IoT - Bridge to Make Device Smarter

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I. History

In 1999 the term "IoT" (Internet of Things) was coined. This was named after computer scientist Kevin Ashton. Kevin Ashton is also known as the father of the IoT. The world's first IoT device was invented by the students of Carnegie Melon University, they installed micro-switches into the Coca-Cola slot machine to report the number of coke cans that were available and if they were cold. Later in the 1990s, Jhon Romkey invented a **toaster** that would be turned on and off over the internet**.**

II. Definition

The internet of things was originally defined as the integration of processes, technology, and people with the sensors for the remote controlling of devices. An Embedded system is a combination of hardware and firmware(software) which is designed for a specific purpose. An embedded system consists of sensors or actuators with a processing unit that uses the internet/network for communication with other devices for controlling or exchanging the data(communication).

It can also be defined as the combination of the physical and digital worlds embedded with the sensors and firmware to connect and exchange data with other devices and systems over the internet.

IoT is a technology that allows us to sense and control the physical world by connecting them to the network and making the device or gadgets smarter and easy to operate with the fingertip.

The main five terminologies for the IoT are:

a. Actuator
b. Sensor
c. Power (AC/DC)
d. Communicating device
e. Micro Controller

a. Sensor: The device which is used to accept the data and feed it into the micro-controller.
Example: Sensors, Mic, Camera, Button, a switch, etc.

b. Actuator: The device used to observe the processed data obtained from the input device and perform the specified task is called the output device/actuator.
Example: Buzzer/alarm, LED, Actuators, LCD screen, etc.

c. Power: An IoT micro-controller board and sensor will usually require either 5 volts or 3.3 volts and anywhere between 30 mA to 1 A. The power supply can be AC or DC power supply. All the Arduino boards need electric power to perform some tasks. These power supplies are often a battery, a USB cable, an AC adapter, or a regulated power source device.

d. Communication devices: The device which is used to connect over the internet or electromagnetic signals (RF signals) to communicate with other devices to exchange data, and perform some tasks with or without the involvement of the human. These devices could also be wired or wireless. Generally, they are used to connect between the devices or device and the outside world (via network).
Example: Bluetooth, Wi-Fi, Zigbee, 6lowpan, etc.

e. Micro-controller: Micro-controllers are tiny computers that are composed of many microprocessors with a memory device, and programmable input and output peripherals in a single integrated circuit (IC). These micro-controller boards are utilized in the automatic controlling of the devices.

Some boards which contain the micro-controller are Arduino Uno, Teensy 4.0, Arduino Pro Mini 328, ESP32, ESP8266, Raspberry Pi4, MBED LPC1768, Beagle Bone Black, etc.
Among these boards, Arduino Uno and ESP8266 are beginner-level boards that are easy to program.

III. Arduino Uno R3

ATmega328P chip supports this board. This is an open-source board. This board features various input and output pins both the analog and digital pins. There are 20 I/O pins, 6 PWM (Pulse Width Modulation), 6 analog pins, and 14 digital pins. PINs 0 to 13 are the digital pin that is used for digital communication (I/O purpose). PIN 0(Rx) and 1(Tx) are for receiving and transferring in serial communication. PINs A0 to A5 are the analog pins that are used for analog communication. The Analog Reference (AREF) pin is used to feed a reference voltage to the Arduino UNO board from the external power supply. The ground pin act as the 0-volt pin The board has a flash memory of 32KB, 2KB SRAM, and a clock speed 16Mhz. 7 to 12 volts of external power supply is required to operate the board. 5V and 3.3V of voltage can be drawn (given as input to another device/sensor) from the board. The onboard regulator generates 3.3 volts. The maximum current draw is 50 mA. The Arduino Uno R3 development Board is often easily programmed with Arduino IDE since it is easy to use.

Figure 1: Arduino Uno R3

IV. ESP32

ESP32 is a dual-core (two microprocessors), dual-mode MCU with both Wi-Fi and Bluetooth built-in. This is a Wi-Fi development board that has a Tensilica 32-bit RISC CPU Xtensa LX106 micro-controller It has a built-in USB serial chip to upload the code. This board features a 4megabyte/64kilobyte of flash memory. This module arrives with the per-flashed NodeMCU(Node Micro Controller Unit) firmware. It has 17 general-purpose input output pins. Out of those 11 are digital I/O pins and 1 analog pin. It has a clock speed of 80MHz. The board has an integrated crystal of 40Mhz. The operating voltage of this board is 3.3V. The supply voltage range is from 4.5V to 10V. Using Arduino IDE NodeMCU Development Board is often easily programmed since it is easy to use.

