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Framework Development in Home Automation to Provide Control and Security for Home Automated Devices

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Abstract

Background/Objectives: Home automation has been a booming field in the development of a modern home. The innovations and technology improvements have widely contributed to implementing smart home systems. **Methods/ Statistical Analysis:** In this paper appropriate sensors are used to detect room temperature, movements in room, light intensity and gas leakage through an ARM Microcontroller. The sensed data's aretransmitted directly through WiFi to a webserver. **Findings:** The webserver monitors and to controls the home appliances light, fan, alarm and motor remotely. Communication can be done by 6Lowpan protocol which is an IPV6 protocol for low power wireless area networks.To utilize Constrained Application Protocol (CoAP) for application level communication and Datagram transport layer to provide energy efficient security features. The proposed framework provides monitoring, control and security features for the entire home automation network. **Conclusion/Improvements:** The proposed framework provides a secured Home automation system design.

Keywords: CoAP, DTLS, Home Automation, 6LoWPAN

1. Introduction

Internet of Things (IoT) is the system of physical items or "things" installed with gadgets, programming, sensors and integration to empower it to accomplish more noteworthy esteem and administration by trading information within a network and other joined gadgets. Everything is extraordinarily identifiable through its installed processing framework and also has the capacity to interoperate inside the current Internet foundation. IoT is required to offer high level network of gadgets, frameworks and administrations that goes past machine-to-machine interchanges (M2M) and spreads an assortment of conventions, areas, and applications. IoT has been effectively utilized in various management networks like healthcare, where the blood pressure, heart rate and other can be monitored regularly. Similar to the IoT provides lots of innovations in home automation systems. In home automation IoT plays a major role by monitoring the room conditions and also to control the devices from a remote location. IoT's have opened a new gateway towards the advancement in technology and communication networks. Tremendous rise in clients of Internet and changes on the internetworking technologies has empowered systems administration of ordinary items. IoT allows the machine to communicate between them also with human interaction enabled. Thus a unique system of ubiquity exists within the network of communication. The advancement is not only in the control and monitoring of a network but also in the process of stor-

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ing all the regulated information and communication for future review. The IoT works here as, sensors are utilized to gather the relevant data of its surroundings. This information is passed to a cloud platform by a microcontroller which is able to transmit values generated by the sensors to the cloud platform for monitoring purpose. The devices in the home are controlled from a remote location from the monitored data available. The security is a key concern arises when large number of communication and data transmission is involved for which a security feature is added for providing a secure connection between the devices and the control administration.

In[1] proposed a remote home server which is identical to the dynamic DNS where the dynamic variation in ip address for the devices is same but different in the way of key administration. In[2] examined the security dangers faced in the adaptation layer of 6lowpan stack during the process of the packet fragmentation and proposed a method against this technique of threats by adding a timestamps and nonce options to the fragmented packets. In[3] proposed a tcp header compression for a multihop scenario in 6Lowpan. Trail results have demonstrated that if tcp compression is high for greater the deviation between the tcp sender and the edge router, energy proficiency is achieved. In[4] proposed the methods to use 6LoWPAN in IPv4 network. Therefore it is expected that these methods can make the IPv4 nodes in the Internet have access to the 6LoWPAN sensor network. It means that these methods can survive in the real field as a makeshift solution until IPv6 perfectly substitutes IPv4. In[5] introduced the prerequisites of home automation frameworks and asses the capabilities of IoT compared to earlier machine to human interaction. The migration towards low cost advanced equipments has given way to lot of security scope and increase in the number of connective features of the devices. In[6] proposed a smart home scheme to regulate home devices using IPv6 and IPv4 address. The advantages they offered is high address space, easy interfaceablity with cloud platform and also to conserve energy. This scheme also dispensed the need to have devoted customer software for every client and ideally expand the appropriate rate of buyers. In[7] described a point by point wireless sensor nodes where the answers to use IP address with WSNs were discussed. Also proposed in that the Management of constrained networks and devices (COMAN) which perceives a device's constraint, their management and the networks employed to recognize its respective utilization cases of constrain systems and the kind of network in[8] proposed interoperability at the application level and gave a novel way to deal with a proficient, extendible and brilliant, web administration utilizing CoAP as web protcocol. Further a calculation for a proficient PUSH plan has additionally been proposed and assessed. In[9] developed a web oriented application structure into a fully fledged, web based intelligent house network. The Ipv6 protocols for low power wireless area network were utilized to improve the usefulness of the structure with specifically web-controllable sensor devices. It was also concluded that by HTTP caching, and using web innovations the wireless sensor nodes can enhance execution through wide scale integration with ensured interoperability. In[10] proposed the Step Parent Node (SPN) calculation into the hierarchical routine (HiLow) to unravel the path recovery in 6LoWPAN framework. A step parent request hub message (spn_request) will be telecast from the child hubs to the neighbor hubs. The neighbor hub which has the current number of child hubs that is short of its Maximum Child (MC) value will unicast a step parent hub reply message to the spn_request sender. The power of proposed path recovery of SPN calculation will give a manageable association along the 6LoWPAN routing way. In[11] presented an efficient 6LOWpan stack to provide IPv6 addressability and integration on a profoundly constrained CC430 based wsn. Overcame the restrictions for the 6LOwpan in constrained environment by adding additional features to the stack. A progressive routing protocol could show an increase in system reach ability. In[12] provided a study that utilizing an open source contiki which is a OS embedded and a protocol named Simplicitt allows toarrange sensor network to access through IPv6. Consequently makes it possible by internet association for a cell phone to manage any hub in a subnet. The protocol by[13] is intended to arrange the communication in the setting of home automation, however can also be reached out to more extensive systems for bigger zones and more differing arrangements of gadgets . IT characterizes a focal node to permit the client to control the gadgets communication just from PC or cell phone, in nearby or from the internet. IoT also provides a plug and play network for new gadgets for a simpler setup by client. In[14] proposed a various sectored directing of home 6Lowpan system, with thought on functional home situation. A mapping table was added to take out any error because of the topology, where the 16 bit location was mapped to EUI-64 bit address. To expand the routing effectiveness neighbor

