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IoT Based Home Automation System over the Cloud

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Abstract

Internet of Things(IOT) is a concept that encompasses various objects and methods of communication to exchange information. Today IoT is more a descriptive term of a vision that everything should be connected to internet. The IoT allow objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduce human intervention. This paper focuses on automation of home appliances which can be incorporated using different sensors which have access to the cloud through internet, the owner/user can receive status alerts through internet on the device(Smartphone/laptop) . The overall objective is to not only make access of data irrespective of distance but also aims at creating a disable friendly interface.

Keywords

Internet of Things(IoT), Automation, C programming, Node MCU, Layered Architecture.

Introduction

Internet of Things (IoT) is a concept that encompasses various objects and methods of communication to exchange information. Today IoT is more a descriptive term of a vision that everything should be connected to the internet. IoT will be fundamental in the future because the concept opens up opportunities for new services and new innovations. All objects will be connected and able to communicate with each other. New technologies like short-range wireless communications, RFID and real-time localization is now becoming largely common, allowing the Internet to penetrate into the real world of physical objects. The introduction of IPv6, the efforts for porting the IP stack on embedded devices and the definition of 6LoWPAN enable the vision of the Internet of Things, which refers to a network of objects, where all things are uniquely and universally addressable, identified and managed by computers. It is a collection of technologies that make it possible to connect things like sensors and actuators to the Internet. The Internet of Things is anintegrated part of the Future Internet and could be defined as a dynamic global networkinfrastructure with self-configuring capabilities based on standard and interoperablecommunication protocols where physical and virtual things have identities, physicalattributes, and virtual personalities and use intelligent interfaces, and are seamlessly integrated into the information network. The specific characteristics of the IoT are still under research [1]. Preferences such as its architecture, size, complexity, time and space issues, as well as the ambient intelligence and autonomous control of this novel concept are still in a premature level. Current applications of the IoT are found in logistics (RFID tags), smart homes (ZigBee/6LoWPAN), large-scale platforms for sensor data (Cosm, Paraimpu5), in business cards (QR codes) etc.

This paper is based on the following goals and tasks,the aim of which is to design and implement Home Automation which can be incorporated using various sensors, relays,actuators.

Background Studies

The internet of things give solutions based on the integration of information technology, which refers to hardware and software used in storing, retrieving, and processing data and communications technology which includes electronic systems used for communicating between individuals or groups. The fast convergence of

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information and communications technology is built on three layers of technology innovation: the cloud, data and communication pipes/networks and device [2]. As a result of this convergence, the IoT applications require the adaptation of classical industries and the technology will provide opportunities for new industries to emerge and to deliver new user experiences and services. Besides, handling the sheer number of things and objects that will be connected in the IoT, cognitive technologies and contextual intelligence are important. This applies for the development of context aware applications that require reaching the edges of the network through smart devices that are included into everyday life. In Fig.1 [3], the internet of things layered architecture is illustrated as supposed by the ITU-T (International Telecommunications Union - Telecommunication Standardization Sector) and is composed of four layers; the top or first layer is the IOT application layer which contains the application user interface, the second layer is the services and application support layer, the third layer is the network layer which contains the networking and transport capabilities, the bottom layer is the device layer, which contains the gateways and the hardware and sensors and RFID tags and others. Along the four layers, the security and management capabilities and functions are distributed.

