

# Development of M2M framework integrating short range wired and wireless protocols for home automation system

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**Abstract**—Home automation is one of emerging application domains of the Internet of things and M2M. Many home automation technologies are already available, they are basically designed for signal-family homes automation with a very costly, and along with the constant growth of digital appliances in home automation. Due to the large diversities of the M2M applications (e.g., home automation, smart grid, wireless and short wired sensor networks, etc.) and M2M devices, various wireless network technologies (e.g. Zigbee, Wifi, Bluetooth, etc.) are likely to be applied jointly to effectively support M2M applications. However, the heterogeneous network technologies combined with the low-power machine devices and diverse Quality of Service requirements of M2M applications present big challenges to the design and implementation of wireless M2M network protocols and algorithms.

In this paper, we present a Development of M2M framework integrating short range wired and wireless protocols for home automation system, and interconnection which easy extensible *and* fit for future demands. Through subscribing services of the IOT and M2M communication. We focus on the overall Home automation framework, the features and architecture of the components of Home automation, the interaction and cooperation between them in detail.

**Keywords**— Home automation, Machine to Machine communication, Internet of Things, gateway, sensors, short range wired protocols, wireless protocols

## INTRODUCTION

The Internet of Things provides connectivity for anyone at any time and place to anything at any time and anywhere. With the advancement in technology, we are moving towards a society, where everything and everyone will be connected. The IoT is considered as the future evaluation of the Internet that realizes machine-to-machine communication.

Smart Home is one of the emerging application domains of The Internet of things M2M Communication. which is the third wave of the global Information Industry. The Internet is continuously changing and evolving. The main communication form of present Internet is human to human. The Internet of Things (IoT) can be considered as the future evaluation of the Internet that realizes machine-to-machine communication(M2M) learning. IoT's main applications are (i) Smart Health (ii) Smart Transport (iii) Smart Home, etc. So here how the things can make smart? Today, we are seeing the electrification of the world around us. Almost any manufactured good now includes an embedded processor, along with user interfaces that can add programmability and deterministic “command and control” functionality. The embedded processing and controlling are the keys to making objects “smart”.

## M2M COMMUNICATION

M2M Communication is one type of technology that allow wired and wireless both systems to communicate with other devices of the same type.

The M2M system consists of three main domains: M2M Device, Network, and Gateway and includes the following key elements:

**M2M Device.** A device capable of replying to requests and notification and capable transmitting data contained within those devices autonomously. A device is capable for accept the request and send the notification to the server through network.

**M2M Area Network.** A network providing connectivity between Server and Gateways and Devices. Examples of m2m Area Networks include: Personal Area Network technologies such as ZigBee,Wifi, Bluetooth; and local networks such as serial communication through serial cable.

**M2M Gateway.** Gateway is The main components of the M2M Communication system.Gatways capabilities to ensure that M2M Devices interwork and interconnect to the communications networks or server.

## HOME NETWORKS

Home networks are used to monitor and control various devices in the home. Wireless technology and Serial communication technology that has evolved from automated home control, is mainly used to automatically monitor and control home appliances and security. Many wireless protocols are available but Zigbee is a proximity wireless technology for home use. It is compatible with IEEE 802.15.4, a wireless technology standard for low-bitrate, low-power consumption wireless networks, known as Wireless Personal Area Networks. Hence, Zigbee is beginning to resemble wireless communication technology for sensor networks. While there are other similar proximity wireless technologies, such as Bluetooth, Wifi, Zigbee is slower and thus consumes less power. Because of this feature, it is mainly used for periodic transmission of electricity.

## PROPOSED SYSTEM ARCHITECTURE

Proposed System Architecture Mainly consist the following components as show in Figure. 1.

