

# Design and Implementation of Indoor Environment Monitoring and Control System

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**Abstract :** After more than 20 years of development, Internet of things has a lot of applications in the actual scene, which greatly facilitates people's work and life. As people paying more and more attention to environmental quality, the application of Internet of Things in indoor environment monitoring and control has become an important branch. In this paper we present a set of lightweight intelligent solutions for the management of rooms after studying the key technologies of IoT. The system uses sensors to obtain environmental information, through the process of arduino, such as temperature sensing and gas leakage detection. The controllers will make adaptive response, such as turn on the air conditioner, water sprinkle. The experiments demonstrates the system can be a good solution to the backwardness of current room management, especially house rooms, college rooms, and provides a new application for IoT.

## I.INTRODUCTION

The current advances in the fields of technology and economy are having a significant impact over the Environment, and have led to serious concerns regarding pollution and climate change. Internet of Things (IoT) is a concept and a paradigm that considers pervasive presence in the environment of a variety of things/objects that through wireless and wired connections and unique addressing schemes are able to interact with each other and cooperate with other things/objects to create new applications, services and reach common goals. Environmental monitoring applications of the IoT normally exploit sensors to aid in environmental protection by monitoring parameters like temperature, gas detection and atmospheric conditions. This paper designs a prototype of wireless environmental monitoring system to upload information from array of sensors to the database. This application allows us to observe or measuring the environmental conditions from remote location from anywhere in real time. This system consist of main three modules namely sensor nodes, the wireless communication and the web server. The sensor nodes in remote location collect the information from surrounding environmental conditions and send data wirelessly using Node MCU to the server.. Our concentration is to allowing simple data connections with little programming required and moreover easy of use.

Environment monitoring and device control allows new level of comfort in homes and it can also manage the energy consumption efficiently which in turns promotes the

saving. In the twenty first century, there is revolution of the sensor networks which have also come up with various applications like surveillance, traffic control, environmental and wildlife monitoring, agricultural application, home automation and industrial process control.

The Internet of things (IoT) is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these objects to connect and exchange data.<sup>[1][2][3]</sup> Each thing is uniquely identifiable through its embedded computing system but is able to inter-operate within the existing Internet infrastructure.

The IoT allows objects to be sensed or controlled remotely across existing network infrastructure,<sup>[7]</sup> 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 reduced human intervention.<sup>[8][9][10][11]</sup> When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, virtual power plants, smart homes, intelligent transportation and smart cities.

## II.BLOCK DIAGRAM

The Block diagram consists of a Microcontroller, a LCD display, sensors, Node MCU and power supply. In this system mainly we have microcontroller, power supply, LCD. The Micro controller is the heart of this project. The total controlling action will be done through this micro controller.

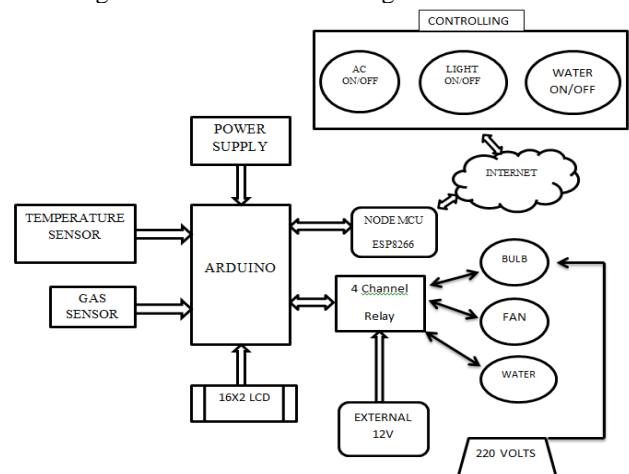


Figure 2.1: Block Diagram

When the fire, heat, smokes has detected by the sensors then it automatically sends a message to the relevant control system with the help of microcontroller. It also ensures the fire sprinkler system gets operated and the fire extinguisher or the temperature is brought down subsequently. The maximum power supply required to operate the circuit is +5V DC voltage. We also have temperature sensor which detects the room temperature and the temperature can be monitored in the lcd. We can turn on the AC to reduce the temperature using the web portal. A LCD display is used at the output section to display the status. The system is comprised of several subsystems. The design process included designing the basic units for sensing the: Temperature and gas detection. The proposed system is involved with sensors networks like temperature, gas leakage detection etc. which are connected to the Arduino microcontroller. The controller preprocess the data and convert it into the desirable format then data is send to the web portal using local Wi-Fi network/internet service, this can be employed by the NodeMCU (ESP8266) module. We can monitor the data collected by the sensors using a LCD. From the web portal we can control the respective actions such to turn on the AC , like turn on the water sprinkle etc.

