Automatic control of medical fluid pumps using NodeMCU in healthcare automation

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ABSTRACT

Internet of Things (IoT) is an extension of the Internet, which now includes physical objects of the real world. The main purpose of Internet of Things is to increase a quality of people's daily life. A smart home is one of the promising areas in the Internet of Things which increases rapidly. It allows users to control their home devices anytime from any location in the world using Internet connectivity and automate their work based on the physical environment conditions and user preferences. The main issues in deploying the architecture of IoT are the security of the communication between constrained low-power devices in the home network and device performance. These issues have been deepened with the spread of cheap and easy to use microcontrollers which are used by electronic enthusiasts to build their own home automation projects. In this paper we proposed an automatic water motor circuit which operates by button switch and timer. The main part of the circuit is Node Mcu which is an open source IoT development board. One of its most exclusive characteristic is that it has built-in support for Wi-Fi connectivity, and therefore makes IoT application development much easy.

Keywords: Node Mcu, home automation system, IOT, Wi-Fi connectivity

INTRODUCTION

The main aim of Internet of Things concept is to make different small devices able to communicate to each other and with the user to collect and exchange data over the Internet. In other words, Internet of Things (IoT) is an extension of the Internet, which now includes physical objects of the real world. When IoT is expanded with sensors and actuators, it becomes a part of the more general class of cyber-physical systems. Data processing helps us to automate some actions and add more intelligence to our system. The main purpose of Internet of Things is to increase a quality of people's daily life [1]. In today's world Internet of Things applications cover different areas from business to human dwellings. We can highlight the following domains: transportation and logistics, health-care, smart environment (city, office, and plant), industrial, and consumer [2, 3].

Some of the IoT devices have constrained capabilities and limited access to power. Constraints of the devices affect the characteristics of the communication. Battery capacity also limits the performance of the wireless communication channel and lifetime of the device. The Node MCU (Node Microcontroller Unit) is exposed source software and hardware progress environment that is put up everywhere a very low-price System-on-a-Chip (SoC) called the ESP8266. The main purpose of this paper is to design an automated water motor circuit for any purpose like domestic, industrial and commercial purposes by using Node MCU (Node

Microcontroller Unit) which makes IoT application development much easier.

EXISTING WORK

There are many works that show a comprehensive survey of the Internet of Things and smart home applications. This topic is quite popular among the researchers because of its actuality. For example, L. Atzori et al. in the paper [4] give an overview of different visions of Internet of Things paradigm and their technologies with an emphasis on using wireless technology as a basis of IoT. When IoT is improved with sensors and actuators, the techniques becomes a specimen of the more common class of cyber-physical systems, which comprises technologies like monitoring of diverse home appliances like light, fan, water pump and many more. A system has been intended to connect sensor data with user's everyday life. In papers [5,6] open issues in Internet of Things and security aspects, in particular, are considered. J. Granjal et al. [6] deeply analyze existing protocols and mechanisms used in IoT and how they ensure fundamental security parameters of communication. The same document also creates a list of proposals and alternative approaches from different researchers. These papers can be used to concentrate on current research in IoT security. Bharat Bohora[7] considered a system based on Blynk framework which regulate and observed appliances via smart phone by means of Wi-Fi as communication protocol and raspberry pi as reserved server. All the appliances and sensors are connected to the internet via Node MCU. For theoretical analysis of protocols and mechanisms in IoT, open issues in IoT papers [8] give the good background knowledge. For building a model of a smart home, defining its use cases and requirements works [9] was useful. Smart home model and model of a capillary network with heterogeneous devices including unidirectional and non-IP devices defined in [9] inspired to create a model of a home automation system with a sensor node.

SMART HOME AND HOME AUTOMATION SYSTEM

As it was mentioned, the major part of IoT devices concentrates in consumer field what covers: wearables, media devices, home automation, and smart appliances [3]. The coverage of these applications is usually limited by Local Area Network (LAN), Personal Area Network (PAN), or Body Area Network (BAN) inside consumer's home. The home technology is developing rapidly to integrate all home systems under one centralized management system which forms Home Area Network (HAN). But problem complexity and incompatibility of multiple technologies, products from different vendors result in a high price of such system and limit its practical implementation. The main components of this structure are: home automation system (e.g., lighting, HVAC (heating, ventilation and air conditioning), security locks); energy management system or smart energy (smart appliances, e.g., heating/AC, water heater, oven, dishwasher, dryer, plug-in electrical car); entertainment devices (smartphones, laptops, PCs, tablets, TVs, home cinema systems, game consoles, etc.) in PAN; wearable's (e.g., smart watches, heart rate monitors, body temperature sensors, accelerometers, blood pressure sensors) in BAN. Smart home can include a lot of different systems and applications, as illustrated in Figure.

