Review on IoT-aware, smart system for automatic monitoring and tracking of patients, personnel, and biomedical devices within hospitals and nursing institutes

Rahnuma Gaffar Khan [#1], Gurpreet Singh [*2]

[#1]MTech Scholor, Department of ECE, TITR, Bhopal

[#2,] Assistant Professor, Department of ECE, TITR. Bhopal

[1] duashaan92@gmail.com

[2] gurpreetsingh.bpl@gmail.com

Abstract*— Technology plays the vital role in healthcare not only for sensory devices but also in communication, recording and display device. It is very important to monitor various medical parameter and post operational days. Hence latest trend in Healthcare communication method using IOT is adapted. The IoT has a variety of application domains, including health care system. The IoT revolution is redesigning modern health care with promising technological, economic, and social prospects Among others, mainly radio frequency identification(RFID), wireless sensor network (WSN), and smart mobile technologies are leading this evolutionary trend. In the wake of this tendency, this paper proposes a survey on novel, IoT-aware, smart system for automatic monitoring and tracking of patients, personnel, and biomedical devices within hospitals and nursing institutes. Staying true to the IoT vision, a smart health care and management system (SHS), which relies on different, yet complementary, technologies, specifically RFID, WSN, and smart mobile, Internet of things serves as a catalyst for the healthcare and plays important role in wide range of healthcare applications.

***Keywords*— IOT, Internet Protocol, SHS, RFID, Microcontroller, Embedded system, ECG, ICU, Monitoring.**

I. INTRODUCTION

Today Internet has become one of the important part of our daily life. It has changed how people live, work, play and learn. The Internet of Things (IoT) is a concept reacting a connected set of anyone, anything, anytime, anyplace, any service, and any network. The IoT is a megatrend in next-generation technologies that can impact the whole business spectrum and can be thought of as the interconnection of uniquely identical smart objects and devices within today's internet infrastructure with extended benefits.

Visualizing a world where several objects can sense, communicate and share information over a Private Internet Protocol (IP) or Public Networks. The interconnected objects collect the data at regular intervals, analyse and used to initiate required action, providing an intelligent network for analysing, planning and decision making. IoT-based healthcare services are expected to reduce costs, increase the quality of life, and enrich the user's experience.

From the perspective of healthcare providers, the IoT has the potential to reduce device downtime through remote provision. As a saying goes "Health is wealth" it is exceptionally crucial to make utilization of the innovation for better wellbeing. Consequently it is obliged to add to an IOT framework which gives secure health awareness checking.

Up-to-date healthcare networks driven by wireless technologies are expected to support chronic diseases, early diagnosis, real-time monitoring, and medical emergencies. Gateways, medical servers, and health databases play vital roles in creating health records and delivering on-demand health services to authorized stakeholders. Research trends in IoT-based health care include network architectures and platforms, new services and applications, interoperability, and security, among others. In addition, policies and guidelines have been developed for deploying the IoT technology in the medical Field in many countries and organizations across the world.

Improving the efficiency of healthcare infrastructures and biomedical systems is one of the most challenging goals of modern-day society. The entire concept of IOT stands on sensors, gateway and wireless network which enable users to communicate and access the application/information. Be that as it may, among all the regions no place does the IOT offer more prominent guarantee than in the field of health awareness.

I.I WHAT IS THE INTERNET OF THINGS (IOT)

The Internet of Things may be a hot topic in the industry but it’s not a new concept. In the early 2000’s, Kevin Ashton was laying the groundwork for what would become the Internet of Things (IoT) at MIT’s Auto ID lab.

Ashton was one of the pioneers who conceived this notion as he searched for ways that Proctor & Gamble could improve its business by linking RFID information to the Internet. The

concept was simple but powerful. If all objects in daily life were equipped with identifiers and wireless connectivity, these objects could be communicating with each other and be managed by computers.