hubs were included furthermore distinctive way recuperation measures embraced to diminish path recovery costs and to enhance system dependability.

2. Working Methodology

The working methodology involves three phases: Real time sensor values updating in cloud platform, Displaying and control of appliances using webpage and finally providing security to the network system using 6lowpan protocol. To detect room temperature we use temperature sensor, for light intensity estimation a light detector resistor is used, for determining gas leak a gas sensor is employed and for motion detection a PIR sensor is employed Figure1.

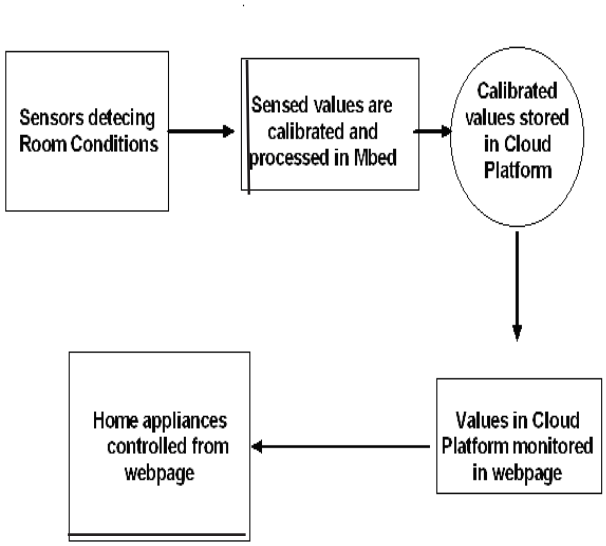

Figure 1. Block diagram.

2.1 Real Time Sensor Integration with Cloud

The values of the sensors is measured and given to analog inputs of the Mbed board. The Mbed consists of four Ethernet pin connections which have two receive ports and two transmission ports. For the purpose of transmission the Ethernet jockey is connected to this particular set of pins. The wires in Ethernet cable 6,3,2,1 are given to RD- , RD+, TD- and TD+ of the Mbed board. Xively is a cloud platform where. The values can be uploaded simultaneously and also monitored. It generates an API key and also a Feed ID key which is we use in our Mbed compiler to update the sensor values in Xively. Xively platform displays the log details of the sensor values being updated simultaneously. The standard graphs are also generated using the xively platform by which the variation can be plotted simultaneously. The Application peripheral interface key generated by the xively effectively points the http request to GET the value taken as output from the sensor interface devices. The Feed ID is used to take the feed values of the sensors into the xively as a network of streams with an interval predefined by the host. The sensor host name is given by the host or can be created in the xively platform for denoting a stream values obtained from a sensor Figure 2.

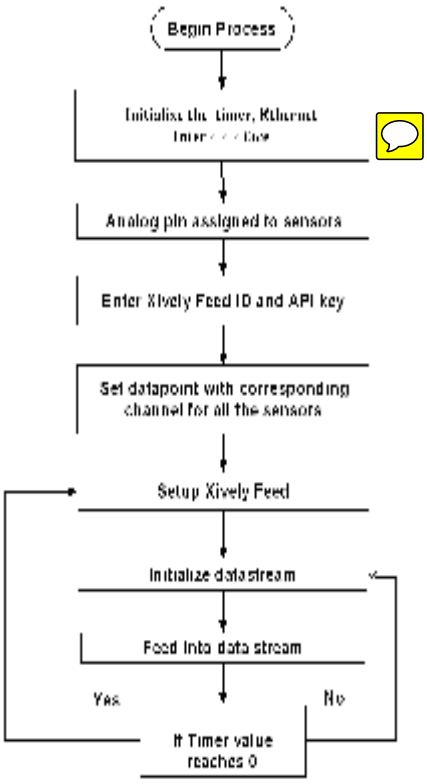

Figure 2. Real time sensor integration with cloud.

