

IoT Based Health Care System for Blood Pressure Monitoring and Diabetes using ANT+ Protocol

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Abstract- In the Internet of Things (IoT), objects and animals or people are provided with unique identifiers and they can transfer the data over a network. This process does not require any human-to-human or human-to-computer interaction. In health care body area network, it requires low energy consumption. There are several protocols like BlueTooth, WiFi, ZigBee which were used previously, but none of them give superlative results. ANT+ protocol supports the goals of Internet of Things, and easily communicate with other devices like smart phones, smart watch etc. ANT+ architecture is flexible, scalable and robust. The approach is validated on a health care application that integrates blood pressure and diabetes.

Keywords- Internet of Things, Health Care, ANT+ Protocol, Diabetes, Blood Pressure

I. INTRODUCTION

Over the years, the Internet has grown exponentially from a small network to a worldwide pervasive network connecting billions of users. The technological devices have been evolved in a way that makes it possible to expand the Internet into a new dimension. The objects or we call it 'things' can be a smart object which is a cyber-physical system, consisting of a thing and a computer that processes sensor data and creates a link to a wireless communication.[7]

The Internet of Things (IoT) is a scenario in which objects, animals or people are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.[7] The Internet of Things (IoT) is the network of physical objects or "things" embedded with electronics, software, sensors and network connectivity, which enables these objects to collect and exchange data. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit.[8]

The developing countries are facing the healthcare issues which has been always a major problem for the people of the small town/village. The healthcare field is changing drastically the physicians are seeking ways to make

improvements amidst the evolution. We can reach to a new level of accuracy, efficiency and safety by real-time visibility and intelligence into their data i.e. records of the patients, medications, emergency actions, self-health-caring, etc.

II. ANALYSIS OF CURRENT SYSTEM

Internet of Things based health care systems play a significant role in Information and Communication Technologies and has contribution in development of medical information systems. The development of IoT-based health care systems must ensure and increase the safety of patients, the quality of life and other health care activities. The tracking, tracing and monitoring of patients and health care actors activities are challenging research directions.

ANT+ is a proprietary protocol for applications where monitoring operations are desired for a long time with low battery consumption. It divides its bandwidth into 125 channels of width equal to 1MHz and operates on 2.4GHz spectrum with transmission duration less or equal to 150 microsecond/frame for 8bytes of data. It uses special network keys to distinguish different networks. ANT+ provides management of physical, data link, network and transport layers of OSI stack.

The proposed system consumes low power. This system is efficient to send the large amount of data. ANT+ based system sends data in three formats: Broadcast, Acknowledge and Burst. In Burst format, we can send large data by appending the information.

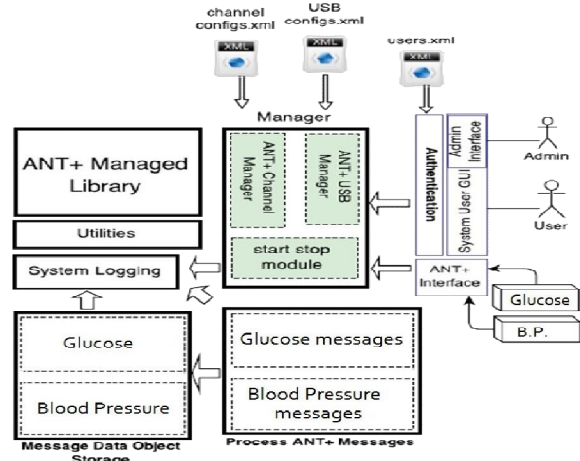
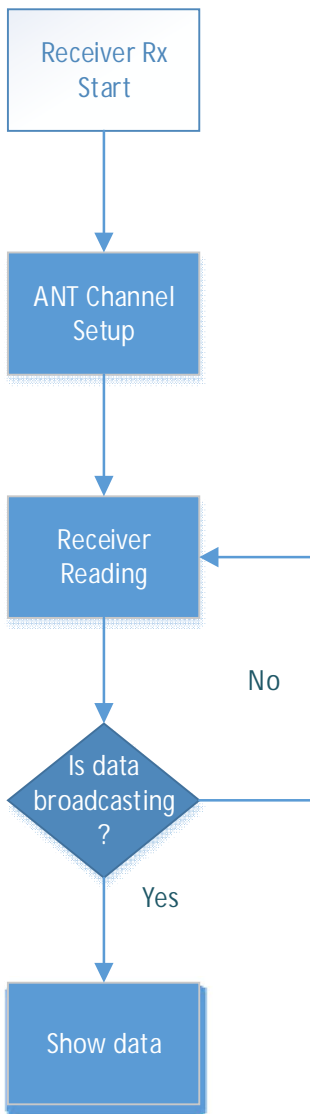


