Design of 6LoWPAN and COAP Based Health Monitoring System-a Review

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Abstract:- Wireless sensor networks are mainly established in some areas like water treatment, tele-monitoring health care, hospitals etc. These Wireless Sensor Network (WSN) is comprised of miniature, low energy, wireless, smart sensor hubs and massive base stations. WSN predominantly operate in fields where humans can't access. The determining factor of wireless networks is that they work unattended over substantial interval of time. These distinctive characteristics has guided the wireless networks accomplishment in the real time global applications. Wireless Networks are customarily constructed using resource constrained systems that are low price, low operating power and low communication bitrate bearing small scale communications.

In this project, the notions of Wireless Networks have been administered for health monitoring where variables like pulse rate, heart rate and temperature are quantified in remote areas and make it accessible to the doctors. This enables the doctors to examine the variables and determine the condition of the patient and take actions if necessary.

***Keywords*:-** *Internet of Things, 6LoWPAN, sensor nodes, CoAP.*

I. INTRODUCTION

The term Internet of Things (abbreviated as IoT) was named by industry researchers but has broken out into mainstream public view only more recently. Internet of Things is a network of hardware devices, including objects like smartphones, portable medical devices, vehicles, appliances used at home, and more, that connect to and exchange information or data with computers.

Some of the researchers consider the Internet of Things cantotally change the way computer networks will be used in the coming generation, while some people think Internet of Things is overrated and that it won't impact the normal lives of most of the world. But we are able to display some of the advantages and how impactful Internet of Things can be and change everyday lives through its many branches and one of the ways we do that has been described in this project.

II. NECESSITY OF HEALTH MONITORING USING WIRELESS SENSOR NETWORKS

In the current global situation we are seeing lot of healthcare crisis and lack of medical care and attention although it seems to have gained primary focus of concern of life. Healthcare and medical Technology have become more prominent in recent times but the availability and economic constraints hasn't. Advancement has been made in medical technology and healthcare but still we face lot of health monitoring issues. This may be due to lack of medical technology applications and devices which aren't available in India.

Relying on the manufacturers from outside countries and servicing the devices from them costs a lot. Medical treatment and monitoring prices aren't affordable also there are no large scale manufactures of medical devices and rarity in remote areas. The above mentioned issues are major concerns but with development and innovation in the medical engineering technology we can eradicate it. Healthcare facilities are developing and human life being the most important task, continuous and remote monitoring and transmitting of health vitals to hospitals. Doctors can take care of patients with full care in hospitals but when people aren't in hospitals we need medical attention which is tough.

This problem can be solved using wireless communication of the bio-signals to monitor the patients from far. This method is easier and efficient. With wireless communication doctors can be prepared for the patient before admittance to hospital and the vitals are already quantified in ambulance using portable medical devices. This is the age of internet of things.

This project involves various steps like data attainment, calculation, and activation for the health care. It requires the implementation of network to monitor the patient with frameworks like pulse rate, heart rate and temperature sensors. The acquired data from these bio-signal sensors will correspond wirelessly to a hub station, and then coalition to a network sanctioned host computer. The obtained data will be shown ina real time web page.

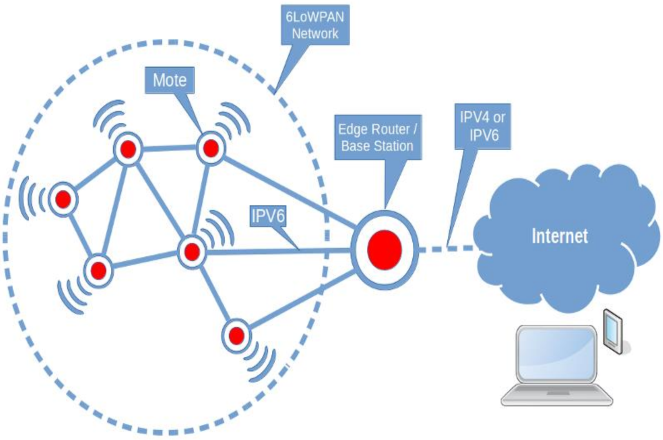

Fig 1:- Working representation of WSN communication

III. IMPLEMENTATION

The above setup is multiple sensor integration of all three sensors. But in order for the multiple sensors to work we need GPIO extension pins. As the Telos B node used here has only 10-pin extension we are implementing single sensor integration which is reconstructed if we need to change the sensors. All three sensors are integrated with the telos module separately considering the desired parameter. Body temperature of the patient was measured. The Output pin of temperature sensor was connected to the ADC pin of the extension pin. The output obtained from the analog to digital converter is fed to the GPIO pin of Telos. Temperature sensor continuously quantifies the temperature of the patient body.
Analog value of the temperature sensor was recieved at the output pin of the LM35 sensor. Output from LM35 pin was sent to telos via ADC pin. Telos module was programmed to do wireless communication of data. Same steps are carried out to obtain pulse rate and blood pressure using the sensors one at a time following the same pin configuration as mentioned above.