2.2 Control of Home Automated Devices

The programming language used for generating a webpage is HTML coding. The HTML coding should be given within the Mbed Compiler program. The library files are added to the program. Remote Procedure Call (RPC) is used for the process of transmitting the required command for the controlling of the appliances. The rpc commands are executed by the server through the HTTP.

Figure 3. Webpage generated.

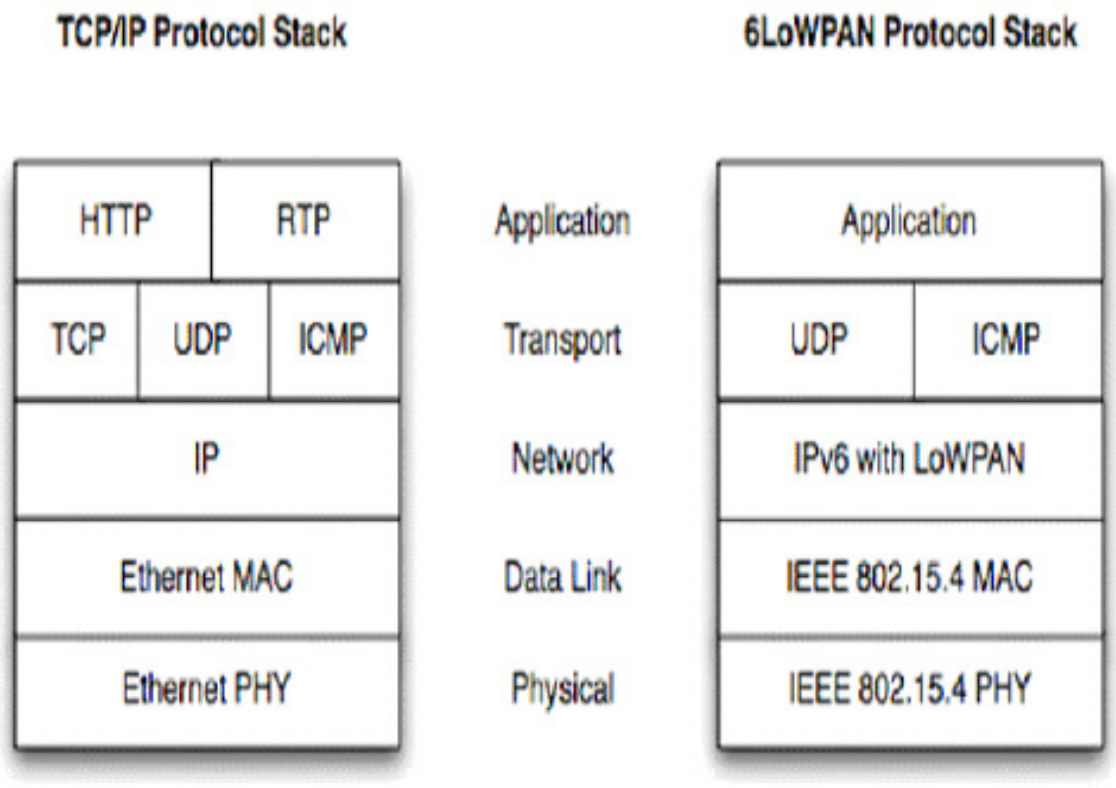

Figure 4. 6Lowpan stack compared to TCP/IP stack.

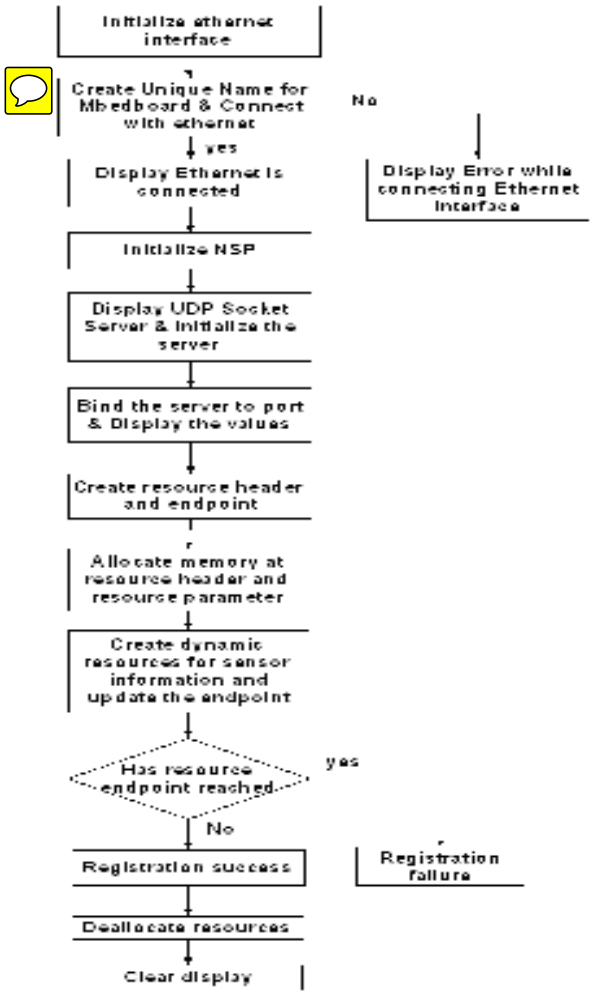

Figure 5. Flowchart of the 6Lowpan implementation.

