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An Integrated System for Regional Environmental Parameters Business Data Distribution Based on Internet of Things

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Abstract. *The measured data of temperature and humidity came from temperature sensor DS18B20 and humidity sensor DHT11. The data was processed by "Raspberry Pi", saved to a log file, transmitted via the internet to the Weibo platform and issued by special Sina Weibo accounts and Sina Weibo application. At the same time, the images produced by the measured data were also issued. The proposed system not only can issue images about temperature and humidity in real time, but also share data for others and do remote management through private messages or comments by owners of Sina Weibo. The developed system was verified using sensors and network of Internet of Things devices deployed at a selected location in Fujian University of Technology, China. The results show the system is very promising for data sharing and (IOT) application.*
Keywords: Raspberry Pi; IOT; DS18B20; DHT11

1. **Introduction.** With the advancement of the living standards of people, the publics demand for environment quality is becoming more and more strict. More and more people hope that they can get information about the environment by more effective means and have a better environment. In the practical production, there are methods that will help to meet the special requirements of production environment. For example, in the zone of agriculture, some parameters, temperature, humidity etc. are strictly controlled in a range, on the other hand, workers cannot always on the post that monitor the temperature, humidity and other information, so the technology of real-time monitoring system for solving these problems has been developed [1-3]. Joaquin Gutierrez et al. [4] reported an Automated Irrigation System Using a Wireless Sensor Network and GPRS Module, the system has a distributed wireless network of soil-moisture and temperature sensors placed in the root zone of the plants and has a duplex communication link based on a cellular-Internet interface that allowed for data inspection and irrigation scheduling to be programmed through a web page. The system was tested in a long term and it found that the water savings of up to 90% compared with tradition irrigation practices

of the agricultural zone. The result showed that the system has the potential to be useful in the zone of agriculture. Anuj Kumar et al. [5] proposed a system based on the Zigbee device and PIC18F4550 microcontroller for monitoring animal body temperature, surrounding temperature and humidity. The measured data from sensors can be present on GUI PC. The developed design, which is inexpensive and low power consumption, with high accuracy in a long term test and easy to operate, would be ergonomically usefully for livestock. Sean Dieter Tebje Kelly et al.[6] proposed a system used for monitoring environmental conditions and remote controlling by mean s of smart sensors and ZigBee network. The advantages of the developed system are to possess a higher reliability higher than 97% and good compatibility for other wireless sensor networks. Shifeng Fang et al. [7] introduced an integrated information system used for climate change and environmental monitoring and included multi-sensors which were used to collect data, networks which were used to collect data, profile server which used to store data, on-line analytical processing and application software which used to process and share data. After a long-term test, the result showed that the developed system provides a new route for environmental monitoring and management in the future. With all these advancement in research Mostly available system focuses only on data transmission between point to point. Literature review reveals that data sharing will be an important feature of real time environment monitoring in big data field in the near future [8-10].

Sina Weibo, established in 2009, which is the largest microblogging service in China, has become a major data sharing channel in our society [11,12]. It provides services that allow users to update brief content called "microblogs" that is visible for everyone [13]. The sharing content in the form of short sentences, individual images, web page links, or video links attracts many people. As of March 2017, Sina Weibo has about 340 Million users more than Twitter as it is the world's largest independent social media company. Subsequently, Sina Weibo is powerful tool for us to sharing data and real-time monitoring [14-16].

This paper illustrates an effective design based on Sina Weibo, Raspberry Pi and Wireless Network Card for condition monitoring and data sharing. The basic operations include data aggregation such as temperature, humidity etc., remote management and control of Relays, and providing data for other persons through IoT technology are the key functions of the developed system. It has many advantages such as intelligence, data sharing, data broadcasting, new technology at lower cost and high performance.

2. **System Overview.** Fig.1 depicts the Overall system structure. The system is consisting of sensors, raspberry PI, wireless network card and relative clients. The signals came from the sensors are transmitted and processed by Raspberry PI model B, then the output signals are sent to Sina Weibo platform through wireless network card. The continuous values of surrounding temperature and humidity can be displayed on clients such as personal computer, portable computer and mobile. The developed system has good compatibility for adding extra sensors, while it can be remote managed by owner of Sina Weibo comments.

2.1. **Raspberry PI model B.** A low-cost credit Vcard-sized single-board computer Raspberry Pi Model B has been used as the primary part of the developed system. The board can be worked like a desktop computer because: firstly, it also has CPU with 700MHz clock speed, 512M RAM, SD card storage, USB port, some interfacing peripherals such as SPI, HDMI port and 8 GPIO port for expansion and so on. As shown in Table.1; secondly Monitor, any generic USB computer keyboard and mouse may be operated on Raspberry PI board; finally, It supports many operating systems such as Raspbian,