The hardware interfaces to the microcontroller are Sensors, power supply, LCD display,relay board,.. The sensors are used to sense the temperature above the normal atmospheric temperature in three aspects.The sensors also detect the gas leakage in the room. If anything occurs it automatically sprays water through the sprinklers.. The LCD Display is used to monitor the room temperature and gas level in the room.

The Micro controller is the heart of this project. The total controlling action will be done through this micro controller. When the fire, heat, smokes has detected by the sensors then it automatically sends a message to the relevant control system with the help of microcontroller.

### III.HARDWARE DESCRIPTION

#### 3.1 Arduino

Arduino is open source physical processing which is base on a microcontroller board and an incorporated development environment for the board to be programmed. Arduino gains a few inputs, for example, switches or sensors and control a few multiple outputs, for example, lights, engine and others. Arduino program can run on Windows, Macintosh and Linux operating systems (OS) opposite to most microcontrollers' frameworks which run only on Windows. Arduino programming is easy to learn and apply to beginners and amateurs. Arduino is an instrument used to build a better version of a computer which can control, interact and sense more than a normal desktop computer. It's an open-source physical processing stage focused around a straightforward microcontroller board, and an environment for composing programs for the board. Arduino can be utilized to create interactive items, taking inputs from a diverse collection of switches or sensors, and controlling an assortment of lights, engines, and other physical outputs. Arduino activities can be remaining solitary, or they can be associated with programs running on your machine (e.g. Flash, Processing and

Maxmsp.) The board can be amassed by hand or bought preassembled; the open-source IDE can be downloaded free of charge. Focused around the Processing media programming environment, the Arduino programming language is an execution of Wiring, a comparative physical computing platform.

#### 3.2 Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduno, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform



Figure 3.2: Top view of ARDUINO UNO

### 3.3 Memory

The Atmega328 has 32 KB of flash memory for storing code (of which 0,5 KB is used for the bootloader); It has also 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

### 3.4 Input/Output

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalWrite() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. AREF. Reference voltage for the analog inputs. Used with analogReference().

### 3.5 ATmega328(microcontroller)

The high-performance Microchip 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts.

By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened. If a sketch running on the board receives one-time configuration or other data when it first starts, make sure that the software with which it communicates waits a second after opening the connection and before sending this data. The Uno contains a trace that can be cut to disable the auto-reset. The pads on either side of the trace can be soldered together to re-enable it. It's labeled "RESET-EN". You may also be able to disable the auto-reset by connecting a 110 ohm resistor from 5V to the reset line.

#### 3.5.1 ATmega328 Block Diagram

Block diagram shows the internal circuitry and the flow of the program of any device. ATmega 328 block diagram is shown in the figure given below.