The procedure involves where the generated IP address is used to open the webpage and control the appliances present within the room. The various approaches are Figure 3.

Approach 1: The temperature sensor detects the temperature value and stores it in cloud, the link in Webpage shows us the room temperature so we can decide whether we can switch on the fan in our room.

Approach 2: The LDR sensor determines the light intensity of the room by the generated values, we control the on and off function of light inside a room.

Approach 3: The PIR sensor detects the movement in a room and if the radiation from the physical component varies rapidly, the electronic values generated are displayed in cloud which helps us to control the alarm.

Approach 4: The gas sensor values displayed alerts if there is any gas leakage or smoke due to any fire damage inside the home.

2.3 Implementation of 6Lowpan

6LOWPAN is an Ipv6 protocol for low power wireless area networks. In order to provide protocols to low power devices with restricted processing abilities for them to take an interest in internet of things 6Lowpan protocol stack was deployed.

A Low PAN is the gathering of 6LoWPAN Nodes which impart a typical IPv6 location prefix (the initial 64 bits of an IPv6 location), implying that wherever a node maybe in a hub in a Low PAN its IPv6 location address continues as before Initially the ip address is veri-

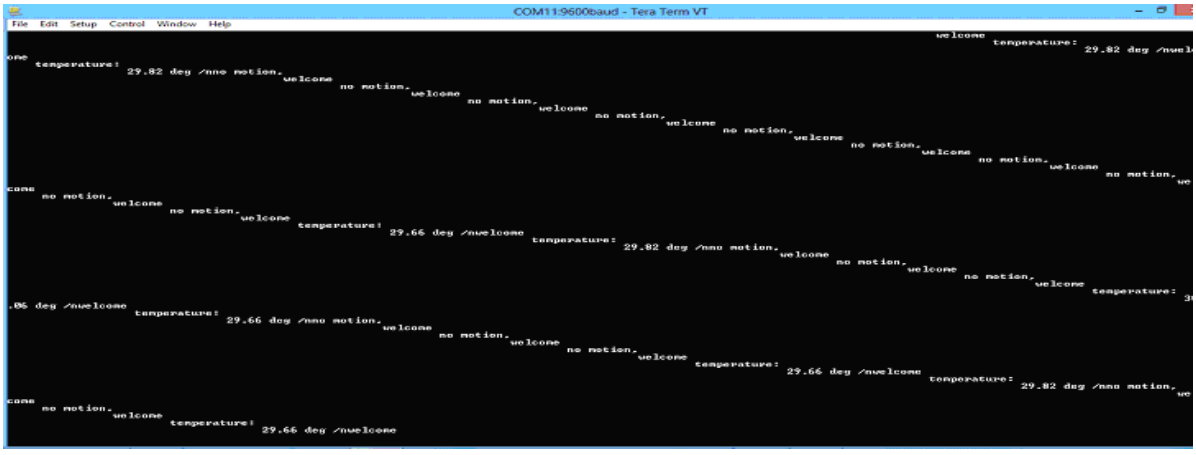

Figure 6. Values generated in teraterm.