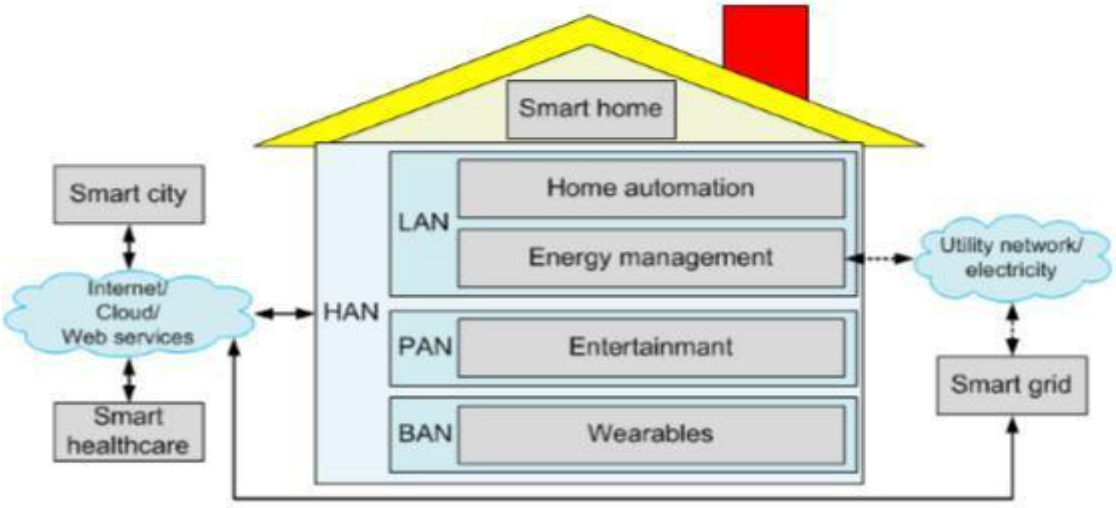

Fig. 1: Structure of Smart Home.

METHODOLOGY

In this paper we use Node Mcu with Blynk app and some of the relays as rated according to the water motor used for a particular purpose. Blynk mobile application in smartphone and Node MCU communicate by using Blynk server. Bidirectional transfer of data between node MCU and mobile app occurs through this server.

Node Mcu Wireless Communication Modules

The ESP8266, designed and manufactured by Espress if Systems, comprises all essential elements of the modern computer: CPU, RAM, networking (wifi), and also a current operating system and SDK.As a chip, the ESP8266 is also hard to access and utilize. The communication range can be increased by connecting an antenna to the transmitter and receiver. We have to solder wires, with the suitable analog voltage, to its PINs for the modest tasks such as powering it on or guiding a keystroke to the "computer" on the chip. Node MCU project targets to make simpler ESP8266 development. It has two key components.

Fig. 2: Node Mcu DEVKIT Board.

An open source ESP8266 firmware that is made on top of the chip manufacturer's proprietary SDK. The firmware proposed a simple programming situation based on eLua (embedded Lua), which is a very modest and fast scripting language with a renowned creator community. The NodeMcu contains DEVKIT board that incorporates the ESP8266 chip on a standard circuit board. The board has a built-in USB port that is by now wired up with the chip, hardware reset button, wifi antenna, LED lights, and standard-sized GPIO (General Purpose Input Output) pins that can plug into a bread board.

The NodeMCU pin Schema

The Node Mcu has digital input/output pins. They can be used as digital inputs to read a digital voltage, or as digital outputs to output either 0V (sink current) or 3.3V (source current).The NodeMcu is a 3.3V microcontroller, so its I/O operates at 3.3V as well. The pins are not 5V tolerant, applying more than 3.6V on any pin will kill the chip. The NodeMcu has 17 GPIO pins (0-16), however, you can only use 11 of them, because 6 pins (GPIO 6-11) are used to join the flash memory chip. GPIO 1 and 3 are used as TX and RX of the hardware Serial port (UART), so in various cases, you can't use them as normal I/O whereas sending/receiving serial data.

