

Application of Artificial Intelligence in Internet of Things

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Abstract

Artificial intelligence is the best solution to manage huge data flows and storage in the IoT network. IoT nowadays becoming more and more popular with the inventions of high-speed internet networks and many advanced sensors that can be integrated into a microcontroller. The data flows internet now will have sensors data and user data that send and receive from the workstations. With the increase in the number of workstation and more and more sensors, some data may be facing problems on the storage, delay, channels limitation and congestion in the networks. To avoid all these problems, there were many algorithms were proposed in the past of 10 years. Among all the algorithms, Artificial Intelligence still being the best solution to the data mining, manage and control of congestion in the network. The aim of this paper is to present the application of artificial intelligence system in the IoT. The importance of data mining and management will be highlighted in the paper. Also, the method used in the Artificial Intelligence like fuzzy logics and neural network also will be discussed in this paper in conjunction with IoT network.

Keywords

Neural Network; Self-Optimizing Network; Software Defined Network; IoT; Artificial Intelligence.

I. Introduction:

IoT (Internet of Things) is a current technology to send a received the sensor data via internet networks. It is same like normal data communication except that in IoT, sensors and microcontrollers are usually used. The sending and receiving of data do not rely on the computer but relies on the microcontroller and portable communication devices such as cell phone, communication pad or even the smartwatch. With IoT, most of the sensors data can be directly routed into the server. This usually is done when the microcontroller is attached to WiFi and there is a connection between microcontroller and WiFi.

Unlike in traditional internet system, to send or receive data, the user must know the TCP/IP address and hence do the necessary setting in the network before transmission. Similarly, for WiFi connection, like in a portable computer, the user has to do connection with WiFi and ensure the service provider provide the channels, then the communication will be available.

In IoT, the WiFi setting usually is done through a programming. For example, Arduino program call for ESP command to have communication links will enable the ESP WiFi to make a necessary connection to the network. This can bypass a lot of steps in the internet setting. Configure the connection or setting through a program is much easier and convenient.

In some cases, the sensors belong to analogue. In order to send the analogue signals represents information signals, analogue to digital converter system must have. Luckily, in most of the modern microcontrollers like Arduino, there is a build in analogue to digital converter function. The only thing user should set in analogue to digital converter is the baud rate and resolution.

A very simple IoT system should comprise of self-optimizing network and software defined networks. The self-optimizing network helps to optimize the network for huge data transmission and reception. Normally in this optimizing network, time and the free channel will be computed and assigned to the user who wants to send and receive the data. The Self-optimizing network can be done automatically by a router and system update the router's table. The system will compute and determine the shortest path for the data to flows.

In software defined networks, a specific software will be used to program the data to send and received. Arduino programming language and Python are two examples of software defined networks. Both of the compilers can instruct the data send, store and received from the receivers.

In order for the Artificial Intelligence system applied into the IoT networks, certain terms and principles must understand. For Artificial intelligence, there are two commonly used techniques - neural network and fuzzy logic [1].

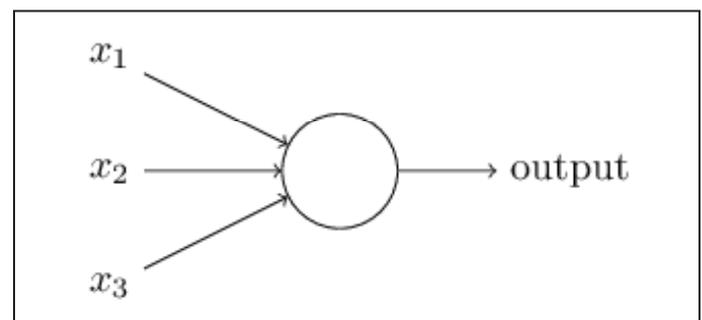


Fig. 1: The Principle of Artificial Intelligence

Fig. 1 shows a neural network system, which comprises of input x_1 to x_3 . All these inputs basically content weights by themselves, but they are not shown in the diagram. The middle circle component is the transfer function. It is a mathematical solution for the inputs. The solution will process the inputs then produce only one output. The decision making may be as below [2]:

$$\sum x_n > 1000 = 1$$

or

$$\sum x_n < 1000 = 0$$

The output either release 1 or 0 based on the transfer function and the decision making.

In more advanced Artificial Intelligence system, weight functions may be introduced to control the inputs. These weight functions produced weigh values that are parts of the parameters to control the input. The new output is reproduced from the input plus the control parameters in the transfer function. In some cases, the control parameters are adjusted so that the input signals can be trained. When input signals are trained, then the next inputs will be compared to the trained values. Finally the "yes" or "no" answer will appear at the output.