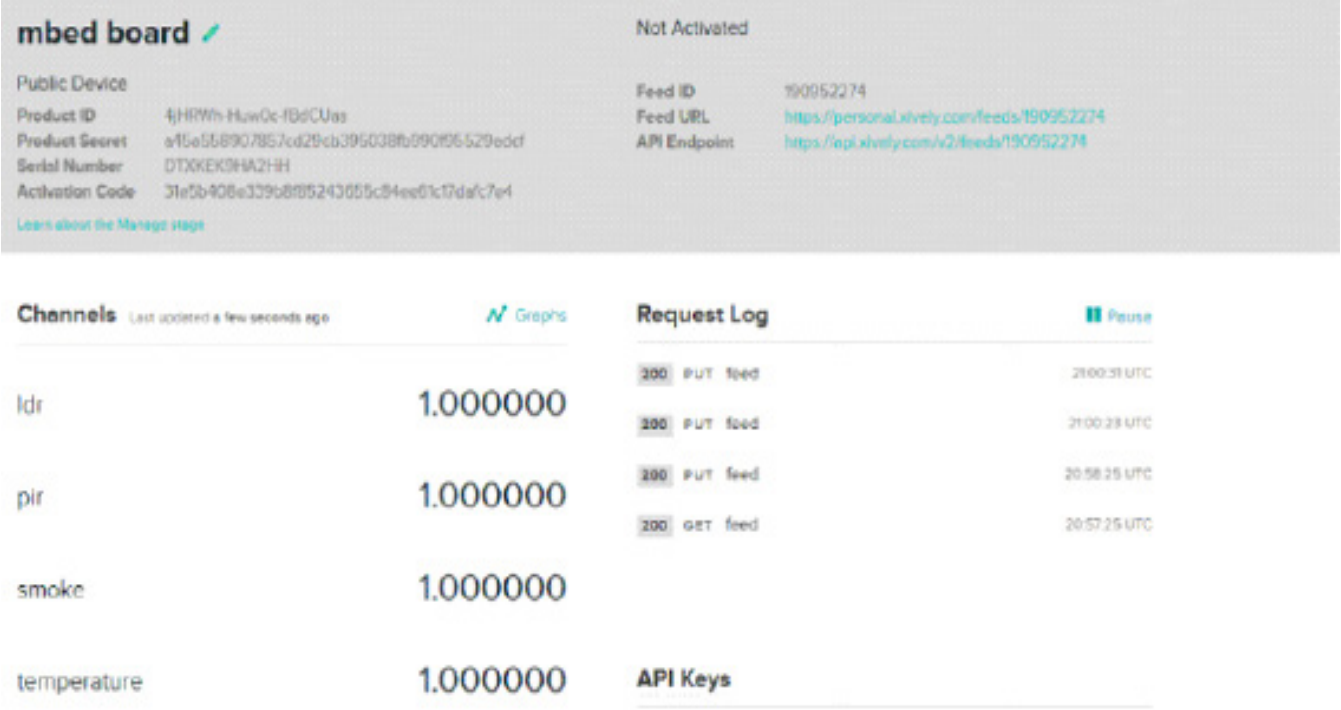

Figure 7. Sensor values displayed in Xively.

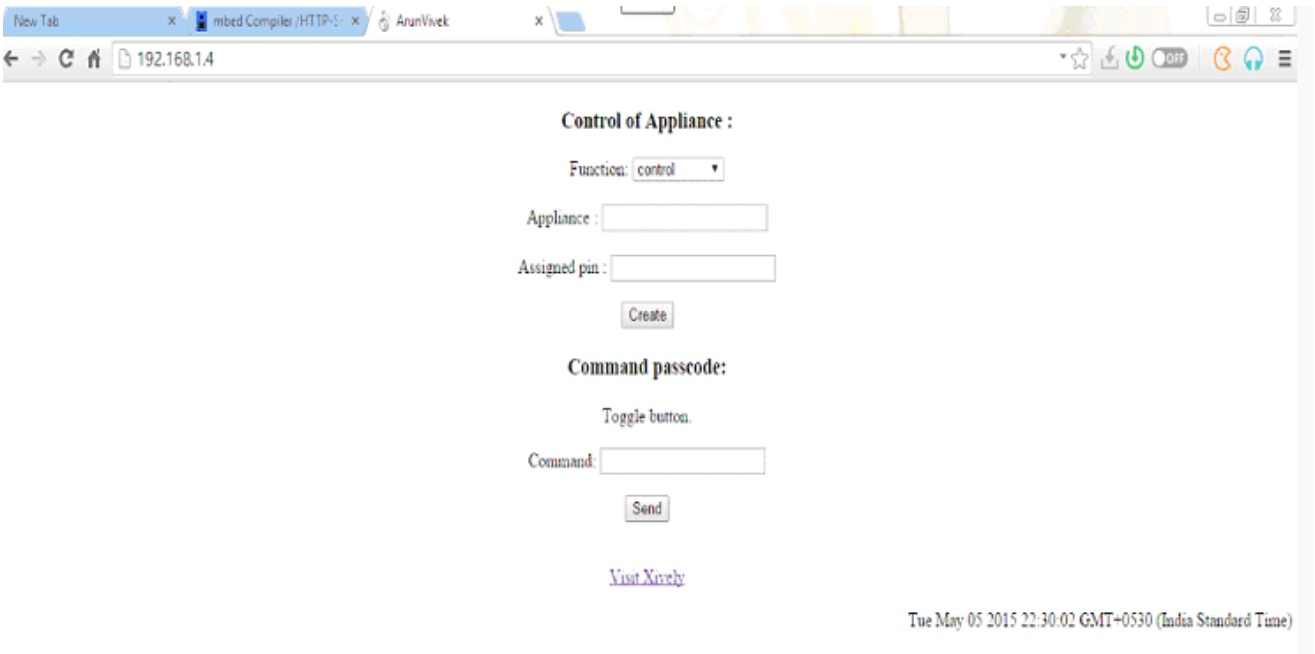

Figure 8. A device is assigned to a pin through the webpage.

