Abstract

Body Area Network has received the true limelight in recent years. When it is connected with internet it is called Biological Internet of Things (BIoT). It is mainly adopted in biological sensor networks. When the number of physical sensors increases, measuring these parameters using BIoT becomes much more complicated and managing the lifetime of these networks is the real challenge among the researchers, because of the reason that every BIoT is operated with a battery. To overcome this obstacle we propose new low power architecture for BIoT called Wake On Reconfigurable Network (WORN) with the application of Distance Effective Adaptive Routing (DEAR) algorithm. To extend the lifetime of IoT devices with the batteries which supports internetworking of physical devices embedded, we implement DEAR in sensor nodes of ZigBee module.

I. INTRODUCTION

Body Area Network (BAN) is the subcategory of Personal Area Network (PAN) which mainly composes of ‘n’ number of wireless sensor networks placed at the different positions of human body. This BAN finds most of the applications in the healthcare - surveillance,
monitoring and diagnosis. Normally BAN consists of simple and powerful central processing unit (CPU) and a transceiver. BAN can be connected with different transceiving techniques. Such as Bluetooth, ZigBee and Wifi. These techniques are nothing but battery powered mechanisms.

The paper is organised as section (1) relative works and (2) mathematical model.

II. WORN (WAKE ON RECONFIGURATION NETWORK) ARCHITECTURE

The WORN is a two tier architecture which is categorized as

2.1. Node Sensing Unit (NSU)

2.2. Node Gathering Unit (NGU)

![Overall Block Diagram](image)

**Figure 2.1: Overall Block Diagram**

2.1. Node Sensing Unit (NSU)

The node sensing unit consist of body sensors which measures the physiological parameters. In this proposed method we use normal temperature sensors, ECG and EMG for monitoring the body parameters connected with the CPU and the transceiver.

2.2. Node Gathering Unit (NGU)

The node gathering unit works on the data collection mechanism from the different sensing units and sends them to the clustered cloud mechanism.

III. WORKING MECHANISM OF DEAR ALGORITHM

Assume NSU(1), NSU(2), NSU(3) are placed in human body for sensing respective parameters.

STEP 1: Initially the NSU’s and NGU are in the deep sleep mode. When the request signal from cloud unit is received by the gathering unit, the gathering unit alone wakes up from sleep mode and enters into the working or functioning mode.
Figure 3.1: Initialisation of NGU

STEP 2: NGU sends the Grant Signal (GS) to the sensing units which upon receiving the signal enters into wake up mode.

Figure 3.2: NSU entering into wake up mode
STEP 3: NSU makes the reconfiguration of the clock frequency using Phase Locked Loop (PLL). It measures the distance; checks for the power and data will be transmitted to the NGU with the principle of power adaption depending on the distance. This can be achieved by changing the MAC firmware using the AT commands.

IV. MATHEMATICAL METHOD

a. For NSU
   - At the initial phase
     \[ E_{NSU(1)} = E_{CPU} + E_{peripheral} \]
     Where,
     \[ E_{CPU} = \text{energy for cpu} \]
     \[ E_{peri} = \text{peripheral energy} \]
   - After receiving Grant Signal
     \[ E_{NSU(2)} = [E_{CPU} + E_{UART}] \times [n] \]
     Where,
     \[ n => \text{no. of bytes received 8 bit data’s} \]
   - At the processing
     \[ E_{NSU(3)} = [E_{CPU} + E_{UART}] \times [n] \times [d] \]
     \[ d => \text{distance between NSU and NGU} \]

b. For NGU
   \[ E_{NGU} = [E_{CPU} + E_{peripheral}] \]
   \[ E_{NGU} = [E_{CPU} + E_{peripheral}] \times [n] \times [d] \]

V. PERFORMANCE COMPARISON

a. NSU with CPU + ZigBee

<table>
<thead>
<tr>
<th>SL.NO</th>
<th>CLK FREQUENCY SPECIFICATION</th>
<th>Power Consumed (Without DEAR)</th>
<th>Power Consumed (With DEAR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>12 MHZ</td>
<td>14.2 mW</td>
<td>13.26 mW</td>
</tr>
<tr>
<td>02</td>
<td>60 MHZ</td>
<td>22.1 mW</td>
<td>21.4 mW</td>
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</tbody>
</table>

b. NSU with CPU + Bluetooth

<table>
<thead>
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<th>SL.NO</th>
<th>CLK FREQUENCY SPECIFICATION</th>
<th>Power Consumed (Without DEAR)</th>
<th>Power Consumed (With DEAR)</th>
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<td>16.8 mW</td>
<td>14.22 mW</td>
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<tr>
<td>02</td>
<td>60 MHZ</td>
<td>24.1 mW</td>
<td>22.4 mW</td>
</tr>
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</table>
VI. CONCLUSION & FUTURE ENHANCEMENT

Though the architecture is similar to the one BIoT normally uses, on application of DEAR Algorithm we can clearly site the change in energy consumption for transmission of data, from and to the transceivers and other components. The same experimental setup can be tested for heterological networks in BIoT environment.

VII. REFERENCES


TO CITE THIS PAPER