## ATmega328 Block Diagram

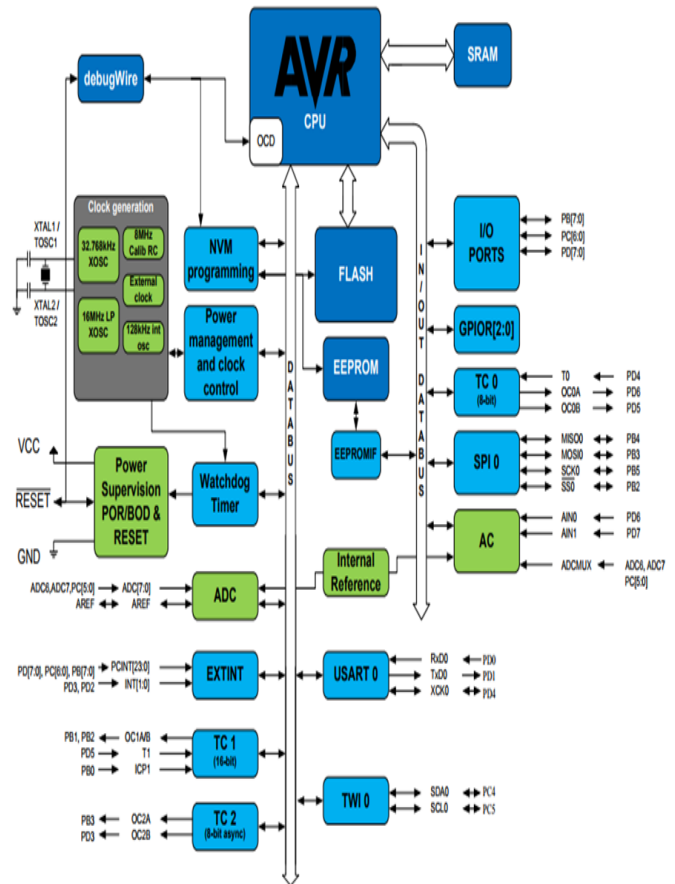


Figure 3.5.1: Atmega328 block diagram

## IV. SOFTWARE DESCRIPTION

### 4.1 Software Used

The software used in the project is ARDUINO Software.

#### 4.1.1 Arduino IDE

The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus.



A program written with the IDE for Arduino is called a sketch.<sup>[57]</sup> Sketches are saved on the development computer as text files with the file extension.ino. Arduino Software (IDE) pre-1.0 saved sketches with the extension .pde.

The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

The open-source nature of the Arduino project has facilitated the publication of many free software libraries that other developers use to augment their projects.

The ARDUINO Integrated Development Environment - or ARDUINO Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

### V.RESULTS

The following figure shows the results for “design and implementation of indoor environment monitoring and control system”.

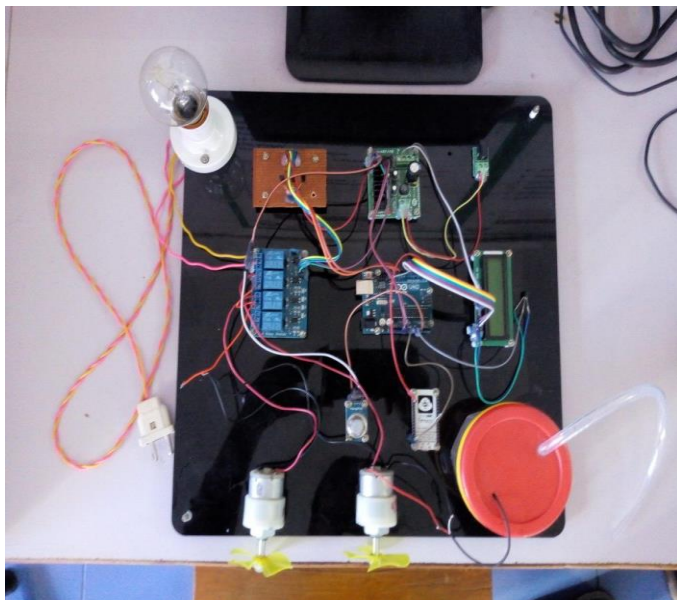


Figure 5.1 : Development Kit

We can control the control the system from remote location by using webportal. The below figure shows the webpage from which we control the devices.

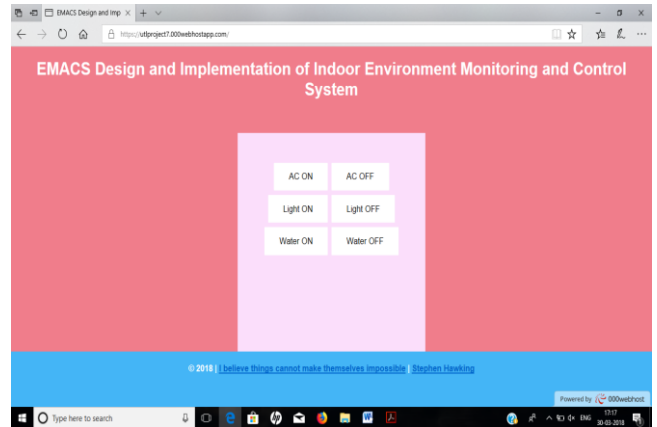


Figure 5.2 : 000webhost server

Turning On the device 1 that is AC from the webportal using the internet.

