International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 5, Issue 05, May-2019

Current Progress and Future Prospective for Energy Conservation and Management based on Internet of Things

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Abstract: ***To withstand with the balance between demand and supply of energy, Energy conservation is the need of an hour. With the abrupt rise in the field of automation and IoT technology conservation of energy along with economic saving has become easier. This paper encapsulates the use of IoT and automation for maintaining energy conservation, comfort and economic strength in domestic lives. This paper throws light on the different methodologies for easy monitoring and remotely controlling the power consumption of the domestic places along with their economic and manufacturing benefits.***

Keywords: Energy Conservation, Sensors, Embedded devices, Internet of things, Message Queuing Telemetry Transport (MQTT), Intelligent building, Smart Appliances

I INTRODUCTION

Digital innovation in the field of energy conservation is growing day by day. With the introduction of intelligent building [1][2] and smart appliances [3] there is growth in conservation of energy .These systems brings together the concept of IoT along with embedded devices. The ease and comfort which comes along with energy efficiency makes IoT a focusing topic. The devices are injected with artificial intelligence and decision making abilities. Sensors acts as the detectors and send the information to the embedded devices, that commands them too take the action along with it they send and receive information from the cloud[4]. These devices provide the wireless connectivity and are the vital part of this IoT system. The data is transmitted following pre- assigned protocols mainly MQTT or CoAP. In most of the cases Wi-Fi mode is selected, controlled with MQTT protocol along with espressif chips as the embedded devices.
This paper gives the analyzed study of IoT technology in the field of energy conservation. In addition, the implementation and the architecture are also mentioned. It also presents the future scope of work keeping energy conservation as the constant constraint.

II THE ARCHITECTURE

The fundamental structure of any building using IoT technology comprises of four layers namely Peripheral layer, Network layer, Storage layer and Application layer [8].All layers are having significant role for proper machine to machine communication. The figure[1] one depicts of all the layers.

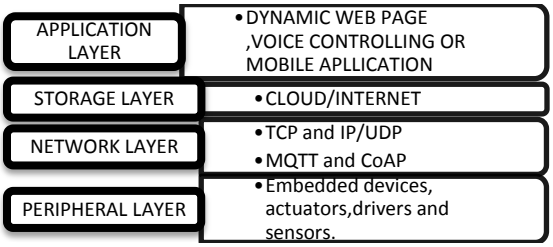

FIGURE 1| The figure summarizes all the layers and their respective components.

A.PERIPHERAL LAYER

The ultimate task of this layer is to develop the input and outputdevices which can perform the commands as well as can transmit the data to the network layer through web API's.This layer comprises of all the sensors, actuators and drivers which execute the action to be performed by machine. Apart from this embedded devices are the vital part of the whole communication[6]. These devices are the things in internet of things. Earlier these devices were of 6 and 8 bits. Now with the growing advancement it has reached to 32 bits microprocessors. There are several Bluetooth, WI-FI, ESP modules, Zigbee etc., which are designed with greater flexibility and easier troubleshooting. Automation industry totally bends their interest

towards these embedded devices due to the open platforms available for there coding and interfacing. Bromley stated how automation can enhance the quality of lifestyle in [7].

B.NETWORK LAYER

The network layer has two types of connectivity firstly the local networks just like 6LoWPAN, ANT, Bluetooth, ANT ,MAN,Z-Wave,Zigbee etc.which works within a confined range secondly there are networks which acts as gateway to transmit and receive the data from cloud. There are certain codes of conduct to send the data over internet to keep the data authentic and secure. Mainly web protocols are not preferred for IoT as they require 100s/1000s bytes so this turns us towards the existing two protocols namely CoAP (Constrained Application protocol) and MQTT (Message Queuing Telemetry Transport). MQTT is the rising star for IoT as it is light in weight and uses only 2 bytes of header [5].There are good amount of MQTT brokers available which makes it far easier to work on. With the increasing demand of automation. the comfort it brings is also appreciable[9].This lead to control through voice which is the advancement in this technology. The applets can be created to perform a task which can be transmitted through MQTT protocol to accomplish a task.

C.STORAGE LAYER

For proper storage there should be enormous amount of data storage capacity, to store the data for longer period of time. The monitoring of building for simulation there is a need of larger storage capacity .Therefore, cloud acts as the basic storage system .Few examples of cloud are Google drive, icloud, one drive etc. In back years cloud is used as a metaphor for internet. Practically it takes the data from embedded devices and stores it .There can be either a personally designed cloud or a third party as cloud storage provider.

D.APPLICATION LAYER

For monitoring and controlling dynamic web page or front end client mobile application is required which comes under this layer. This is where the client choose or operate the appliances available at the other end .This layer is vital to achieve the monitoring systems , analysis of data for real time applications. It provides the interface between embedded devices and cloud storage .Therefore it is a client oriented layer.

III IMPLEMENTATION

In order to merge the IoT with energy management and conservation there is a need to understand the whole mechanism. The complete work cycle can distributed in two blocks namely detection block and the controlling block

A.DETECTION BLOCK

All the appliances are attached with advanced sensors that can sense the change in the present situation. These sensors send the data to embedded devices that can be programmed as per the task we desire to accomplish. Moving forward we have gateways that send the data to the cloud for storage, analysis and simulation. This data can be accessed with dynamic webpage or through mobile application by the client.

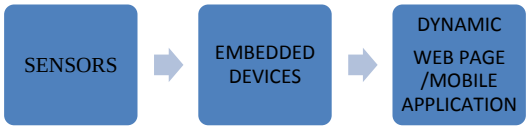

Figure2| Flow chart depicting how the detection block works

B. CONTROLLING BLOCK

The end side client or sometimes the embedded system has to take the decision to save the power consumption .The end side client can control by clicking on the desired option presented on the webpage or mobile application. With the growing era controlling can be done through voice which makes the work much simpler. IFTT application allows us to create our own applets for accomplishment of a particular task. IFTT stands for if this than that ,it acts as an interface between application layer and embedded devices .The ultimate performer is the actuator or drivers which works under the supervision of embedded devices receives the commands through the client present at the end. Circumstances can appear where these embedded devices take the self decision.

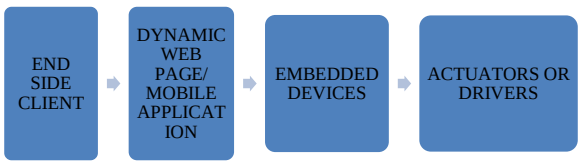

FIGURE 3| Flow chart depicting how the controlling block works

IV. CONCULSION

Today cloud based energy management and conservation can take energy conservation capabilities to net level. It provides deeper understanding of energy, can reduce cost, mitigation risk and address environmental concerns. Through IoT based system we can detect fault in components, store data and remotely access and monitor appliances. This technology provides connectivity ,sustainability,efficiency,safety and reliability.Furthermore it acts as a convergence of energy management, software and automation blended together into a solution.In this growing era everyone wants to take informed decisions, so with IoT services this can be done.

V.FUTURE SCOPE OF WORK

In the near future loss of energy can be reduced by complete automation, operating and monitoring power consuming devices from anywhere in the world. Instead of IoT the designing of RTOS (Real time operating system) can make it a easier task. With the affordable Wi-Fi modules and open sources like MQTT brokers and IFTT application automation can be easily accomplished. Work need to done in the field so that forgetting to unplug or switch off any power consumption .Appliances can lead to null amount of energy loss. Instead of using third party cloud a energy efficient cloud can be designed as an open source.

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