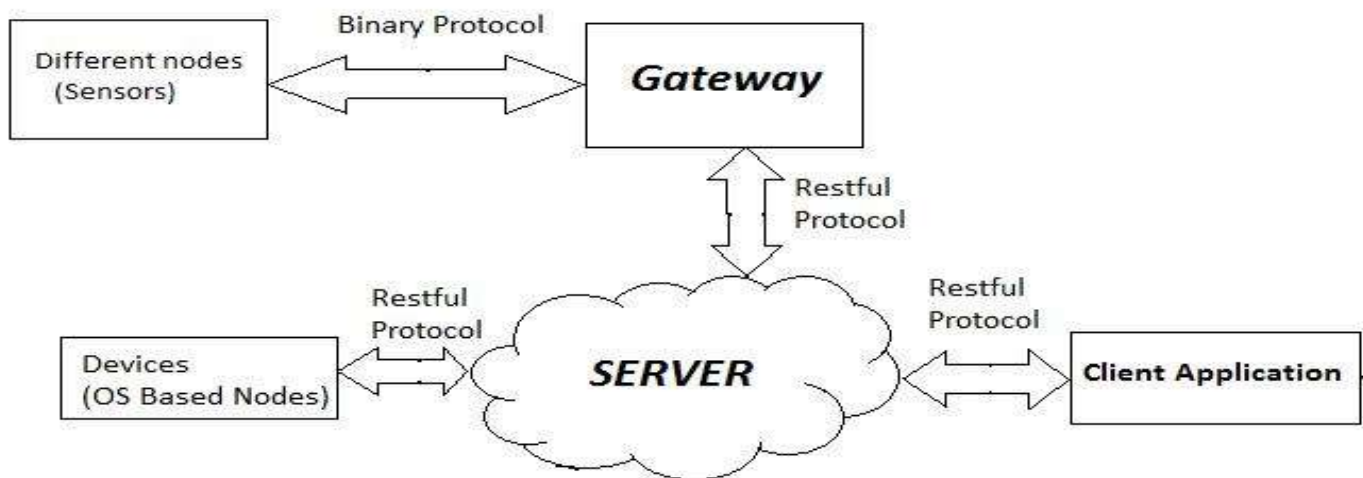


Figure.1 Block Diagram

- (i) Different nodes (sensors, actuators, etc.)
- (ii) Gateway (Raspberry pi b+)

(iii) Server (Device Hive Api)

(iv) Client Application (PC)

In Figure.1 Block Diagram As shown in figure the system architecture is having one or more nodes as per the application. Now here the main problem is the connection of different nodes to the gateway. So here I am using Raspberry Pi B+ modules as the gateway which has support of usb, serial port, LAN. Which is basically connects the node via different protocols. The main challenge for me to connect the non-os based component to server. So the gateway is used as a middleware and using which I am going to connect the nodes to the server with JSON object. JSON is used for the conversion of the Binary APIs to the Restful APIs. So it can directly understand by the server now.

Whereas the nodes having inbuilt operating system can directly communicate with the server. Now the server can communicate with the nodes using HTTP or any kind of Restful APIs. At the Client Application right now I am going to use the Personal Computer so the management and control the flow. The system started with the connection of the gateway with the server.

The gateway is the heart of the system because it mainly concerned with all the registration of devices and application to it and it transfers the same to the server. So the gateway maintains a database of registered devices and passed it to server. Using this client application is sending the information in forms of command to server which is again send for the device with its registered Id. As the response the node device is responding. As discussed earlier the command and/or data is converted to binary format from restful data objects using JSON and the vice versa. So in such a manner as discussed above the system is going to work.

## **DESIGN & IMPLEMENTATION**

For suggested system I am going to use the Device Hive Framework. Device Hive is he open source for the development of the IoT application. It will have support for architecture such as X86, Arm, etc. Device hive is the framework which is going to provides different language support for the coding purpose like C/C++, Java, .net Framework, etc. I am going to use the C++ Framework of the Device hive. Device Hive C++ framework provides many Basic Tools for the application development i.e., coding part and also provides many debugging tools as well. Now they also provide the sample codes and a brief documentation of the data structures and APIs.

## **GATEWAY**

Gateway is the main component of proposed system. As the gateway I am going to use the Raspberry Pi B+ module. This module is used because it gives various communication protocols like USB, HDMI, LAN, etc. Using USB wireless LAN adapter even one can connect it to Wi-Fi. The processor it has is the ARMv11 which also supported the Linux Based OS like, Raspbian, Puppy Linux, Archlinux ARM, openSUSE, etc. As mentioned in the last section the gateway is the bridge between the low level nodes and the server.

## **SERVER**

Server is used in the system to connect the different nodes over the internet. Here all the nodes are registered using the gateway to server. So server can communicate with nodes via gateway if they are non-OS based. Otherwise the server can directly communicate with them using the Restful api. I am going to use the Server which is provided by the Device Hive Framework itself. I have to just login to its play ground and I can access the Server provided by the Device Hive. And also receive the notification and requests get server through gateway. and here we can also give the command and we handle whole the process through command.

## **DEVICE**

Here the Nodes can be any types of sensors, actuators or any board with the capability of data collection and transmission. Here we using the MSP430G2553 board. This module is used because this module is in ultra low power applications. And this module supported many sensors and nodes so the server's information and data notification sends to the gateway. this data is binary form and gateway is converts data binary to restful api and gateway send data to server. For the case study of home automation system and so here we can any best sensors for the current most need for home automation system.

## IMPLEMENTATION RESULTS

Here Gateway is the main component of proposed system. Here we use raspberry pi B+ module as a gateway as shown in figure. And we also connect raspberry pi B+ with MSP430 board connect through uart wired serial communication. Raspberry B+ module also connect to PC through HDMI to VGA cable. and also give the 5V power via USB power supply to the Raspberry pi and MSP430 both module. Raspberry pi B+ module also connect to the Ethernet LAN cable for internet server connecting purpose. Here Gateway is the bridge between the low level nodes and server. Also the registration and the conversion of data from binary to the restful api are done on the gateway only. Here we also communication raspberry pi to zigbee module for wireless communication same method.