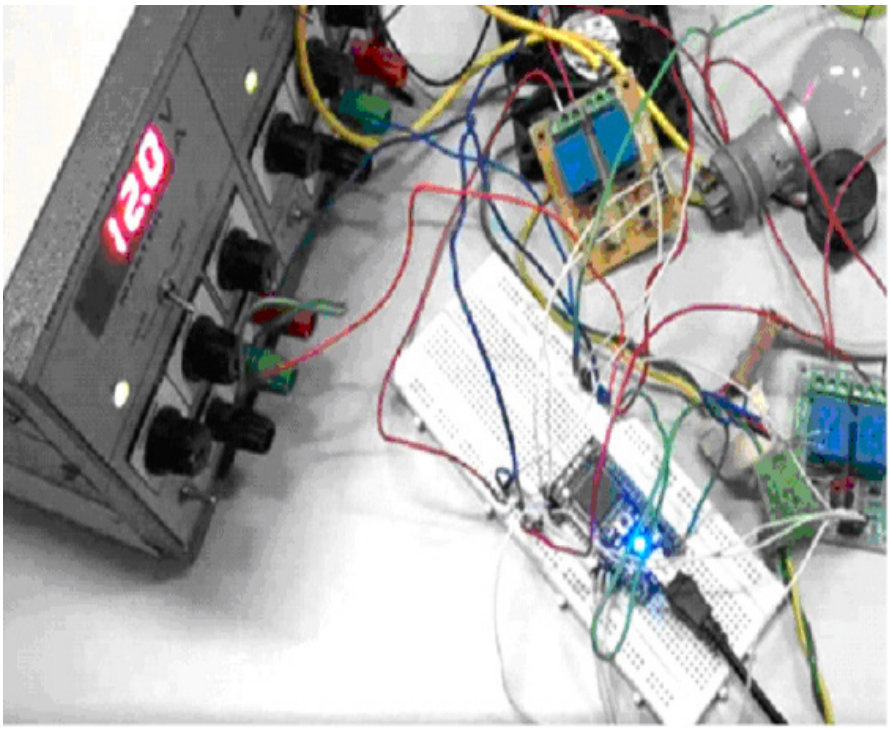

Figure 9. The setup light is initially in off stage.

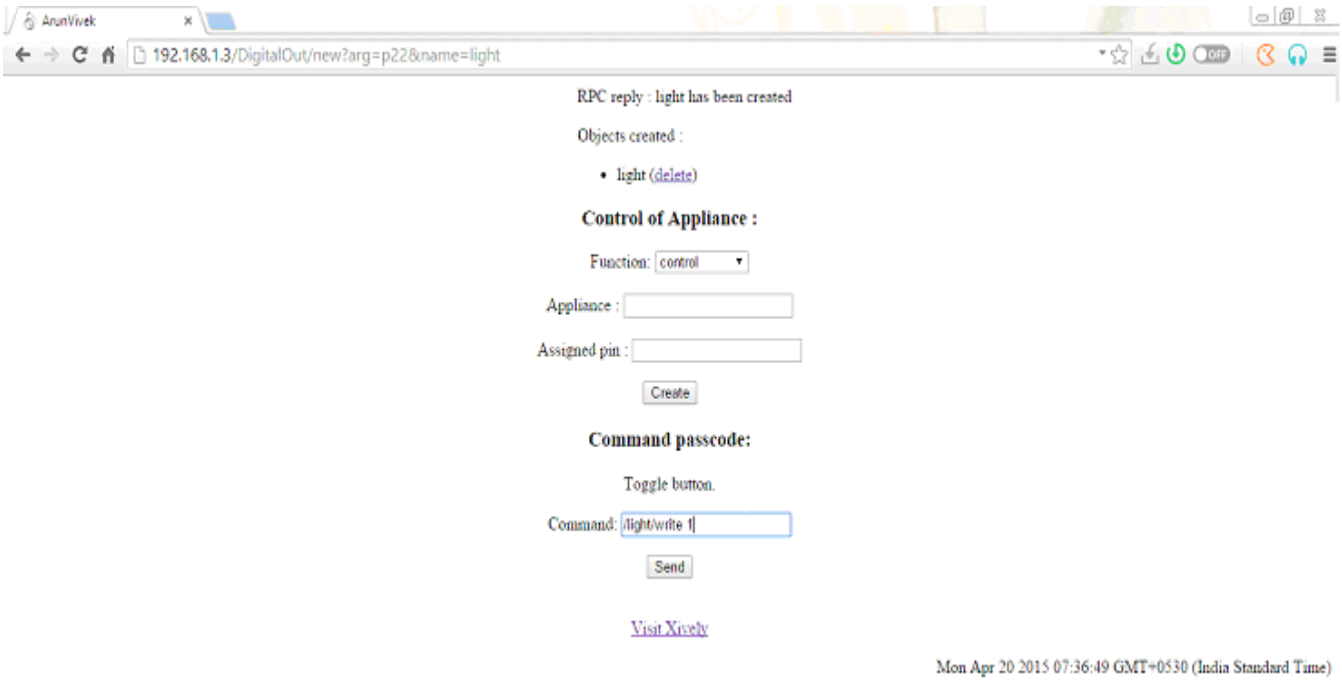

Figure 10. The command for switching on light is given.

