(b) Demonstration to the above example

This highlights the importance of efficient communication as the one provided by Internet of Things. The following requirements from the above example

- Appropriate Sensing Device, wearable sensors, RFID tags devices and the smart phone to provide required service.
- Dealing with emergency situations
- Privacy, authentication and integrity are compulsory when exchange data across network

III. SYSTEM AND PROCESSES

As shown in figure, a little difference is found in hardware capabilities. First category devices are handled by low energy availability and powered by battery with low bandwidth of 250 Kb/s for providing long last services and it belongs to constrained part. And second category shown in two phone is network infrastructure devices belongs to unconstrained part.

Constrained devices compress messages and send it to next level. Unconstrained devices makes and provide tools to understand compressed messages.

IoT solutions categorized messages on the basis of priority in a particular time limit with the periodic update and dispatch back to patient.

Its application are:

- Single devices addresses unlikely and remote access availability.
- Proper communication between browser and website.
- The description can be fetched according to requirement, so that user do not need particular application.

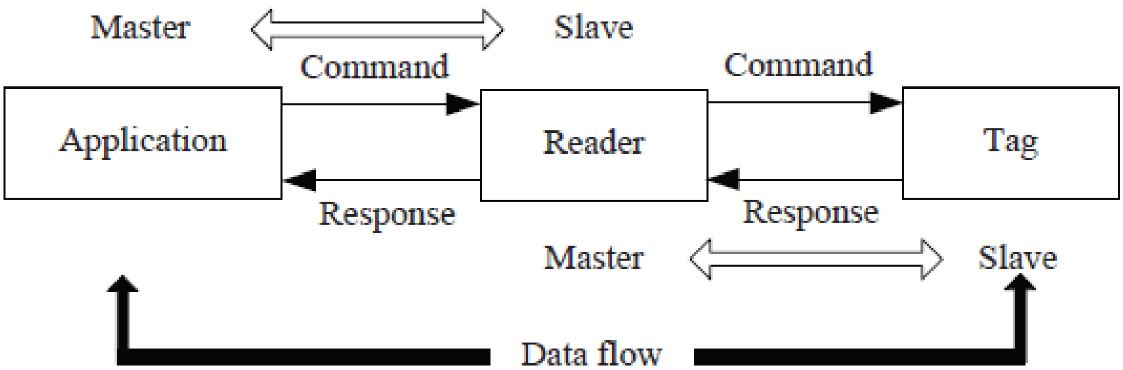

Fig.2 The components of a RFID system

Radio frequency identification system (RFID) is an automatic technology and aids machines or computers to identity objects, record metadata or control individual target through radio waves.

A passive RFID system is composed of a digital device called tag, embedding an antenna and an IC-chip with unique identification code (ID), and a radio scanner device, called reader. Despite the RFID technology is currently mostly applied to logistics of goods, the very recent research is exploring other paths with the common goal of extracting physical information about tagged objects and nearby environment through low-level processing of electromagnetic signals received and backscattered by the tags. RFID systems could, therefore, permit to implement, in a simple and efficient way, the last few meters of the IoT concerning the pervasive quantification of the person's interaction with the environment. This paper is aimed at drawing a landscape of the current research on RFID sensing from the perspective of IoT for personal healthcare