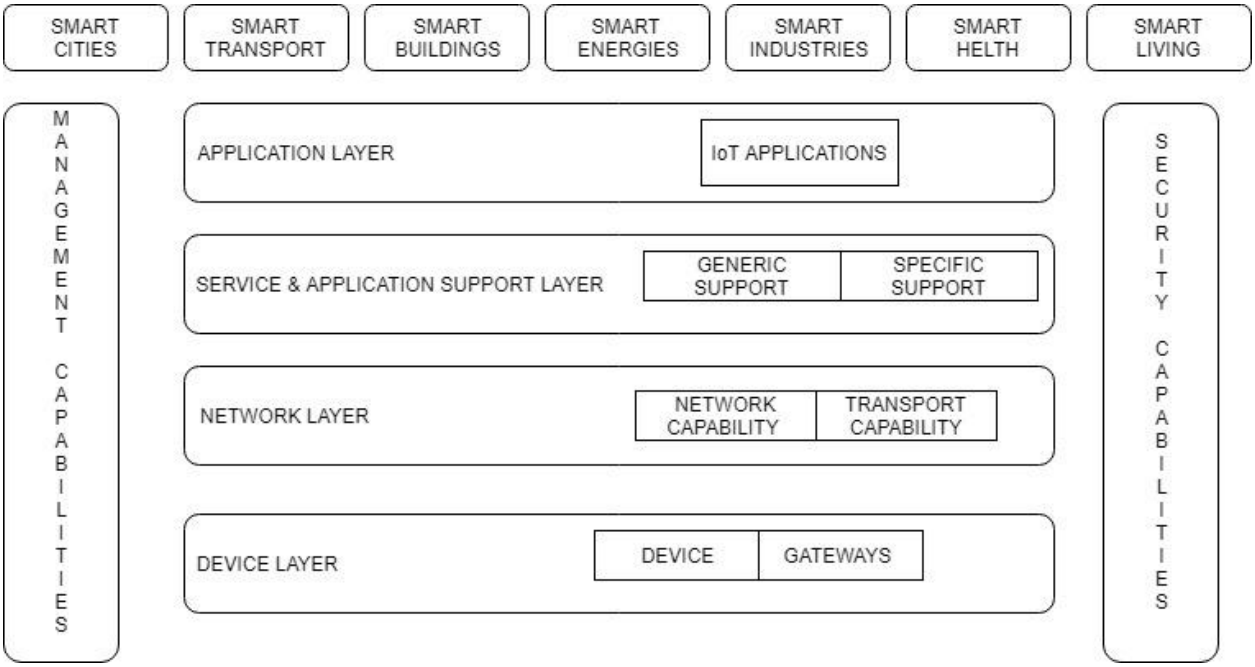

Fig.1 Layered IoT architecture (source :ITU-T)

Proposed Improved Layered Architecture for IoT

In this paper, an improved layered architecture for internet of things (IOT) is proposed. This improved layered architecture depends on seven layers, not on four layers as the traditional layered architecture, and takes all the functions of the traditional architecture and distribute them on the seven layers, but in a more reliable way. The proposed improved layered internet of things (IoT) architecture composed of seven layers as follows[4]:

1- Application layer: includes the IoT application. This layer is at the top of the architecture and is responsible for delivery of various applications to different users in IoT. The applications can be from different industry segments such as: manufacturing, logistics, retail, environment, public safety, healthcare, food and drug etc. With the increasing maturity of RFID technology, numerous applications are evolving which will be under the umbrella of IoT.

2- Application support & management layer: performs the following functions; Qos Manager – Device Manager – Business Process Modeling – Business Process Execution – Authorization – Key Exchange &

Management – Trust & Reputation - Identity Management. In this layer, all actions related to the control, security and management of the application are made.

3- Services layer: performs the following functions; Service storage & orchestration – Service composition & organization – Virtual Entity resolution – IoT service – VE service – IoT service resolution – VE & IoT service monitoring. All decisions related to the monitoring, storage, organization and visualization of the received information, including resolving virtual entities created, are made.

4- Communication layer: performs the following functions; Flow control & Reliability – Qos – Energy Optimization. Also, it performs cross platform communication, if required. The IoT web portal is in this layer. All decisions related to communications and measurements of the flow and its quality and energy consumed are made in this layer.

5- Network layer: performs the following functions; Gateway – Routing & Addressing – Network Capabilities – Transport Capabilities – Error detection & Correction. Also, it takes care of message routing, publishing and subscribing. With demand needed to serve a wider range of IOT services and applications such as high speed transactional services, context-aware applications, etc, multiple networks with various technologies and access protocols are needed to work with each other in a heterogeneous configuration. These networks can be in the form of a private, public or hybrid models and are built to support the communication requirements for latency, bandwidth or security.

6- Hardware layer: Includes sensors, other hardware such as; embedded systems, RFID tags and readers and others. The sensors enable the interconnection of the physical and digital worlds allowing real-time information to be collected and processed. The sensors have the capacity to take measurements such as temperature, air quality, movement and electricity. In some cases, they may also have a degree of memory, enabling them to record a certain number of measurements. Sensors are grouped according to their unique purpose such as environmental sensors, body sensors, home appliance sensors and vehicle telemetric sensors, etc. Many of these hardware elements provide identification and information storage (e.g. RFID tags), information collection (e.g. sensors), and information processing (e.g. embedded edge processors).

7-Environment layer: includes objects to be detected or places to be observed. The objects to be detected vary from physical moving objects, such as humans, cars, to environmental factors such as, temperature, or humidity. The places to observed are ranging from buildings, universities, streets and so on[5].

Implementation

The main objective of this Paper is to design and implement a control and monitor system for smart house. Smart house system consists of many systems that controlled by blynk software as the main controlling system . Also, the smart house system was supported by remote control system as a sub controlling system. The system also is connected to the internet to monitor and control the house equipment's from anywhere in the world using blynk. The prime objective of this paper is to assist handicapped/old aged people. It gives basic idea of how to control various home appliances and provide a security using ios/android/windows.