Fig. 2.1: System Architecture

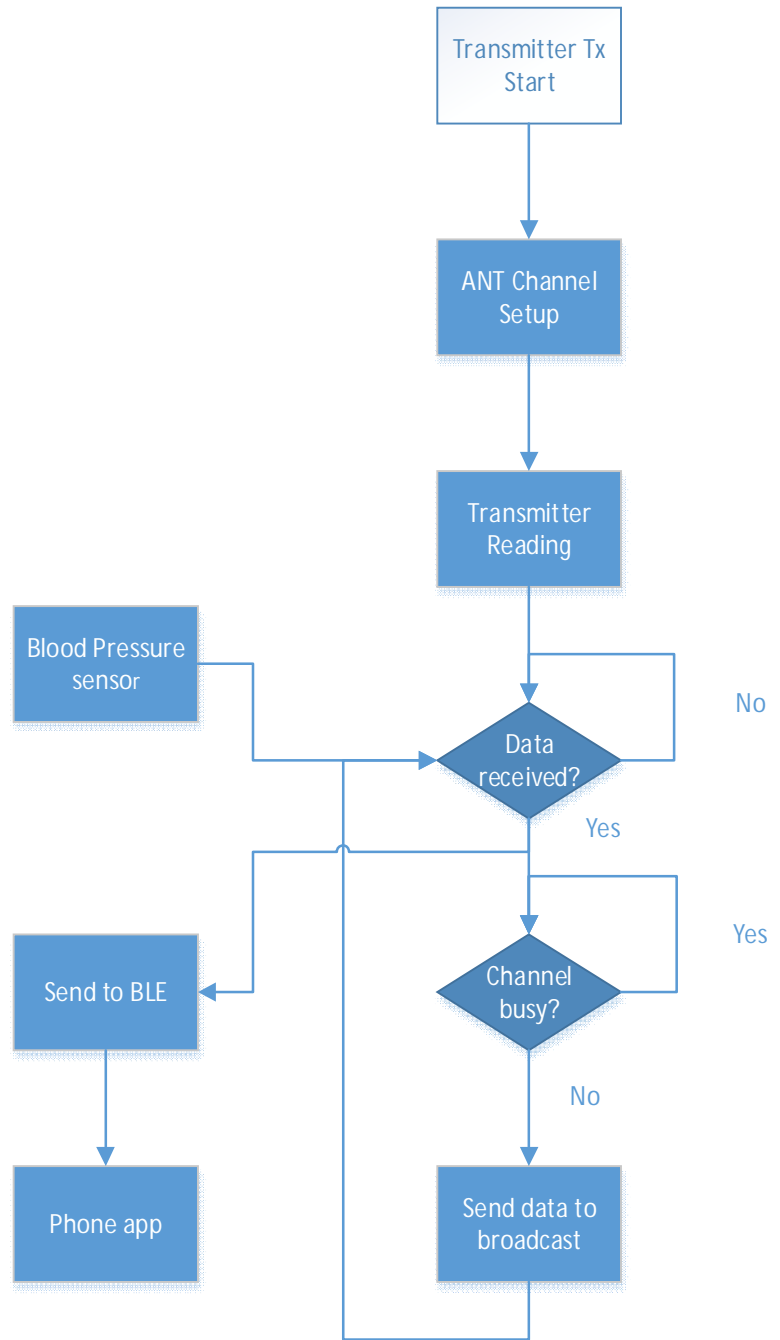
III. PROPOSED METHOD

A. Flowchart

The flowchart of the proposed system:



(Receiver flowchart)



(Transmitter flowchart)

Fig. 3.1: System Flowchart

B. Proposed Solution:

Proposed system provide good quality advice at any place.

The steps in the proposed algorithm are as below:

1. Patient data would be the input of the system.
2. Data is shown to patient.
3. Data is sent to the doctor/care taker.
4. Diagnose result and set up the rule.