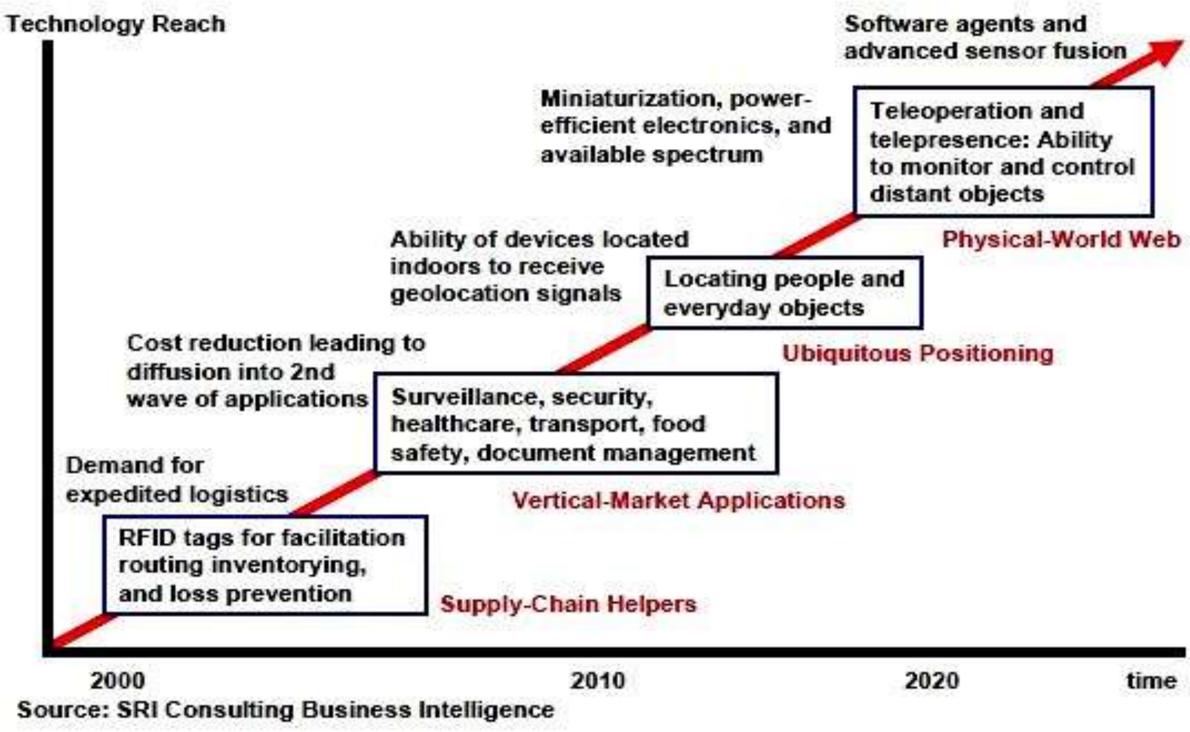

Fig 3(a) Technological and procedural roadmap of IoT.

IV. ENVIRONMENTAL PASSIVE SENSORS

People's wellness and healthcare assessment in living and medical environments may benefit from a continuous and reliable monitoring of critical parameters such as the temperature, the presence/level of humidity, and some other gases.

A passive RFID tag becomes capable to detect changes of the chemical/physical parameters of the environment, when it is functionalized with special chemical compounds or interconnected to the microchips integrating sensing features.

Temperature Tags

Three classes of passive UHF RFID temperature sensors have been experimented in the last few years, and in some cases even commercialized, ranging from threshold sensors, continuous sensors up to better performing digital data-logger.

Body-centric RFID Tags

Autonomous RFID tags suited to be put in contact with the body or in its close proximity are the key enabling devices to develop body-centric healthcare systems which are fully transparent to the user. Wearable, and even more, implantable passive UHF tags have been a technical taboo for a long time because of the huge power attenuation caused by the human tissues. The body-centric networks investigated so far are mostly based on active devices [1]. In the last five years, instead, the availability of commercial off the shelves (COTS) low-power RFID micro- chips has completely changed the games and many prototypes of passive body-centric tags have been successfully developed and experimented with read distances compatible with a true remote monitoring.

Wearable RFID Tags

The human body is characterized by high electromagnetic losses and, therefore, the energy scavenging efficiency of a wearable antenna is really poor [2] as well as, in case of passive systems, the expected read distances. The antenna-body electro- magnetic interaction can be, however, minimized by using multilayer tags, for instance, involving dipoles with dielectric insulators [3], or more effectively folded patches [4]–[6], which are also suited to be embedded into plasters Fig. 4(a).

