An approach towards low cost Wireless Sensor Network for the applications of IoT

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Abstract— The usage of embedded system in our day to day life is expanding rapidly. We rely on technology for our day to day activities, from simple tasks like calculation numbers till performing high end operations like flying a rocket. Technology and embedded system is playing an important role. The next big thing in this filed is IoT or Internet of Things. This technology is nothing but it combines the existing technology to the internet. From small sensors like moisture till home automation devices like remote control Switch, which is connected to the internet making it accessible from anywhere in the world. The basic ideology of the project is to implement a low cost sensor network which will collect the local data via wireless sensor network and upload it on the local server. This local server will be connected to a global server, which can be accessed from anywhere in the world.

Keywords—Sensor network; open source computing; home automation; low power wireless communication

I. INTRODUCTION (*HEADING 1*)

The main objective of this paper is to develop alternate and low cost methods to connect the current devices to the internet. There are certain methods through which these devices can be connected to the internet. One of the methods include which is creating a WSN Wireless Sensor network in which every sensor is wirelessly transmitting the data or the value of that particular sensor connected to it on the server which is collecting the sensor data and storing it on the local server. In these WSN Network various control nodes are available which can also be fixed with relay, through which we can control any type of electrical appliances or any electrical device through the network from local server. The general architecture includes many nodes which are referred as ”child” nodes and the central node which gets all the data from the child nodes called as “Parent” node. There can be multiple parent node also connected to various child nodes. These parent node act as child node to other parent node which collects data from these parent nodes. Once the WSN has been performed, the data can be now transferred using the current base protocols for transmitting the data. Since, we are using NRF, we will follow the protocols issued by standard IoT protocols set by NRF Library and mysensors.org where we can directly find the NRF data sending and receiving methods on conventional WSN networks which are using NRF and Arduino to form nodes. We are currently proposing a system where rather than connecting each and every sensor directly to the internet we are connecting this to the local servers and then connecting, the local server to the global server. This will make the system more reliable and more secure. For local server we are using raspberry pi which is open source and free to use. It provides a more secure and strength connection on the network. Raspberry pi will act as a Server to its child node and collect all the data from the local sensor network and store it in the database. It will parallel update the data of present active sensor network. Through interfaces made in REST API and Node.js, we can make a very easy and user friendly GUI for the user. Who without any technical knowledge can easy operate and use the Technology for fields like irrigation, health and corporate sectors. There are numerous opportunities and applications of this field and technology. The emphasis by this project is given on developing a low power, low cost, open source and user-friendly version of Internet of Things which will make the world more connected and easily affordable for anyone. And making it global to be used in any kind of application and any kind of field.

II. METHODOLOGIES

A. Internet of Things using Arduino

Most of the researches will Use the arduino platform for developing the tiny nodes. Since arduino is low cost and open source, we are also implementing the arduino to form nodes. There are currently various existing controllers on arduino platform each having a different version of flash memory and IO pins. According to our demand in the project the Arduino UNO is the best suited for making the nodes of the sensor since it is low cost and easily available. Also the SMD version of the node will consume less power which can last up to 6 Months depending upon the type of battery power supply given. Also the Analog pins which are available on the controller are enough for the need of the project making it best suited to make tiny nodes.

B. Using NRF24l01

The nRF24L01 is a single chip 2.4GHz transceiver with an embedded baseband protocol engine (Enhanced Shock Burst), designed for ultra low power wireless applications. The nRF24L01 is designed for operation in the world wide ISM frequency band at 2.400 - 2.4835GHz. An MCU (microcontroller) and very few external passive components are needed to design a radio system with the nRF24L01. The nRF24L01 is configured and operated through a Serial Peripheral Interface (SPI.) Through this interface the register map is available. The register map contains all configuration registers in the nRF24L01 and is accessible in all operation modes of the chip. The embedded baseband protocol engine (Enhanced ShockBurst™) is based on packet communication and supports various modes from manual operation to advanced autonomous protocol operation. Internal FIFOs ensure a smooth data flow between the radio front end and the system's MCU. Enhanced Shock- Burst reduces system cost by handling all the high-speed link layer operations. The radio front end uses GFSK modulation. It has user configurable parameters like frequency channel, output power and air data rate. The air data rate supported by the nRF24L01 is configurable to 2Mbps. The high air data rate combined with two power saving modes makes the nRF24L01 very suitable for ultra low power designs. Internal voltage regulators ensure a high Power Supply Rejection Ratio (PSRR) and a wide power supply range. This ultra Low power consumption and low cost makes the NRF very suitable for using in the WSN technology, since it will make the whole structure more cheaper and fast to implement

III. Raspberry pi as webserver

A Raspberry Pi is a small computer that uses an ARM 11 processor running at 700MHz with 512MB RAM. A Raspberry Pi uses much less power than a PC, and takes up much less space. The fully featured Linux operating system comes with lots of software, including the Apache web server which is used to host some of the world's biggest web server. Also it is open source which makes it really affordable and usable when it comes to public use. There will be a webpage made in technology using HTML5, PHP and JavaScript which will concurrently updated itself in every time lapse and display the data being collected by the raspberry pi from the local WSN. This data is used to plot graph on the webpage. The advantage of making the webpage is that it can be seen from anywhere in the world using the IP of the raspberry pi and easy accessible from anywhere in the world. This webpage will show the data of the sensor along with the controlling buttons which will be used to control the devices and appliances connected on the local network. These buttons will be present on the GUI which when clicked will send data to the particular node with the node id and turn that particular device on and off. And since this can be accessed from anywhere in the world, it is easily accessible from any computer, tablet or any handheld device.