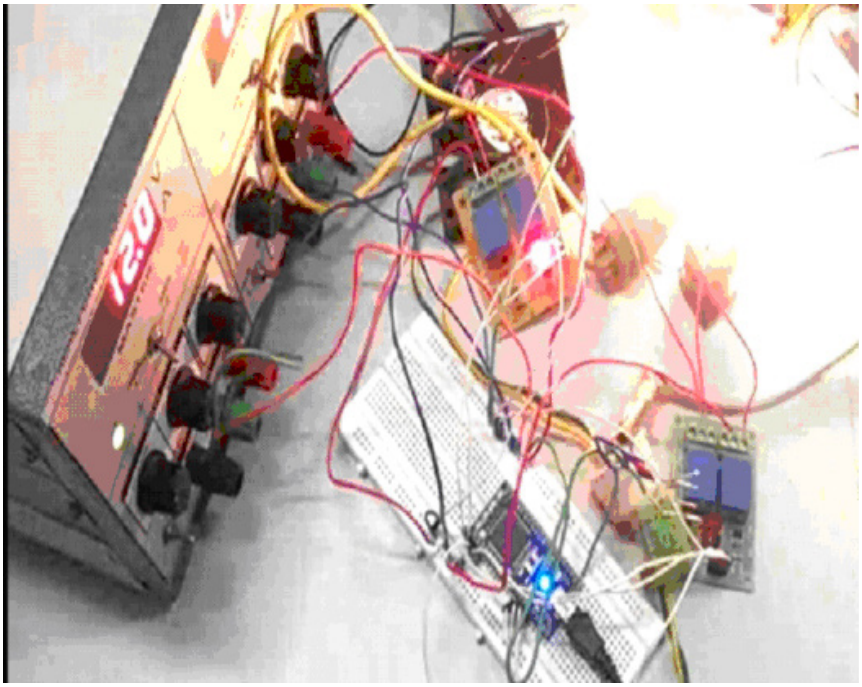

Figure 11. Light is switched on after the command is given.

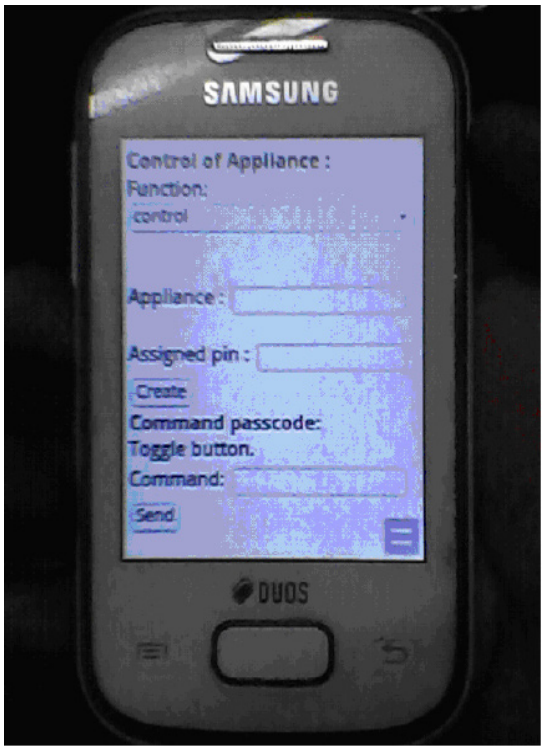

Figure 12. Webpage accessed through mobile device.

fied whether it is dynamically assigned or should it be assigned manually Figure 4.

If dynamic assigning is not possible predefined ip address, mask and gateway is provided. Adjustment within IPv6 and the LoWPAN configuration is performed by routers present at the end of 6LoWPAN fields, alluded to as edge routers. From both the directions this change is straightforward, productive and effective and typically in correlative with the IPv6 stack. Since all packed fields are recognized by each nodes routers don't have to use IPv6 and UDP header formats completely. The nodes of LOWPAN can easily navigate through out the edge routers or other LOWPANs also Figure 5.

3. Results

The obtained data outputs are displayed in tera term Figure 6, a Serial display for Mbed Compiler.

Figure 7 Shows the values updated in the xively when a trigger is applied.

In Figure 8 a device is assigned to a pin so that the commands are executed through that pin to control the appliance. Initially the device is in off stage Figure 9.