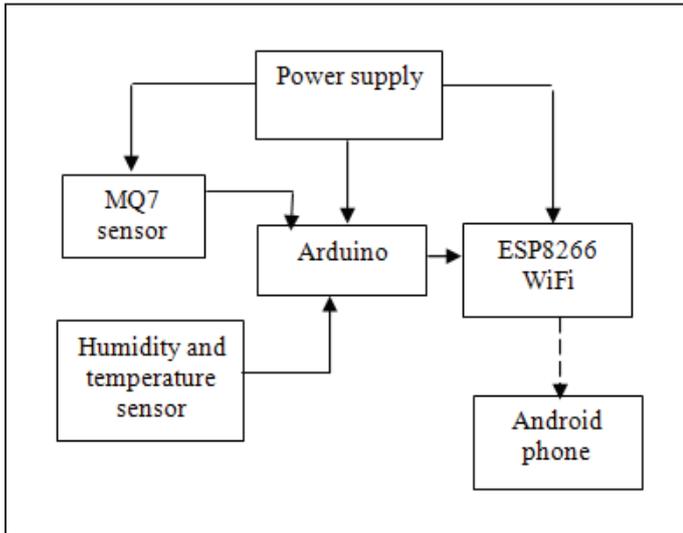


Fig. 3: The proposed IoT hardware implementation using Artificial Intelligence Technology

The proposed idea comprises of two sensors: MQ7 gas sensor and humidity sensor. Both sensors output are connected to Arduino microcontroller. The Arduino is then connected to ESP8266 WiFi chip. The connection between the Arduino and Android phone is via an air interface. The dotted line of the arrow as shown in fig. 4 represents an air interface.

B. Programming Design for Artificial Intelligence used in IoT:

By referring to block diagram as shown in fig. 4, the complete program written in Arduino C language is shown below:

```

#define BLYNK_PRINT Serial
#include "DHT.h"
#include <ESP8266_Lib.h>
#include <BlynkSimpleShieldEsp8266.h>
#include <SoftwareSerial.h>
SoftwareSerialEspSerial(2, 3); // RX, TX
#define DHTPIN 7
// Uncomment whatever type you're using!
#define DHTTYPE DHT11 // DHT 11
// #define DHTTYPE DHT22
#define DHTTYPE DHT21
// Startup the Artificial Intelligence
DHT dht(DHTPIN, DHTTYPE);

```

```
char auth[] = "24688ea5e1c44d5f874fdc5748e4aefe";
```

```
char ssid[] = "OPPO N5206";
char pass[] = "12345678";
```

```
#define ESP8266_BAUD 9600
```

```
ESP8266 wifi(&EspSerial);
```

```
BlynkTimer timer;
```

```
int mq7,mq135,hum,temp;
```

```
void setup() {
Serial.begin(9600);
```

```
delay(10);
```

```
// Set ESP8266 baud rate
EspSerial.begin(ESP8266_BAUD);
delay(10);
```

```
Blynk.begin(auth, wifi, ssid, pass);
timer.setInterval(15000L,SendWeb);
timer.setInterval(1000L,SendData);
```

```
dht.begin();
```

```
}
// Artificial Intelligences
void SendData()
```

```
{
float h = dht.readHumidity();
// Read temperature as Celsius (the default)
float t = dht.readTemperature();
// Read temperature as Fahrenheit (isFahrenheit = true)
//float f = dht.readTemperature(true);
```

```
hum = (int)h;
temp = (int)t;
```

```
mq7=analogRead(A1);
mq7=map(mq7,0,1023,0,255);
```

```
Blynk.virtualWrite(V1,mq7);
Blynk.virtualWrite(V2,temp);
Blynk.virtualWrite(V3,hum);
}
```

```
void SendWeb()
```

```
{
Blynk.virtualWrite(V0,mq7,temp,hum);
}
```

```
void loop() {
// Wait a few seconds between measurements.
Blynk.run();
timer.run();
}
```

V. Physical Prototype:

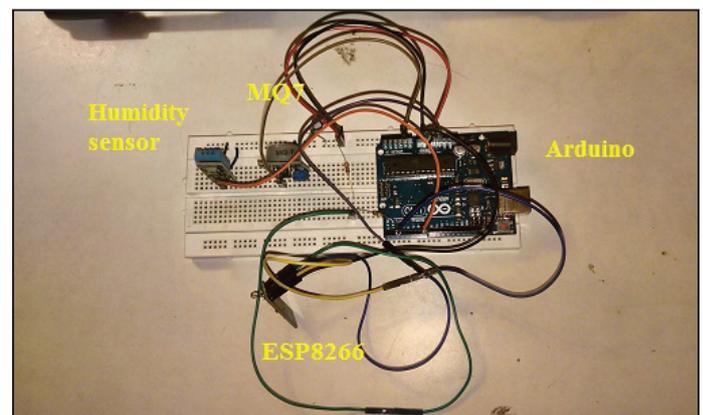


Fig. 4: Simple IoT Prototype with Artificial Intelligence

Notice that all the components are put on the breadboard to form a complete circuit and ready for testing. To test the system, the program in the previous section has to download into the Arduino and then follow the steps below to do the setup [8]:

1. Turn on the Arduino microcontroller
2. In the serial monitor of Arduino compiler, enter a correct WiFi username and password
3. Wait until the connection is read, then turn OFF the serial monitor

The serial monitor is a platform to check whether the Arduino has connected to WiFi or not. If the Arduino successfully connected to WiFi. The serial monitor will pop up a message and vice versa [9].

To view the data, one can access the page: <https://thingspeak.com/channels/296352> or Download a Blynk Apps and view the data. The data will be presented in the form of graphs [10].

The next section will an example of data plotted in the page of thingspeak.com. Note that, temperature and gas sensor data are plotted. The data is updated every 2 to 3 seconds.

VI. Conclusion

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