A System is a way of working, organizing or doing one or many tasks according to a fixed plan, program or set of rules. A system is also an arrangement in which all its units assemble and work together according to the plan or program.
Today, many of these obstacles have been solved. The size and cost of wireless radios has dropped tremendously. IPv6 allows us to assign a communications address to billions of devices. Electronics companies are building Wi-Fi and cellular wireless connectivity into a wide range of devices. ABI Research estimates over five billion wireless chips will ship in 2013.2 Mobile data coverage has improved significantly with many networks offering broadband speeds. While not perfect, battery technology has improved and solar recharging has been built into numerous devices.

There will be billions of objects connecting to the network with the next several years .IoT describes a system where items in the physical world, and sensors within or attached to these items, are connected to the Internet via wireless and wired Internet connections. These sensors can use various types of local area connections such as RFID, NFC, Wi-Fi, Bluetooth, and Zigbee. Sensors can also have wide area connectivity such as GSM, GPRS, 3G, and LTE.

The Microcontroller is connected to Wi- Fi Module (ESP8266) which provides information to doctor/caretaker when the heart rate is greater than 90 or less than 60 and when the temperature is less than 20 or greater than 35. During this time the buzzer turns on and alerts the caretaker. LCD is connected to microcontroller to display the transaction process and healthcare data.
Webpage will automatically refresh for every 15 seconds hence patient health status is continuously sent to the doctor. Hence continuous monitoring of patient data is achieved.

II. IOT BASED SMART HEALTH CARE SYSTEM

Recent years have seen a rising interest in wearable sensors and today several devices are commercially available for personal health care, fitness, and activity awareness. In addition to the niche recreational fitness arena catered to by current devices, researchers have also considered applications of such technologies in clinical applications in remote health monitoring systems. During the last quarter of the century, there has been a tremendous increase in the use of electrical and electronic equipment in the medical field for clinical and research purpose.

In medical instrumentation, the main function is to measure or determine the presence of some physical quantity that may be useful for diagnostic purposes. Therefore, many types of instrumentation systems are used in hospitals and physician clinics .The primary purpose of medical instrumentation is to measure or determine the presence of some physical quantity that may assist the medical personnel to make better diagnosis and treatment. Accordingly, many types of instrumentation systems are presently used in hospitals and other medical facilities.

Certain characteristic features, which are common to most instrumentation systems, are also applicable to medical instrumentation systems. In the broadest sense, any medical instrument would comprise of the following four basic functional components: Measure and Transducer/Sensor, Signal conditioner and display system. Patient monitoring system in all ICUs is the most needed and essential device for monitoring the patient vitals.

As the physicians cannot stay next to the patients for all time round the clock, we go up for the wireless patient monitoring and tracking system, to have a quantitative assessment of the important physiological variables of the patients. Patient monitoring systems are used for measuring continuously or at regular intervals, automatically, the values of the patient important physiological parameters.

This system consists of simple and low cost components that are capable of processing real time temperature, ECG, BP, heart rate and transmitting the same. There exists a demand for such a system, as current implementations are complex to use and high in cost. Our system design aims to provide solutions to the problem encountered in acquiring temperature, ECG, BP and heart rate from the subject, as well as providing remote transmission of the data. The availability of the patient stationary can be possible to make a good hardware and software development is possible.

Technologically, the vision presented in the preceding paragraph has been feasible for a few years now. Yet, wearable sensors have, thus far, had little influence on the current clinical practice of medicine. In this paper, we focus particularly on the clinical arena and examine the opportunities afforded by available and upcoming technologies and the challenges that must be addressed in order to allow integration of these into the practice of medicine.

III. REVIEW OF SMARHEALTH CARE MANAGEMENT SYSTEM USING IOT

Smart health care, that measures users' living conditions and health status using small sensing devices and collecting their data over a network under daily life, is expected as a new

trend. It is getting paid more attention along with the increase of demands of preventive care.

Over the last few years, the convincing forward steps in the development of Internet-of-Things (IoT) enabling solutions are spurring the advent of novel and fascinating applications. Among others, mainly Radio Frequency Identification (RFID), Wireless Sensor Network (WSN), and smart mobile technologies are leading this evolutionary trend.