The proposed home automation system can control the following appliance:

Lights on/off/dim

Fan on/off

On/off different appliance

The proposed model of the home automation system consists of different sensors. Initially the node MCU connects to the internet through WiFi. When the connection is established it will start reading the parameters of sensors like p1, p2, p3 etc. The threshold levels for the required sensors are set as t1, t2, t3 etc. The sensor data are sent to the web server and stored in the cloud. The data can be analyzed anywhere any time.

The proposed system is a distributed home automation system, consists of server, sensors. Server controls and monitors the various sensors, and can be easily configured to handle more hardware interface module (sensors). The node MCU , with built in WiFi acts as web server. Automation System can be accessed using server IP,or remotely from any PC or handheld device connected to the internet with appropriate web browser

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through server real IP (internet IP). WiFi technology is selected to be the network infrastructure that connects server and the sensors. WiFi is chosen to improve system security (by using secure WiFi connection), and to increase system mobility and scalability.

Proposed model architecture

This section describes the proposed architecture and design of flexible and low cost home controlling and monitoring system. The architecture is divided into three layers: Home Environment, Home Gateway and Remote Environment.

Remote Environment represents authorized users who can access the system on their Smart phone app using the Internet via Wi-Fi or 3G/4G network. Home Environment consists of Home Gateway and a hardware interface module. The primary function of the Home Gateway for the proposed architecture is to provide data translation services between the Internets. The main component of the Home Gateway is a micro Web - server based on node MCU. The main task of the server is to manage, control and monitor system components, that enables hardware interface modules to successfully execute their assigned task using actuators and to report server with triggered events via sensors.

Hardware interface modules are directly interfaced with sensors and actuators through wires. It has the capabilities to control energy management systems like lightings, power plugs, heating, ventilation and air conditioning system.

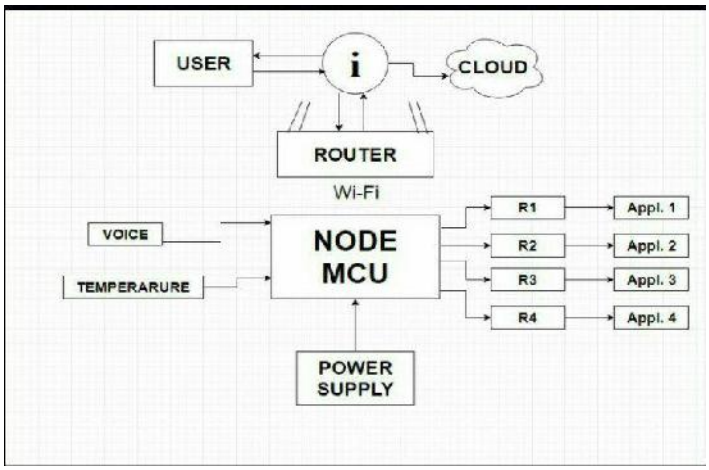

Fig 2. Approved Layout

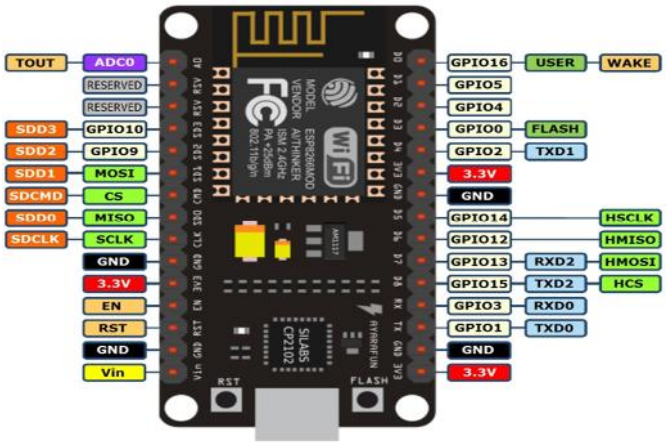

Fig: Node MCU

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NodeMCU Device Board is based on widely explored esp8266 System on Chip . It combines features of WIFI access point and station + microcontroller and uses simple LUA based programming language. ESP8266 nodeMCUoffers-