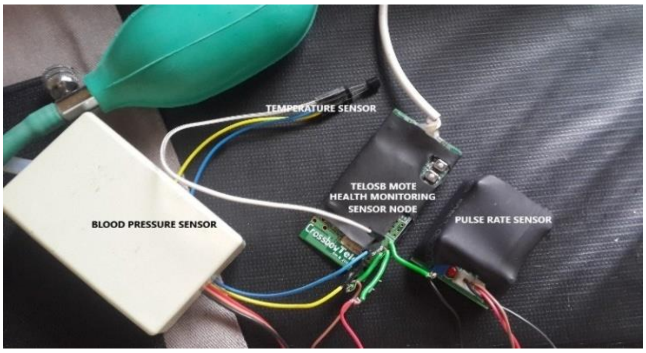

Fig 2:- Working proof of Concept of Health monitoring Sensor Node

Three bio-signals sensors were considered for multiple sensor integration. Pulse rate, blood pressure and temperature sensors were connected to the telos module via the GPIO pins. Pulse rate, blood pressure and temperature sensors continuously quantify the parameters of the patient. Obtained values from the sensors were sent to the Telos B module through GPIO pins. Wireless transmission of data takes place through 6LOWPAN network packet transfer compliant to IEEE 802.15.4 standard.

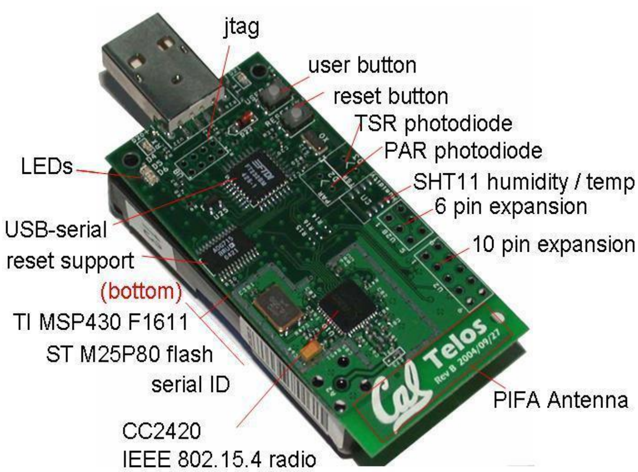

Fig 3:- Telos B mote

We use two TelosB nodes here, one as Border Router and the other as Health monitoring sensor node. The wireless communication happens between these two nodes through CC2420 radio module. The TelosB node has MSP430 microcontroller which runs the program. Border router is set as root to connect different nodes and this is done by Routing Protocol (RPL) for 802.15.4 networks. The C program is dumped to each of these TelosB mote, one to perform Border router operation and the other to perform data acquisition, processing and transfer of all three sensor data.

Fig 4:- Working Proof of Concept of Border Router

The Border router is programmed to set an IPv6 prefix address for the other nodes i.e. our Health Monitoring Sensor node to connect. The border router is connected to Laptop via USB although the actual communication happens through Serial Line Interface Protocol (SLIP) by which the border router is set and it starts sending signal for any nodes to connect to. the Health sensor node with any one of the three sensor is connected to a charging adapter and connected to any plug point. the program is run and the health sensor is set and up todate to perform its operation that is patient vital data acquisition and transfer.

The border router after tunslip operation and setting IPv6 prefix address sets a CoAP server. The nodes run CoAP server managing the monitor able CoAP resources i.e. Sensor data. The sensor resource and onboard sensors can be accessed and CoAP waysare done using the identified CoAP URI. The CoAP application network will be attached to the IPv6 internet using CoAP border router. The set prefix address is copied to CoAP URI and we get the neighboring sensor nodes that are available which is Contiki RPL. Now the route address that is generated in the webpage is copied and pasted in a new tab and we get sensor data outputs.

Health monitoring network comprises of CoAP client motes and web page. CoAP clients can be used for real time access to sensors data, while web server can give access stored data to the doctor and the caretaker.