Figure 2: ESP32

V. Relay

A relay acts as the gateway that connects the device operating the high current or voltage together in a connected electrical circuit.
We can't connect the electrical devices like a bulb, fan, motors, pumps, etc which operate in 230V/415V directly to the Arduino board or any other micro-controller board. Since these operate at very low voltages, we can't directly connect electrical devices with these boards. With the help of the relay module, we can connect the micro-controller board and electrical devices together in a circuit. With the help of the micro-controller boards along with the relay, we can turn on/off the devices operating at 230 volts.
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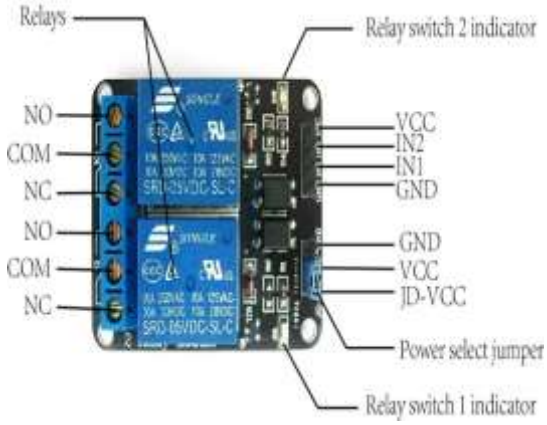


Figure 3: 2-channel relay

VI. Fundamental Building blocks of IoT

a. Sensors
b. Actuators

Sensors

The sensor measures some physical quantity and converts the measured quantity into a digital signal. These signals are passed to further sent to microcontroller/any devices for processing of data. They have greater precision when compared to human sensory organs. They can be readily embedded into the physical objects that are connected to the internet/network, they can interrupt and make intelligent decisions.
Examples: Temperature sensor, IR sensor, LDR sensor, Humidity sensor, proximity sensor, pressure sensor, level sensor, etc.

Nowadays sensors are seen everywhere us. Sometimes it may be easily identifiable but sometimes it may not be. They are every around us in our homes, workplaces, shopping malls, hospitals, etc. They are embedded in devices and

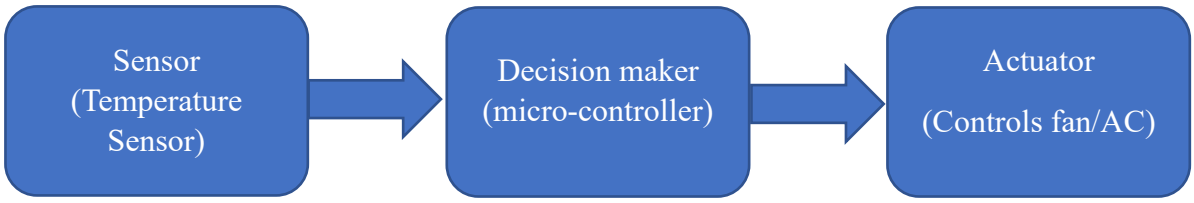
gadgets to make them smarter. Sensors detect the changes that are occurring around them in their particular range and respond to changes that take place. They get input from various sources like light, temperature, pressure, speed of a body, and motion of body/any device. They shared the obtained data in the network to which they are connected.

Actuators

Actuators are the complement of the sensors. They receive some control signal (digital or electrical signal) that triggers the physical device based on the input signal. They are responsible for moving and controlling mechanisms. Example: Servo motors, relay, Piezoelectric actuator

Working of sensor and actuator

Example on temperature sensor and actuator



Working of IoT Model

These control system works in the medium inn which they are implemented. The temperature sensors sense the temperature of the surrounding in which they are deployed. They measure the temperature continuously. Sensors measure the temperature and sends the signal to the micro-controller (decision maker) they process the signal obtained from the sensors and send the signal to the actuator. According to the received signal actuator operates.