C. Tools and Technology:

Research Approach	Diabetes and blood pressure monitoring using IoT
Technology	ANT+ protocol, IoT
Software	Keil, nRFgo Studio, Docklight
Dataset	Blood Pressure data set

D. Advantages:

The consumption of energy in this technology is low. Other protocols (Bluetooth Low Energy, Zigbee etc.) are having low limit of data sending to the other device comparing to the ANT+ protocol based system. Android Smart phone, iPhone, USB dongle, Micro and mini SD card, Adapter boards for open source micro controller all are supported from the ANT+. These advantages make a wider span to use the ANT+ system rather than BLE or Zigbee.

IV. IMPLEMENTATION TOOLS

Keil:

Keil implemented the first C compiler designed from the ground-up specifically for the 8051 microcontroller. Keil provides a broad range of development tools like ANSI C compiler, macro assemblers, debuggers and simulators, linkers, IDE, library managers, real-time operating systems and evaluation boards for Intel 8051, Intel MCS-251, ARM, andXC16x/C16x/ST10 families. In October 2005, Keil were acquired by ARM. [12]

nRFgo Studio:

The Nordic nRFgo Studio is a Windows application that enables engineers to quickly explore and evaluate radio performance and functionality. The application supports a range of radio testing, including output power and sensitivity. Engineers can also easily configure and set-up the tests to match their own specific application requirements. nRFgo Studio is designed to be used in conjunction with the Nordic nRFgo Starter Kit and Nordic nRFgo-compatible development kits. It supports auto detection of Nordic nRFgo motherboard

and radio modules. It also support the nRF51 evaluation kits and programming nRF51 devices through SEGGER J-Link nRFgo studio provides a visual editor for creating GATT clients (Profiles) and GATT Services for the nRF8001 and generating the nRF8001 Setup as a header file. [11]

Docklight:

Docklight is a testing, analysis and simulation tool for serial communication protocols (RS232, RS485/422 and others). It allows you to monitor communications between two serial devices or to test the serial communication of a single device. [13]

V. RESULT AND ANALYSIS

A. Result

Following graph shows the comparison of Mean current consumption for three protocols at different sleep intervals.

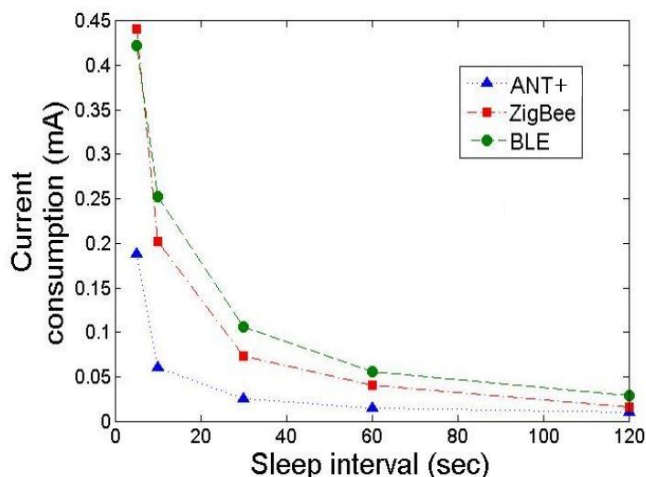


Fig. 5.1: Comparison of Mean current consumption

B. Analysis

Following table shows experimental results using 5 V supply.

	Buetooth	Zigbee	ANT+
Time of one connection ±SD	1150 ms ±260 ms	250 ms ±9.1 ms	930 ms ±230 ms
Sleep Current	3.1 μA	4.18 μA	0.78 μA
Awake Current	2.9 mA	9.3 mA	4.5 mA
Min Current (At 120 sec interval)	28.2 μA	15.7 μA	10.1 μA
Optimal Sleep Interval	15.3 s	14.3 s	10.0 s

VI. CONCLUSION

Internet of Things will connect people in more relevant ways, delivering the right information to the right person or machine, efficiently and effectively. In this paper, we have analyzed different protocols to use an Internet of things based system for healthcare application i.e. Blood Pressure Monitoring. It can be concluded that the ANT+ is the most effective protocol comparing to the others. The proposed system is low power consumed and the data limit to send the information to the connected device is high.

More diseases can be targeted in future. Medical study shows that with heart failure threats, patients also suffer many other diseases like Asthma, Diabetes, Obesity, Depression, etc. The data we send through the devices can be stored to the remote servers for the future study of the patients' health over the time period. For this, our system should be flexible to upload the data to any remote server. This thing can give us a more predictive analysis of the health. To make the wide use of our application/system, we shall make the proposed system accessible from the different platforms.

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