IV. Proposed System Archtechture

The current proposed system architecture is explained using figure 1. In the figure, as we can see, there will a mesh of sensor network where there will be tiny nodes connected to the sensors and they will transmit the data on the raspberry pi using NRF trans-receiver which works on 2.4 GHz. Now the raspberry pi can be made available on the global network using internet.

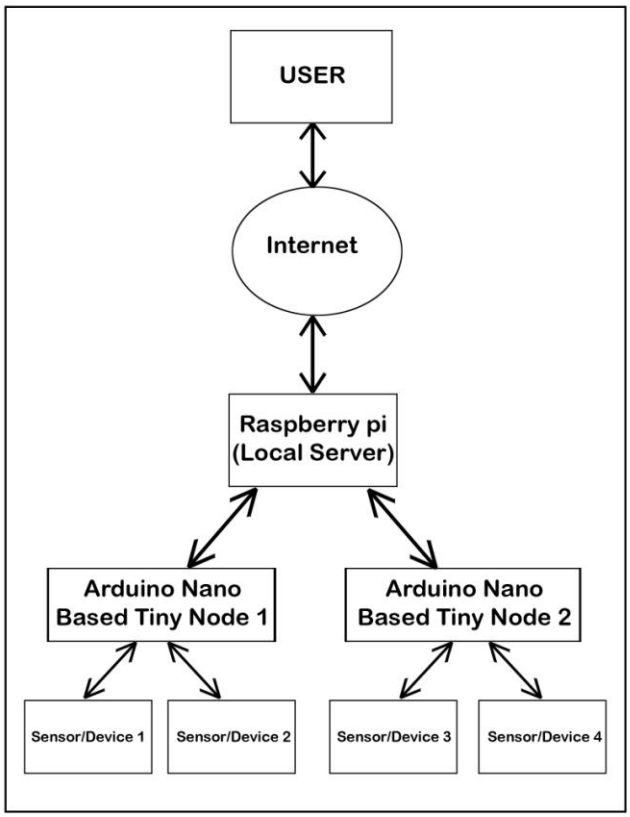

Fig. 1. Block Diagram of Internet of Things using Raspberry pi

The main advantage is that there is no need to attach a dedicated controller for every single sensor. The Arduino Uno has 8 ADC pins i.e. we can connect 8 sensors of different types on a single node and 14 IO pins through which we can send and control over 14 different appliances and devices. Making it to cover maximum area and multiple number of sensors. This advantage will also make the whole architecture cheap to implement.

The architecture for transferring the data we are using is in pipelined architecture based on timesharing basis. Where the parent node will collect the data from its child nodes one by one at a time on time sharing basis. The GUI on raspberry pi will be designed in such a way that it can easily identify the new nodes attached in the network. It will then assign the address to each node which will be saved into their EEPROM. So that whenever the node goes in sleep mode, and comes back to working mode, it will automatically identify itself in the network and distinguish from other nodes.

The controlling system in the nodes will act as same, the phase of the nodes will be in transmitting as well as listening mode concurrently, when a node wants to send the sensor data and also take the data from the parent node for turning on any relay, then when the parent node gives the time sharing to that particular node then it will first send the data and then listen to the data. Once it is finished, then the parent node gives the time to the other following node covering each node of the network and then starting again.

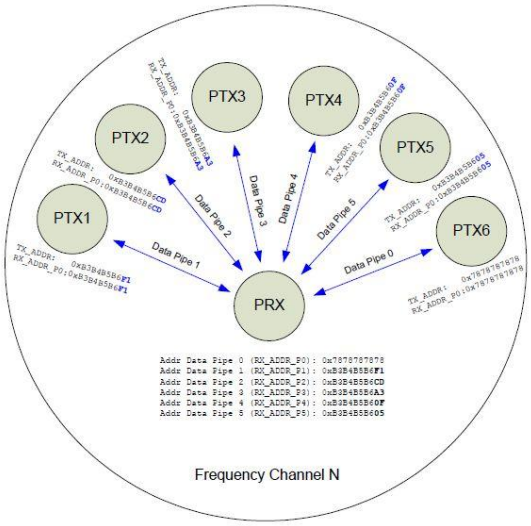

Fig. 2. Pipelined Architecture

As shown in Fig. 2, the pipelined architecture which we are currently going to use in the system. The central node will be responsible for assigning the addresses to its child nodes which will send the data to its parent node in timesharing basis. The addressing will be permanent in that particular network area. It will help to distinguish itself from other nodes.

V. Evaluations

To evaluate the current system architecture, we can use SMD version of the peripherals used in the present system which will make it more cheaper and rate cut off on the present system will be up to thirty percent. The SMD of Arduino UNO and NRF will cut down the whole cost. Also multiple servers can be connected to form a meshed network and a dedicated central server can be made which will collect the data from the various raspberry pi present in different regions of the world. The dedicated server must be capable of handling the data coming from various raspberry pi servers and managing the data properly. In this way we can get a reliable kind of network for all types of applications including medical, irrigation, forensic, environment monitoring etc. Also this will be proved to be the cheapest solution for creating a global wireless sensor network.

VI. Conclusion

In this paper we have explored the various possibilities of creating a reliable and low cost solution for implement the Wireless Sensor Network. We have explored the methods of creating a low cost server which can collect the data from the local servers and upload it to the global server or itself become the global server. The easy interface design and ease to access makes it more secure, reliable and secured. Since it runs on Linux architecture, types of attacks on the network is useless making it more stringent and secured to the use. There are many multinational companies which are currently working on Internet Of Things who are currently exploring numerous possibilities of achieving the task. Heavy researches in various companies, countries and organizations are going on this current technology. The day is not far where our tiniest things like refrigerator, toaster, oven etc. will be connected to the Internet. And they will become smart enough to help you in day to day activities making the world a better place to live.

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