In the wake of this tendency, this paper proposes a novel, IoT aware, smart architecture for automatic monitoring and tracking of patients, personnel, and biomedical devices within hospitals and nursing institutes. Staying true to the IoT vision, we propose a Smart Hospital System (SHS) which relies on different, yet complementary, technologies, specifically RFID, WSN, and smart mobile, interoperating with each other through a CoAP/6LoWPAN/REST network infrastructure. The SHS is able to collect, in real time, both environmental conditions and patients' physiological parameters via an ultra-low-power Hybrid Sensing Network (HSN) composed of 6LoWPAN nodes integrating UHF RFID functionalities. Sensed data are delivered to a control center where an advanced monitoring application makes them easily accessible by both local and remote users via a REST web service.

The simple proof of concept implemented to validate the proposed SHS has highlighted a number of key capabilities and aspects of novelty which represent a significant step forward compared to the actual state of art.

The current method of monitoring patients in hospitals keeps patients tied to their beds and can be uncomfortable for patients to wear. The number of nurses in the workforce is also expected to decline by 2020, causing strain in an environment where excess pressure can lead to unfortunate accidents happening to patients. The goal of this project was to produce a wireless patient monitoring system that could allow patients to be mobile in their environment.

IV INTRODUCTION TO EMBEDDED SYSTEM

A System is a way of working, organizing or doing one or many tasks according to a fixed plan, program or set of rules. A system is also an arrangement in which all its units assemble and work together according to the plan or program.

An Embedded System is one that has computer hardware with software embedded in it as one of its important components.
Its software embeds in ROM (Read Only Memory). It does not need secondary memories as in a computer hardware.

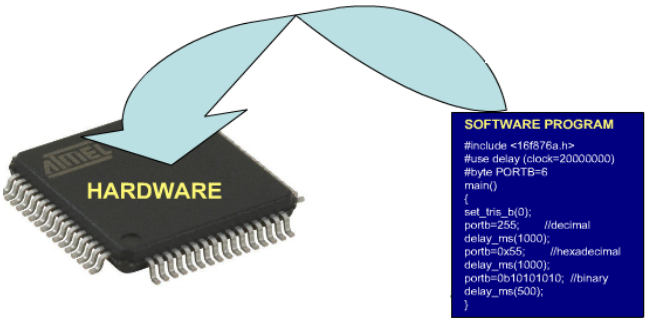

Figure 1: Overview of Embedded System

IV.I History of Embedded Systems

When computers came into the market in the 1940's, they were all Embedded Systems. However, they were never regarded as Embedded Systems because, firstly, they were regarded as computers; and secondly, because they were too large and improper to be formally termed as Embedded Systems.

The Apollo Guidance Computer changed history. It became the world's first modern Embedded System. The Apollo Guidance Computer was developed by Charles Stark Draper. The size of the device was reduced considerably from its monolithic ancestor. However, this increased other risk factors.

Mass production of Embedded Systems began in the year 1961.Ever since; there has been no stopping the production and increase in the use of Embedded Systems.

The integration of microcontrollers has further increased the applications for which embedded systems are used into areas where traditionally a computer would not have been considered. A general purpose and comparatively low-cost microcontroller may often be programmed to fulfil the same role as a large number of separate components.

IV.II why do we need embedded systems?

The first reason why we need embedded systems is because general-purpose computers, like PCs, would be far too costly. Another reason is because general-purpose solution might also fail to meet a number of functional or performance requirements such as constraints in power-consumption, size-limitations, reliability or real-time performance etc. The digital revolution has reached a stage that we cannot conduct our normal modern daily lives without this technology. All sectors of the economy have been influenced by the digital revolution and the industry has experienced tremendous developments in all aspects of engineering disciplines.

IV.III Hardware Classification Of Embedded System

IV.III.I Small scale Embedded System

As the name implies, it is the smallest type of Embedded System which has less complexities in their hardware and software. It requires a board level design. Usually they are designed with 8 or 16-bit microcontroller. 'C' language is mostly used while installing this software. It can be battery operated.