VII. An Interpretation to make bulb smarter

a. Abstract

This method presents an efficient approach to switching on/off an LED bulb from a remote place using Android Applications installed on a Smartphone. With the speedy development of the Smartphone in recent years, it has been a popular personal mobile communication device that helps to control things easily with one tap. How to make the Smartphone a better service for our lives is an important direction of research in this smart application. This article describes how to integrate the Android, Bluetooth technology, and HC-06(Bluetooth device) into the control of a light bulb from the mobile application, which also saves electricity when it is not in use.

b. INTRODUCTION

This project focus on designing a system that controls the light bulb using an android application communicating with Bluetooth as a transmission media. This system controls the LED bulb using Bluetooth technology. Relay can control the voltage supply of 230V of any home appliances. This system is user-friendly, accurate, and booming technology. This Bluetooth technology uses a radio frequency, short-range connectivity technology, and wireless technology. This smart system can be controlled by any device like android, iOS, or PC. HC-06 Bluetooth module uses UART (Universal Asynchronous Receiver and Transmitter) technology.

c. Application Architecture

The below architecture diagram describes how the circuit connections are made. Here mobile acts as the transmitter that transmits the user command and HC – 06 acts as the receiver and sends the signal to the ESP8266 board. The android app acts as the main source for giving the instruction (commands to control the bulb). The interface is made in such a way that any android user can conveniently use it easily without any problems. The transmitter device transmits the signal in the form R-F signal (wireless electromagnetic signal). This transmitted signal is received in the receiver end and passed to the ESP8266 board, it further operates received information and performs the specified operation.

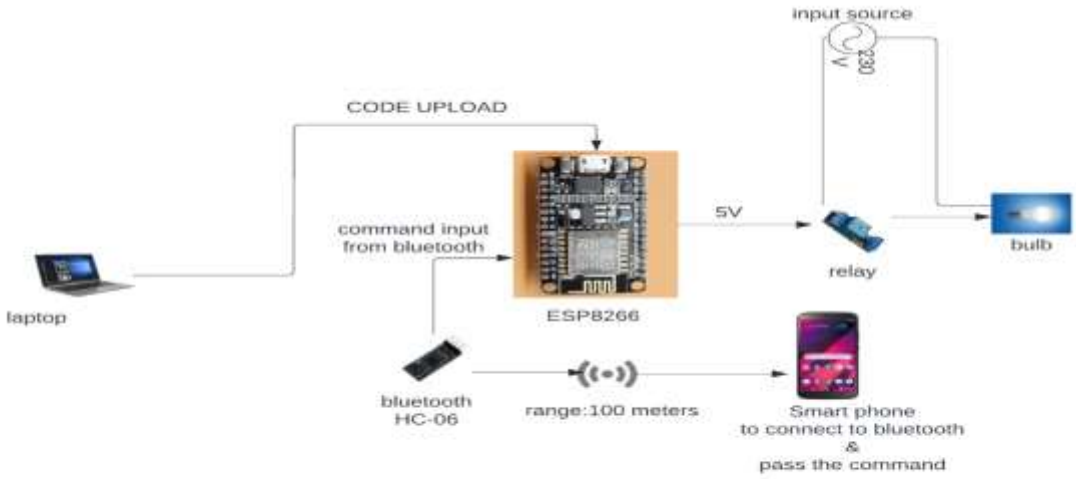


Figure 4: Architecture of the project

d. RELEVANCE OF THE WORK

- It's an application that simplifies the task of the operating bulb.
- This application is flexible and can be used anywhere.
- This application is meant to provide an easy and simple operation of a bulb.

e. SYSTEM REQUIREMENT SPECIFICATION

This section specifies the various requirements that are essential for this project. These requirements need to be fulfilled for the successful execution of the project. The aim and scope along with the hardware and software requirements are given below.

f. SOFTWARE REQUIREMENTS

- Arduino (IDE) with ESP8266: To write and code and upload to the ESP8266 board
- MIT Emulator: To create a user interface application

g. HARDWARE REQUIREMENTS

- ESP8266
- LED bulb / Incandescent bulb
- HC – 06 (Bluetooth device)
- Relay (to control the blub in 230V input)
- Smartphone
- Power supply

h. CONCLUSION

This project brings out a smart approach to home automation of a bulb. The bulb used here is for controlling it to turn on/off using wireless technology. This technology helps us to remote control any devices in the home, school or banks, etc., Not only the bulb can be implemented, but the same method can be implemented to other home appliances/ devices like fans, air conditioners, refrigerators, etc., This system gives you the convenient option to use the Control function on the app, so you can turn the bulb on/off all at once with only a single tap. This technology also helps to save lots of energy.

i. FUTURE ENHANCEMENTS

This Application can be implemented not only for one bulb but for all the bulbs at home. We can also implement this to voice technology, denoting that we can give the command to turn on/off the bulb from the voice commands. Also, we can control the bulb's glare by the intenseness of the surrounding environment (Implementation of this technology will be more effective in street lights). Currently, this technique works in the range of 100 meters, The project also can be advanced by connecting throughout the globe (i.e., controlling it from any part of the world) by maintaining a server.

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