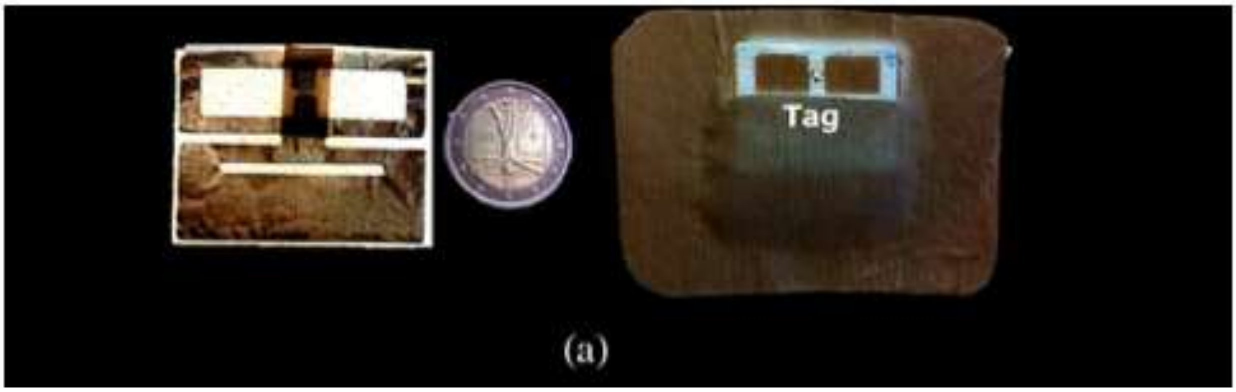

Fig. (a) Example of wearable flexible tag suitable to be integrated with clothes

Embroidery techniques have also been successfully experimented to fully integrate RFID tags inside clothes [7], [8]. According to the current microchip sensitivity, the maximum read distance achievable nowadays with an RFID transmitter compliant with the regional constraints over power emission, may reach 5–6 m, and it is going to continuously improve over the years thanks to the progress in the microchip transponder technology (3 dB reduction in the chip sensitivity each 1–2years). Current link performances are, however, already enough to track inside a regular room a person provided with two tags placed over the front and rear torso, or over the arms Fig. 4(b).

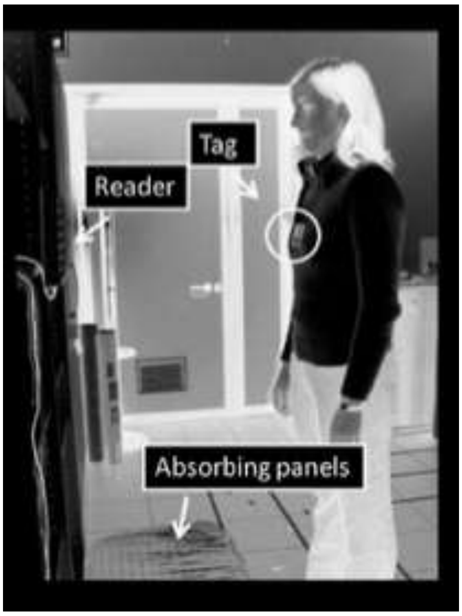

Fig 4(b)Horizontal read regions in [m] [5] by using two tags over front and rear torso

V. AAL (Ambient Assisted Living)

Human body is affected by number of factors such as illness, drugs intravenous fluids, physical and psychological stress, and misbalanced meal schedule which cause drastic negative change in blood sugar levels.

Physicians gives insulin dosage which leads to dose error but generally every person is different in his self from other, it gives birth to abstract disaster therapy management in ambient assisted living (AAL), so that it gives more accurate factors of dosage calculation for insulin therapy. It provides patient's profile management based on personal RFID cards and global connectivity between patient's personal device, 6LoWPAN to number of group formed by patients, physicians and nurse.

1. Introduction

Diabetes is upper hand grooming problem in the world. It leads to failure of heart, liver, and other body parts. It can be controlled by controlling blood glucose level. Research suggests that diabetes self-management system leads to control glycemia and blood sugar levels. Softwares had been developed for monitoring and modelling of blood glucose. In this, number of solution classes are explained like glucometer integrates in digital photography.

Internet of Things (IoT) is one of the most important achievement in recent years, it connects internet with everyday sensors and working devices with IP-based architecture, connects physical and virtual objects and provides mobile assistance services in order to reduce patients list for hyperglycemia and its risk. It supports 6LoWPAN connectivity for linking personal devices with the developed gateway. For loading patient's profile, it uses RFID identification from personal healthcare connection which is done with the help of RS232 connector.

2. Insulin Therapy Model

In normal conditions, blood glucose level must be in between 100 and 140 mg/dl and below 180 mg/dl two hours after meal for the period of digestion.

In AAL, for keeping glucose level within the listed range patients are educated and motivated with deeper understanding for his own therapy in guidance of physician. Insulin therapy is based on different consideration like patient's weight, glucose level, carbohydrate, consumption etc.