The ESP8266 has a solitary analog input, with an input range of 0-1.0V. The NodeMCU have an on-board resistive voltage partition, to get an easier 0-3.3V range.

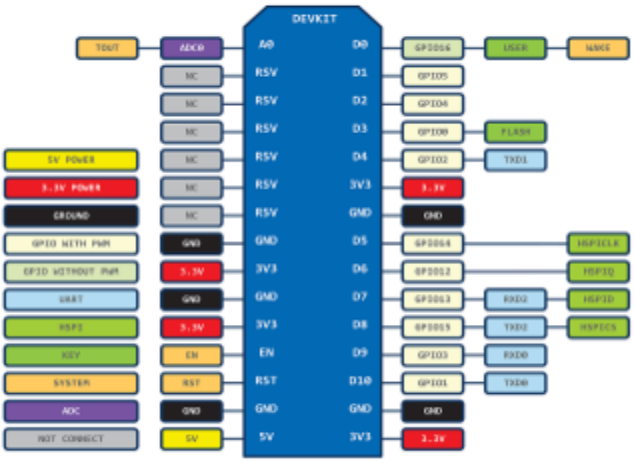

Fig. 3: Node Mcu Pin Schema.

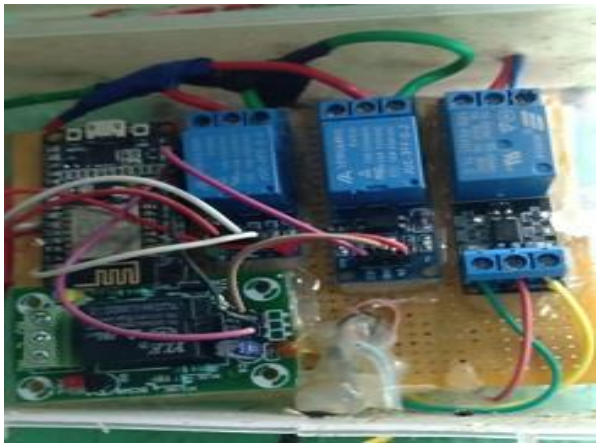

Fig. 4: Circuit Connection.

Most of the ESP8266 improvement boards have a built-in LED. This LED is usually connected to GPIO2.The RST pin is pulled LOW, the NodeMcu resets. This is the same as pressing the on-board RESET button.GPIO16 can be used to wake up the ESP8266 from deep sleep. To wake up the ESP8266 from deep sleep, GPIO16 should be associated to the RST pin. ESP8266 permits software PWM in all I/O pins: GPIO0 to GPIO16. PWM signals on ESP8266 have 10-bit resolution. The NodeMcu supports interrupts in any GPIO, except GPIO16.

The relays will work on 5V DC so one side of relay is connected to 5V DC of NodeMcu. The NodeMcu is a 3.3V microcontroller, so its I/O operates at 3.3V as well. Each relay has been provided by this voltage to work. An input pin is provided for each relays according to that input relay works.

In this circuit we have used two relays for the water motor to work automatically. One relay will act according to button press in the blynk app. The button widget is clicked to change the state of appliances. The present state (on/off) of appliance appears on the button widget.The other relay is used as timer relay which works on timer widget in blynk app. The following circuit shows overall connection of the circuit with relays as shown in Figure 4.

Blynk is a Podium with IOS and Android apps to regulate Arduino, Raspberry Pi and the likes over the Internet. It's a digital dashboard where you can build a graphic interface for your plan by solely dragging and dropping widgets. We want to install the Blynk Arduino Library, which supports generate the firmware running on your ESP8266.Blynk works with hundreds of hardware models and linking types. Select the Hardware type as NodeMcu.

IMPLEMENTATION AND RESULTS

To design the circuit, we have used NodeMcu and three relays are used. Each relay is selected as per the water motor current and power ratings. We have selected relays as 10v, 5A relays. The water motor varies as per the application like in industries, domestic and commercial. According to the water motor, the relays current and voltage ratings have to be selected. In this paper we used 1 HP water motor which operates with a maximum current of 5 Amperes.