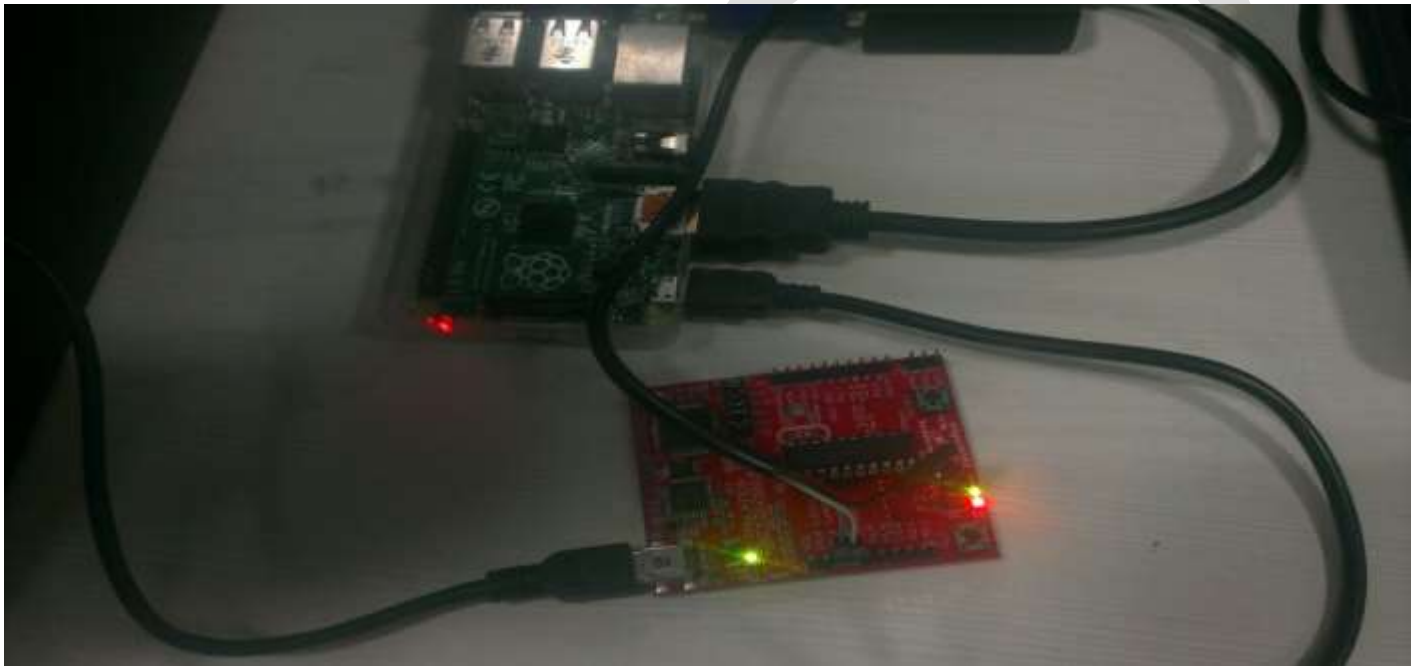


Figure 2. Connection between MSP430 and raspberry pi B+ via uart

## OUTPUT ON SERVER

After successfully registration gateway gives response to the devices. and then start communication between server and device. in this simple basic LED blinking code start give notification and command in shown in below figure 3. here we can see there are three options are available first equipment is describe registers devices on server. and second notification option is shown in below figure. That option is showing the devices notification in server side. and last one option is commands. In that option we can also give the command and we handle whole the process through command.

equipment notifications commands

enter new command

name	time	parameters	status	result	
UpdateLedState	03/20/2015 17:31:57	{"equipment":"LED_R","state":true}	Success	"OK"	copy
UpdateLedState	03/20/2015 16:32:29	{"equipment":"LED_R","state":false}	Success	"OK"	copy
UpdateLedState	03/20/2015 16:23:12	{"equipment":"LED_R","state":true}	Success	"OK"	copy
UpdateLedState	03/20/2015 16:22:56	{"equipment":"LED_G","state":true}	Success	"OK"	copy
UpdateLedState	03/20/2015 16:22:36	{"equipment":"LED_G","state":false}	Success	"OK"	copy
UpdateLedState	03/20/2015 16:22:27	{"equipment":"LED_G","state":false}	Success	"OK"	copy

Figure 3. Result On server

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#### CONCLUSION

As per my research and the related works till now, I can conclude that As M2M devices achieve more market penetration; in future. we will see smart home networks with devices numbering in the hundreds or more. There will be no single physical layer solution that fulfils all of the power, distance, and data rate requirements in the smart home network. Instead, multiple physical layer protocols will be used throughout the smarthome, and it will be necessary for the protocol stacks to communicate with each other. The gateway is most important and responsible components for integrating the home networks. It will facilitate communications between devices that were previously disjoint and provide the homeowner with a convenient interface for network management through server. Our main aim is this article is to reduce the cost of smart home automation in the aspect of hardware and provides the high quality of service through internet of thing and M2M Communication.

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