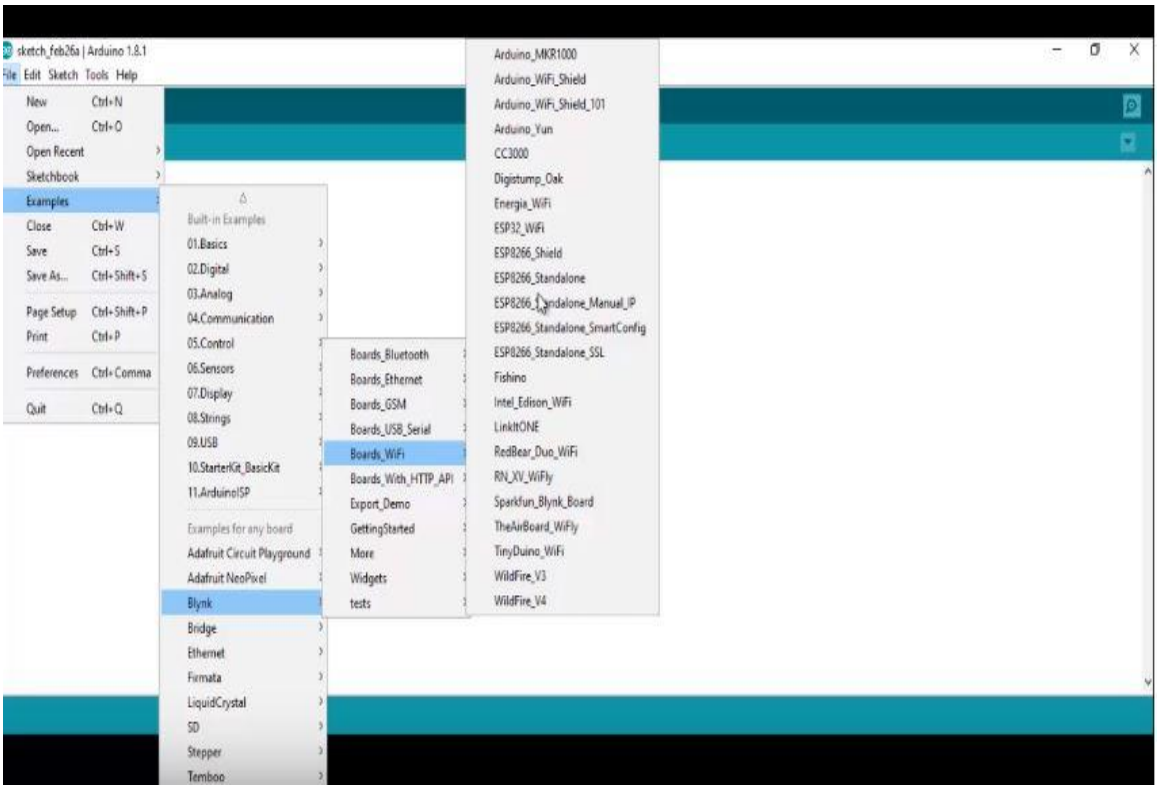
--Arduino-like hardware IO

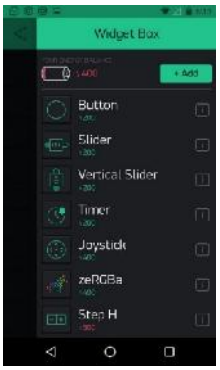
--Event-driven API for network applications

--10 GPIOs D0-D10, PWM functionality, IIC and SPI communication, 1-Wire and ADC A0 etc. all in one board

--Wifi networking (can be uses as access point and/or station, host a webserver), connect to internet to fetch or upload data.

Node MCU programming





Advantages of proposed model

1) Reduced installation costs: First and foremost, installation costs are significantly reduced since no cabling is necessary. Wired solutions require cabling, where material as well as theprofessional laying of cables (e.g. into walls) is expensive.

2) System scalability and easy extension: Deploying a wireless network is especially advantageous when, due to new or changed requirements, extension of the network is necessary. In contrast to wired installations,Inwhich cabling extension is tedious. This makes wireless installations a seminal investment.

3)Integration of mobile devices: With wireless networks, associating mobile devices with the automation system becomes possible everywhere and at any time irrespective of the distance.

4)Disable friendly:This proposed model aims at creating a disabled friendly interface so that disabled people can control anyelectronic appliance using voice controlled mechanism or accelerometer.

Conclusion

The home mechanization utilizing Internet of Things has been tentatively demonstrated to work acceptably by associating straightforward apparatuses to it and the appliances were effectively controlled remotely through web. The composed framework screens the sensor information as well as impels a procedure as indicated by the prerequisite, for instance exchanging on the light when it gets dull. The proposed model can be gotten to not just through the hand held gadgets or PC yet can likewise be controlled however voice .It additionally stores the sensor parameters in the Gmail in a convenient way. This will help the client to investigate the state of different parameters in the home whenever anyplace.This proposed model is easy to control and is cost efficient.

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