An important feature of the Node MCU is its out-of-the-box WI-FI abilities. We can connect the NodeMCU device to any wifi network with a few lines of code.

```
Setup Wifi
wifi.setmode (wifi.STATION)
wifi.sta.config ("SSID","password")
```

We can set the NodeMcu digital pins as input or output. The Overall Purpose Input Output (GPIO) pins are digital pins on the NodeMCU DEVKIT board. Every pin can have solitary two states: a low voltage state and a high-voltage state, demonstrating 0 and 1 correspondingly. We can read the state from each pin, and then set the state.

```
Serial.begin(9600);
pinMode(D1,OUTPUT);
pinMode(D2,OUTPUT);
digitalWrite(D1,HIGH);
digitalWrite(D2,LOW);
Blynk.begin(auth, ssid, pass);
```

We can also specify server:

```
Blynk.begin(auth, ssid, pass, &amp;quot;blynk-cloud.com&amp;quot;, 8442);
Blynk.begin(auth, ssid, pass, IPAddress(192,168,1,100), 8442);
```

The working of circuit is out of two relays one is given input
as button input and other is by timer. Fig 5 shows the blynk app button widget.

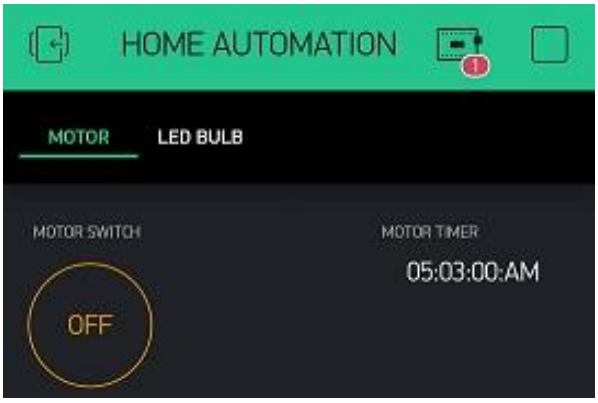

Fig. 5: Application Screen on Motor Tab Shows Status of Motor.

Motor switch widget will shows motor switch button which can be made on/off depending on user. The timer widget is shown in the figure below.

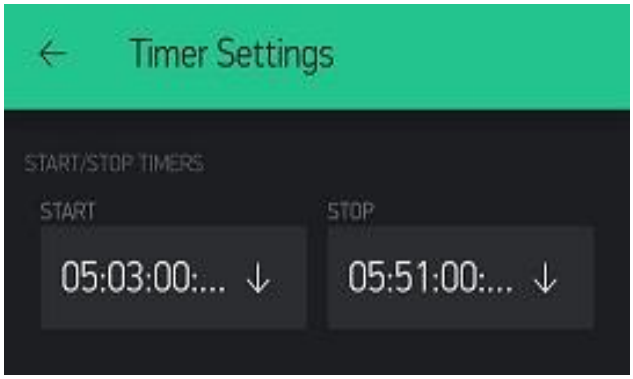

Fig. 6: Application Screen on Motor Tab Shows Timer of Motor.

In the motor timer widget we use two timers one is used for start timer and other is used for stop timer. So, the water motor can be started at specified time and stopped at specified time. Intervention of human is not need for this circuit. Motor circuit will controls the operation of water motor automatically without human need. So this circuit can be operated from any where. The only requirement is internet connected to this circuit.

Circuit we have presented in this paper cost less than 1k which can prevents human presence at highly operated current water motors. In industrial purpose such type of circuits are useful for smooth operation. Same circuit has been used for connection of other household devices which makes it a home automated circuit at very low cost.

CONCLUSION

In this paper, a model of a home automation system with suitable relays and NodeMcu circuit has been designed. This work can further be developed using different sensors and for different home appliances. Smart phones are widely used nowadays, so any person can operate the circuit with some basic knowledge. Many application development companies with dedicated teams are working extensively on IoT-based applications that are connected to the cloud. The results in this paper showed that using automated water motor circuit is simple and operatable for any age group persons. This circuit will reduce the risk of shock hazards. In future the same automated circuit work can be extended for complete home automation.

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