Physician suggestion for patients to aware:
Insulin (IU/day) = Basal + Bolus + Correction Factor - (1)

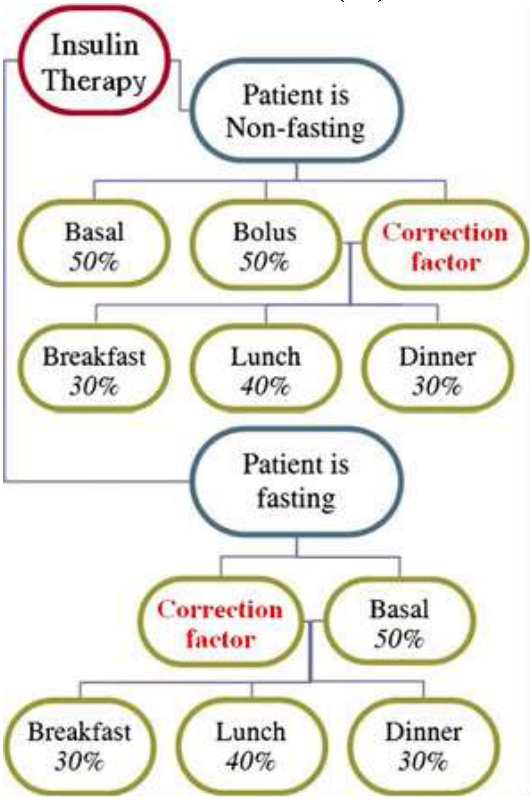

Fig.5(a) shows the Insulin Infusion Protocol.

Glucose level (GL, mg/dl)	Number of IU (IU/kg/day)
<150	0.3
150 – 200	0.4
>200	0.5

Fig.5(b)

The Fig. 5(b) table shows the GL (Glucose Level) with the Insulin Units to be injected in function to glucose level and patient's weight.

Glucose level	<60 Kg	60–90 Kg	>90 Kg
< 80 mg/dl	−1	−1	−2
80–129	0	0	0
130–149	0	+1	+1
150–199	+1	+1	+2
200–249	+2	+3	+4
250–299	+3	+5	+7
300–349	+4	+7	+10
>349	+5	+8	+12

Fig. 5(c)

The Fig 5(c) table shows the GL (Glucose Level) with the additional Insulin Units to be injected in function to glucose level and patient's weight.
Correction factors varies depending upon glucose level before and after meal as well as carbohydrate absorption.

CH(G)	Normal	Obesity	Acute renal failure
IU/CHO	$\frac{1\ \mathrm{IU}}{15\ \mathrm{CHO}_{(g)}}$	$\frac{1\ \mathrm{IU}}{10\ \mathrm{CHO}_{(g)}}$	$\frac{1\ \mathrm{IU}}{30\ \mathrm{CHO}_{(g)}}$

Fig.5 (d)

The 5(d) table shows the additional insulin units to be injected in function of CHO. CH(G), where G is the CHO grams in the meal.

3. Architecture to support diabetes management in AAL environment

By visually inspiring patient's logbook physician analyse glucose logs until and unless patient interpret their own data for this awaring patient how to 'close the loop' and how to adjust their own insulin injection. It should have to be easy so that old age people understand and operate.

- Personal diabetes management device:

It provides electronic devices with stored blood glucose of patient showing advices about right dose of insulin injection after meal.

- RFID based management application

Records must be kept in patient's personal healthcare which includes,

1. User data
2. Dose information
3. Insulin type
4. Body Mass Index
5. RFID reader configuration

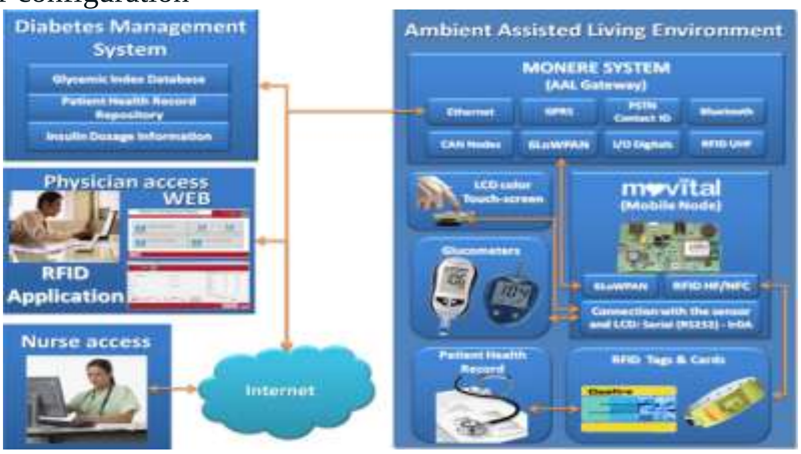

Fig 5(e)

4. Evaluation and Discussion

Solution is designed, evaluated and validated by multidisciplinary group formed by doctors, patients and nurses. Its goal is that how this solution is accepted by clinical staff, patient and on other hand how the clinical instruments, devices and hospital information system should adopt this. For this, feedback is taken from clinical staff and provided to patients.