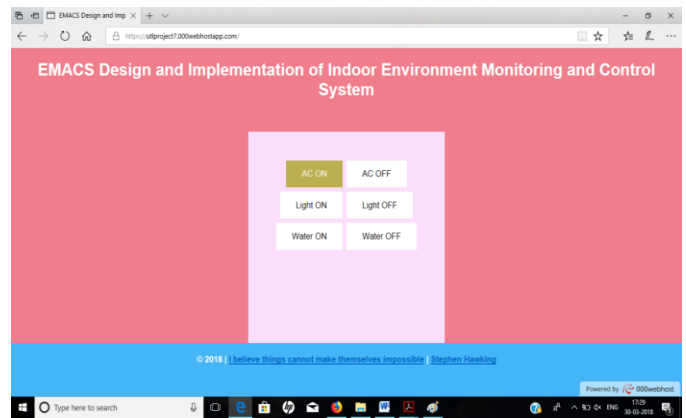


Figure 5.3 : Turning the AC ON

In this we have represented the device AC as fan.



Figure 5.4 : Here AC is represented as Fan

When the switch AC On is clicked on the webpage the device 1 that is fan is On and led in relay also turns On.

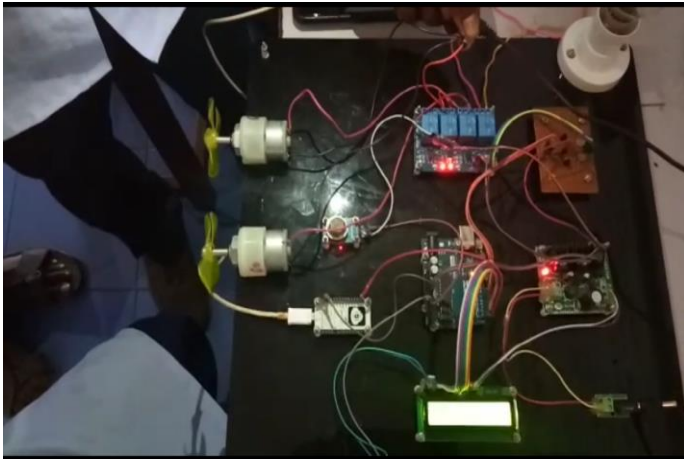


Figure 5.5 : Device 1 Fan is ON

Turning On the device 2 that is light from the webportal using the internet.



Figure 5.7 : Device 2 Light is ON

Turning On the device 3 that is water sprinkle from the webportal using the internet.

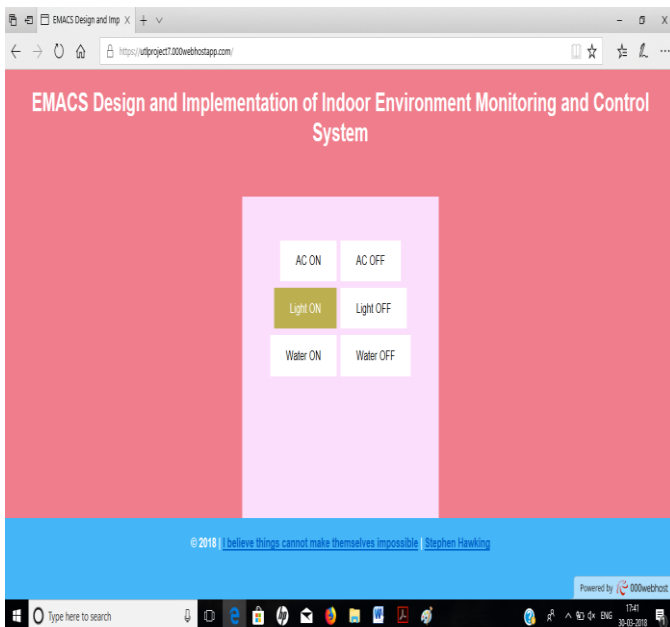


Figure 5.6 : Turning the Light ON

When the switch light On is clicked on the webpage the device 2 that is bulb is On and led in relay also turns On.

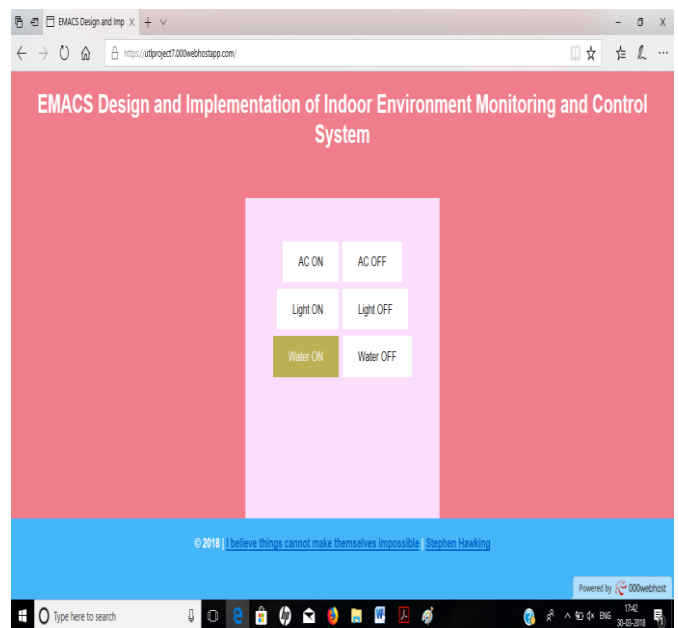


Figure 5.8 : Turning the Water ON(when gas is detected)