IV. RESULTS

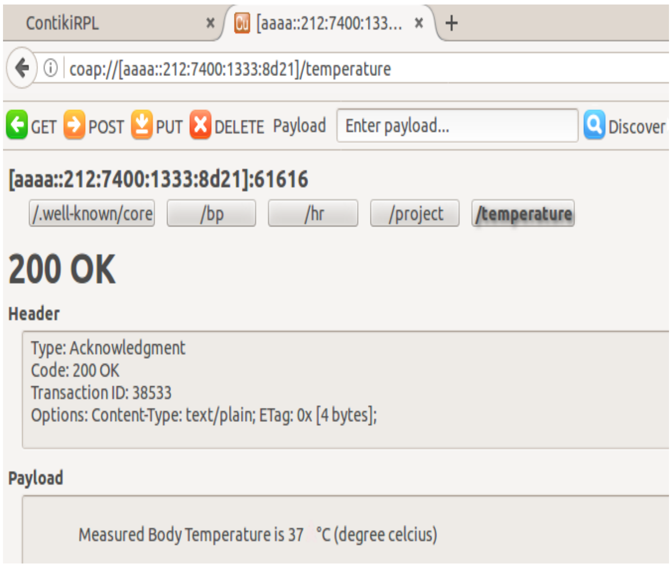

Fig 5:- Temperature sensor monitoring

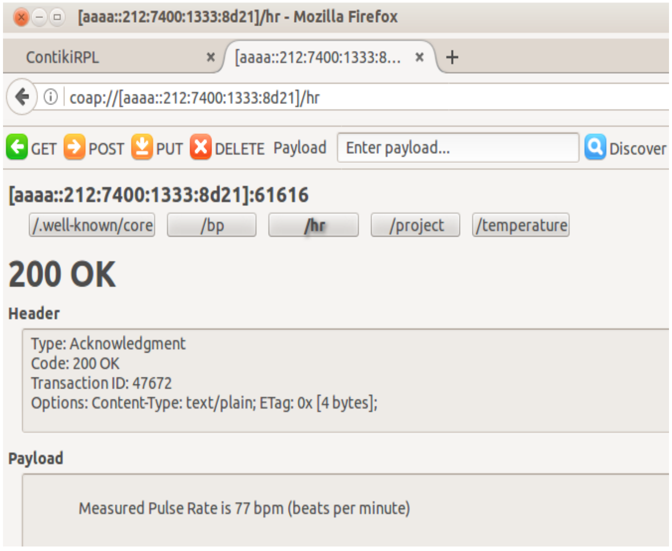

Fig 6:- Pulse rate sensor monitoring

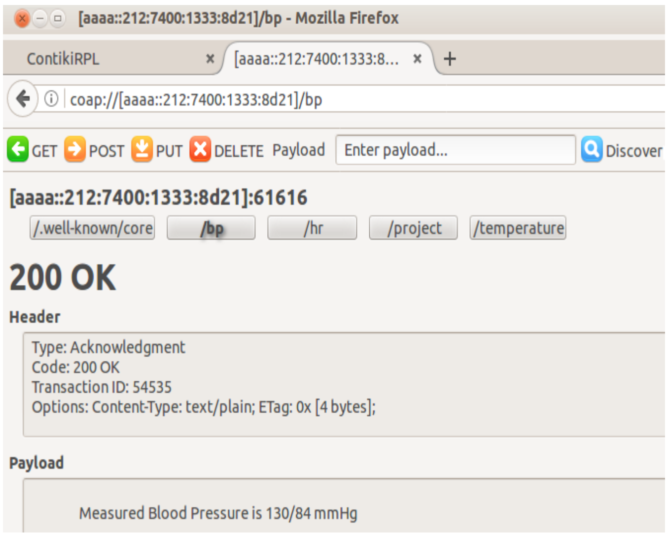

Fig 7:- Blood pressure sensor monitoring

V. CONCLUSION AND FUTURE WORK

The implementation of WSN based IPv6 based Smart Health Monitoring System shown in this project is a proof of concept. The single sensor integration is much better in this system but we can add extra GPIO pins through the 10-pin extension available on TelosB sensor node. The distance that the TelosB sensor nodes can connect and communicate wirelessly is around 100 meters at the line of sight. If there are any obstacles in the line of sight between the two TelosB nodes then its range reduces to 30 meters. The TelosB has an on-board antenna through which it communicates with other nodes wirelessly. By adding an external antenna we increase the wireless communication range. The connection of the TelosB nodes power supply were from either the Laptop or a charging adapter instead of batteries as this is just a proof of concept. It can be made portable by attaching AA batteries on them. If the values or measurements of the patient health monitoring parameters are abnormal then we can send an alert message or call to the official caretaker or nurse or doctor. This project implementation can be done in hospital wards which is cost effective and we can use multiple sensor nodes if range is the liability. Alerting system and actuators such as LED signs or Vibration sensor or buzzers/siren/sound alarms can be embedded in these systems for careful and continuous monitoring of the patient.

If continuous monitoring of patient from far away is necessary we can create a public network where we can host the patient information vital parameters and their database history. For this to be accessed by caretaker/nurse or doctor, they need to have the IP address of the host public network which we have created. Any abnormalities in the patient's vitals can be monitored by sending the doctor an alert. But the issue with public networks is that they can be accessed by any random user and the database can be manipulated which is a risk for patient information safety. Also the cost of creating such huge public networks are high hence private networks are much preferred so that patients can get undivided attention from the caretaker or doctor. Using more sensors and making them wearable can make this system more efficient. Also as we use IPv6 and IoT the communication, scale of healthcare applications is immensely broad, developing and a main concern and responsibility in today's world.

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