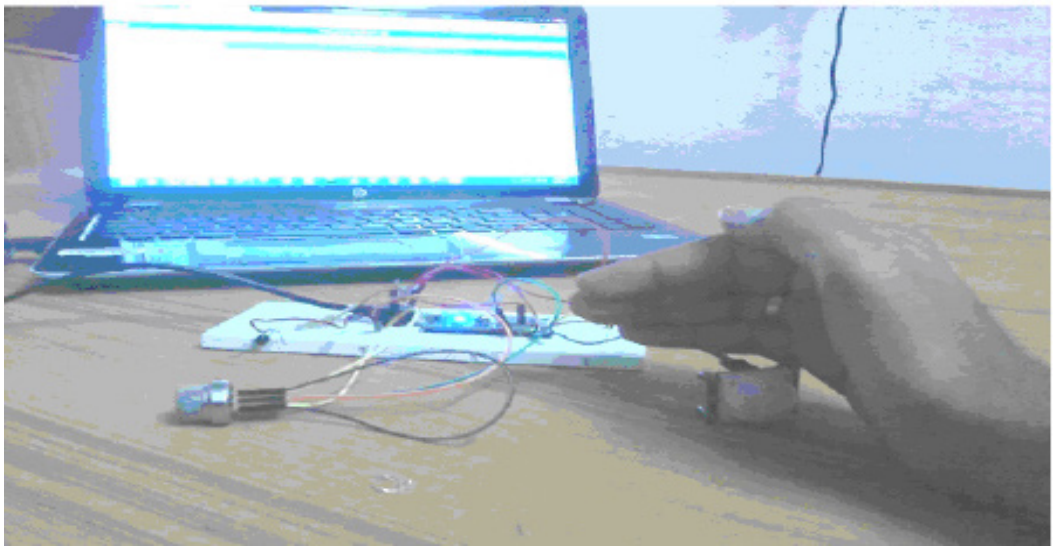

Figure 13. Sensors monitoring the room condition.

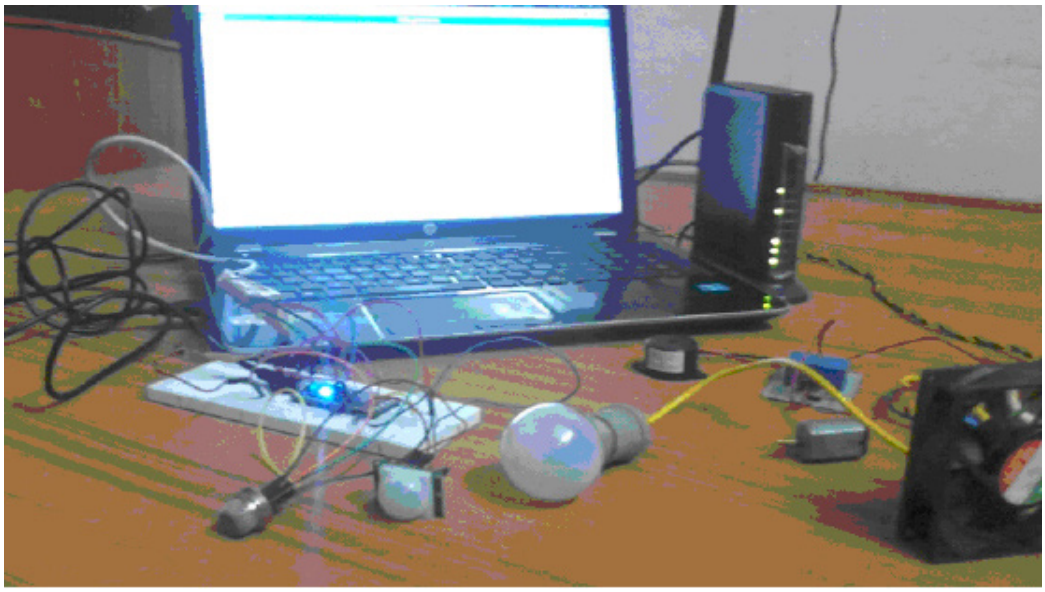

Figure 14. The entire setup of the system.

Figure 10 displays the command executed to switch on light in the webpage which controls the webpage and light is ON Figure 11.

The webpage is also monitored from a mobile device Figure 12.

The initial room monitoring condition which monitors the variation in the room atmospheric conditions Figure 13. The entire setup of the system Figure 14.

4. Conclusion

In this work a smart home feature is proposed where the room conditions are monitored by sensors and actuators for room temperature, motion detection, light intensity and any gas leakage. These generated values from the sensors are later stored in a cloud platform with the help of an Mbed microcontroller. This allows the monitoring of the data stored from any location where internet service is provided. The appliances are controlled through a webpage which uses remote procedure call function to control the function through the HTTP. The asset requirements of the gadgets and the lossy way of remote connections are among the significant reasons that obstruct applying general security features to 6LoWPANs. Thus for web based services the security is provided by Transport Layer Security (TLS) to limit the number of transmitted bytes and to preserve the connotation of the datagram in the transport layer and to reduce the parsing complexity by Constrained Application protocol.

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