VI. SAFETY COMPLIANCE ISSUES

The social and sanitary acceptance of personal RFID healthcare systems, and their positioning in the emerging IoT paradigms cannot skip the concerns about the compliance of radio emission from RFID readers with the human safety.

The wearable and environmental tags have to be reached within a typical room under the constrain that the electric field emitted into the environment and the power absorbed by the human body specific absorption rate (SAR), both averaged over 6 min, are lower than countries-specific safety limits. These requirements may therefore potentially induce constraints to the safety distance between the RFID reader and the human body and put in question the true feasibility of some applications. This issue has been investigated in [5], [9], and [10] with soothing results.

VII. OPEN CHALLENGES AND FUTURE SEARCH

The survey demonstrates the application to an IoT personal healthcare digital environment. Yet, many issues are still uncovered and even challenging, especially the reliability of the sensors and the security of pathway followed by crucial personal information of the concerned client from Intruders and Hackers in between. However, there are many other possibilities in research based on the synergy between the Medical Science, the Neuroscience, embedded, Material science and the Sociology with ability to develop, create and give world a new face or definition to Technology in coming next years.

VIII. CONCLUSION

Worldwide university laboratories are now researching and making prototypes of RFID sensors, both passive and semi-active that can be interrogated from a distance compatible with the interaction with a network infrastructure. On the other side, only few products are commercially available for large-scale applications and demonstration to Tele-HeathCare System using Internet of Things (IoT). Therefore now its time for the conversion from experiments to the reality to give pace to traditional methods and more interconnected perspective.

REFERENCES

[1] P.S.HallandY.Hao,AntennasandPropagationforBody-CentricWireless Communications, 2nd ed. Norwood, MA, USA: Artech House, 2012.
[2] G. Marrocco, "RFID antennas for the UHF remote monitoring of human subjects," IEEE Trans. Antennas Propag., vol. 55, no. 6, pp. 1862–1680, Jun. 2007.
[3] T. Kellomaki, "On-body performance of a wearable single-layer RFID tag," IEEE Antennas Wireless Propag. Lett., vol. 11, pp. 73–76, Jan. 2012.
[4] C. Occhiuzzi, S. Cippitelli, and G. Marrocco, "Modeling, design and experimentation of wearable RFID sensor tag," IEEE Trans. Antennas Propag., vol. 58, no. 8, pp. 2490–2498, Aug. 2010.
[5] S. Manzari, C. Occhiuzzi, and G. Marrocco, "Feasibility of body-centric passive RFID systems by using textile tags," IEEE Antennas Propag. Mag., vol. 54, no. 4, pp. 49–62, Aug. 2012.
S Manzari, S Pettinari, and G Marrocco, "Miniaturised wearable UHF-RFID tag with tuning capability," Electron. Lett., vol. 48, no. 21, pp. 1325–1326.
T. E. Kennedy, P. W. Fink, A. W. Chu, N. J. Champagne, G. Y. Lin, and M. A. Khayat, "Body-worn E-t
[6] extile antennas: The good, the low-mass, and the conformal," IEEE Trans. Antennas Propag., vol. 57, no. 4, pp. 910–918, Apr. 2009.
[7] E. Moradi, K. Koski, L. Ukkonen, Y. Rahmat-Samii, T. Björninen, and L. Sydänheimo, "Embroidered RFID tags in body-centric communication," in Proc. Int. Workshop Antenna Technol., Mar. 2013.
[8] C. Occhiuzzi and G. Marrocco, "The RFID technology for neurosciences: Feasibility of limbs monitoring in sleep diseases," IEEE Trans. Inf. Technol. Biomed., vol. 14, no. 1, pp. 37–43, Jan. 2010.
[9] E. Di Giampaolo, R. Aliberti, and G. Marrocco, "Fast estimation of RFID read-region in real environments," IEEE Antennas Propag. Mag., vol. 51, no. 6, pp. 44–57, Dec. 2009.