When the switch water On is clicked on the webpage the device 3 that is water motor is On and led in relay also turns On.

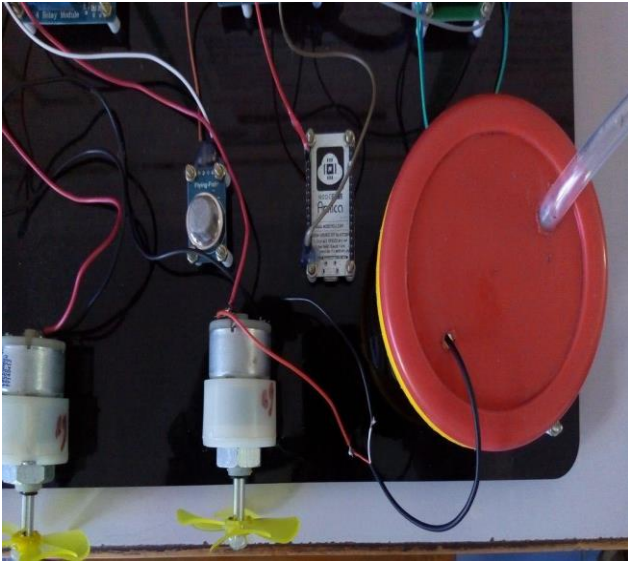


Figure 5.9 : Water sprinkle is ON

We can monitor the indoor environment using the temperature sensor and gas sensor. Here the Lcd shows the temperature and gas level.

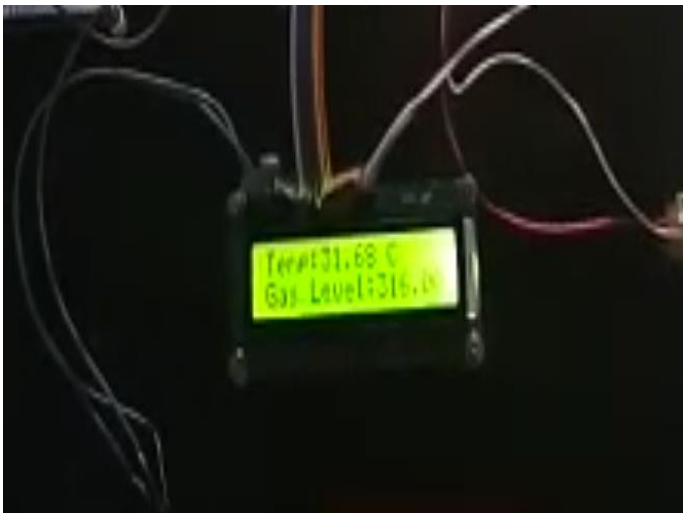


Figure 5.10 : LCD showing Temperature and Gas level

## VI. CONCLUSION

The environmental monitoring system might offer several potential benefits; it provides monitoring services for remote areas. Three different wireless sensors for implementing IoT-based solutions for environmental monitoring were designed, developed, and analyzed. The analysis of the three implementations revealed the fact that Wi-Fi technologies is suited for monitoring applications that can successfully compete with the MQTT protocol. As expected, Wi-Fi consumes more energy but enables the development of solutions with reduced total cost of ownership through the use of the existing infrastructure.

The scope of indoor environmental testing and control is limited, user's other requirements will possibly

leading to the bottlenecks of the application of system. Therefore, we need to increase the system function to effectively reflect the application value of the system.

The future development of the indoor environment monitoring and control system solutions can be concentrated in more areas. On the one hand it can integrate more types of electronic equipment for environmental monitoring and control, on the other hand, it can also adapt to more different types of indoor environment, automatically set the scene and theme. Therefore, studying and designing an environmental monitoring and control model which can meet the specific needs is of great significance to the practical use and future development of indoor environment monitoring and control system.

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