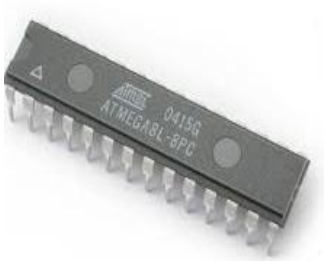

Figure 2: Small scale microcontroller

IV.III.I Medium scale Embedded System

It is designed using 16 or 32 bit microcontroller or DSPs. The software includes RTOS, Source Code Engineering Tool, Simulator, Debugger, and Integrated Development Environment. These things make the software complicated. Software tools also used as solution to the hardware complexities.

Figure 3:- Medium scale microcontroller

IV.III.II Sophisticated Embedded System

Sophisticated Embedded System has an enormous level of software and hardware complexities. Because there is tremendous co-excision between software and hardware and integration in the final system, they are also used for cutting edge applications. Certain functions such as encryption TCP/IP protocol stacking various algorithms and network driver functions are implemented in hardware to obtain great speeds.

Figure 4:- Sophisticated microcontroller

V. PROBLEM IDENTIFICATION

Despite the many benefits and opportunities that result from the use of smart healthcare system using IoT . In this pre dissertation RFID cards in the healthcare sector, smart cards haven't taken over as the default technology in healthcare data management due to several limitations related with their use.

V.I Cost

One of the main limitations is the cost of replacing the existing infrastructure, with smart healthcare system. The current system does not totally fail, rendering the use of modern HIS not an inevitable necessity. The cost of healthcare services is, long term thinking, reduced with the use of HIS and smart cards, but the initial capital required to start such a wide implementation, is too high, making the political and economic decision prohibitive, especially in the middle of an economic crisis.

The lack of interoperability between healthcare professionals and providers is an impediment to the adoption of smart cards. Additionally, the current standardization regarding medical records and health data is not sufficient and this problem must be resolved in order for true ubiquitous healthcare services to be realized across jurisdictional boundaries. These problems in order to be resolved are translated in huge investments and lengthy studies, increasing the already high, implementation cost.

V.II Health data management and security

Problems occur in data consistency, as the use of digital files and management does not guarantee the proper use and accurate filling of medical information. Consistency and accuracy are of paramount importance in smart healthcare system Implementations, and training of the users of these systems is required. It should be noted that the whole point of smart healthcare systems is making the healthcare services delivery simpler and easier and thus systems need to be designed with ease of-use in mind, helping the involved end-users instead of introducing more complexity for the sake of technology advancement.

A point of intense discussions and disputes is private data security. Whether data is to be stored on the smart card or on online servers, what data to be included in the smart cards' memory, what encryption technique to be used, who will have access to what data, and data ownership are just some of the problems that should be handled regarding data security. Several studies have dealt with data security but the high sensitivity and social and political pressure call for a higher level of security reassurance.

V.III Public reaction and new technologies

An obstacle that must be overcome is some involved parties reactions to the implementation of a smart healthcare system. The technical training needed to operate it, the system's high complexity and security concerns, as well as the high transparency of such a system, are just some of the reasons that some healthcare involved parties are adversary to a smart healthcare system adoption.

The benefits and opportunities from the use of smart cards in HIS are overwhelming, but the limitations and drawbacks from a possible implementation are not inconsiderable. Furthermore, a smart card implementation requires the agreement between all those involved: governments, healthcare providers, health insurance companies and the people, and thus demands their right cooperation.

The fact that smart cards are not a new technology, along with the increasing invasion of new technologies in developed and developing countries raises the question if smart cards are the best solution to the problems mentioned.

Mobile smartphone technologies are being adopted rapidly, and may render the use of smart cards obsolete by the time smart healthcare system are fully studied and launched.

VI. CONCLUSION

In this paper, a review on IoT-aware, smart system for automatic monitoring and tracking of patients, personnel, and biomedical devices within hospitals and nursing institutes is discussed. It is very important to monitor various medical parameters and post operational days. Hence latest trend in Healthcare communication method using IOT is adapted. The IoT has a variety of application domains, including health care system. The IoT revolution is redesigning modern health care with promising technological, economic, and social prospects Among others, mainly radio frequency identification(RFID), wireless sensor network (WSN), and smart mobile technologies are leading this evolutionary trend. This paper presents study on smart health monitoring system, technology and security and public acceptance.

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