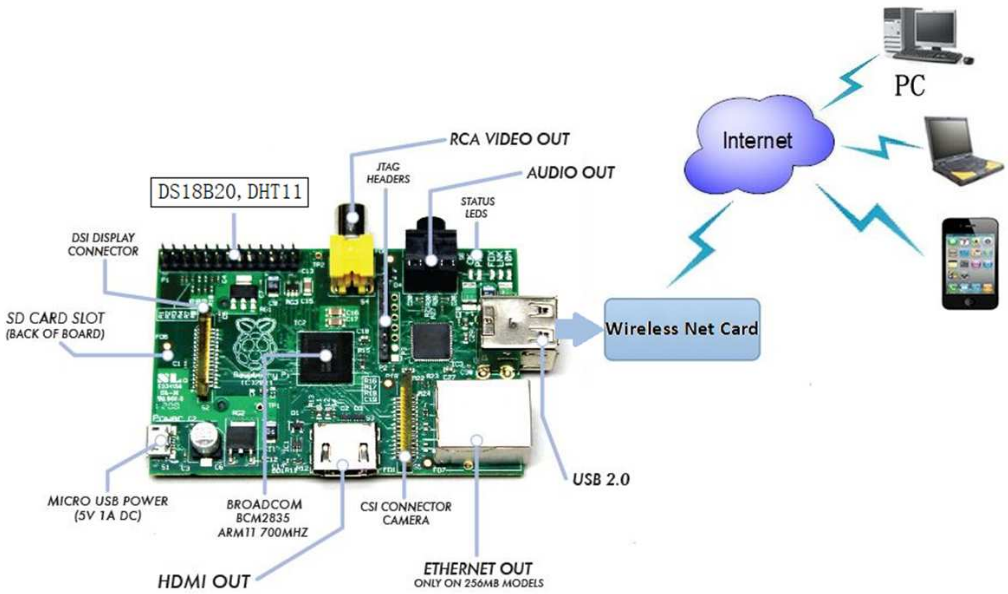

FIGURE 1. Overall system structure with different sensing units

OpenWrt, RISC OS Pi, HelenOS and so on. Raspbian, a Debian-based Linux operating system was used in this design [17].

TABLE 1. Specifications of raspberry PI model B

Type	Parameters
GPU	BroadcomBCM2835 (CPU, DSP, SDRAM, USB)
CPU	ARM1176JZF-S (700 MHz)
Memory	512MB
USB ports	2
on-board storage	SD/MMC/SDIO
on-board network	10/100 Ethernet
Low-level peripheral	8xGPIO, UART, I2C, SPI, +3.3V, +5V, ground
Power Ratings	700mA (3.5W)
Power Source	5V
Size	85.60 × 53.98 mm
Operating system	Debian GNU/Linux

2.2. **Temperature Sensor Module.** To sense the temperature of the surrounding area is used the DS18B20 sensor. DS1820 digital thermometer, which can convert the temperature to digital within 1 second and provide 9-bit digital value of temperature readings is good for temperature -55° $\sim$ +125°C readings with 0.5°C accuracy. As shown in Fig.2. Without external components or backup power supply, the sensors use a unique 1-wire protocol for connecting to the central processing unit [18-20]. The sensor can be directly connected and read by Raspberry PI for the driving of sensor has been embedded. The module w1-gpio and w1-therm can be Dynamic Loaded in Raspberry PI while the value of temperature could be found in file under "/sys/bus/w1/devices/w1/ bus/ master".

2.3. **Humidity Sensor Module.** DHT11 humidity sensor has been extensively used for the measurement of surrounding humidity [21-24]. DHT11 humidity sensor, which can spit out 40 bits data which are in the form of five segments including 8 bits humidity integral

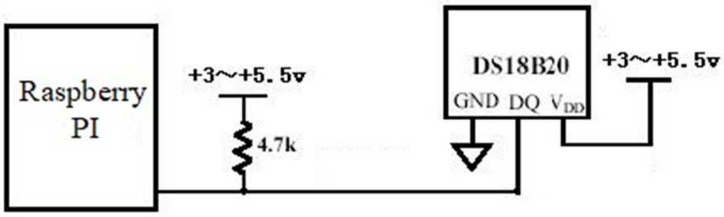

FIGURE 2. DS18B20 diagram

data, 8 bits humidity decimal data, 8 bits temperature integral data, 8 bits temperature decimal data and 8 bits check sum is chosen with the measurement range of 20-80% and the value-added volume of 5%.

A simple single-bus connection between DHT11 and Raspberry PI is shown in Fig.3. DHT11 works under 5 V supply voltage and has a maximum power of 2.5 mW. A 5 k pull-up resistor should be used when the connecting line of DHT11 and Raspberry PI within 20 m.

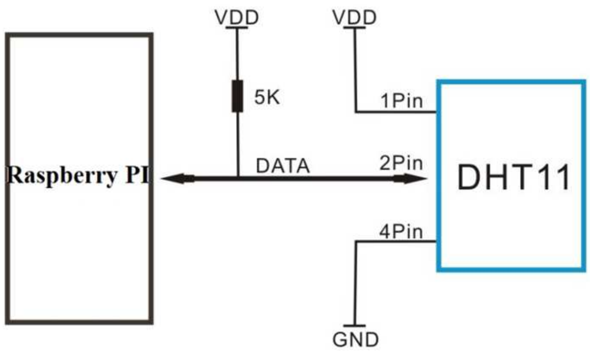

FIGURE 3. DHT11 circuit

3. **System Software.**

3.1. **Design of primary program.** The primary program uses for controlling the working of respective module, configuration and calling function. The command crontab of Linux root from the primary program was called once a minute for reading comment and going over command to do remote management. The primary program starts by reading comment, when it is time for testing data, then the measured data will be wrote into log file, the chart of measured data will be generated according requirement, the chart will be display on Sina Weibo.

3.2. **Soft design of sensors.** The driving of temperature sensor DS18B20 is provided by Raspberry PI official, but the data can be read from DHT11 though GPIO port because the driving of humidity sensor DHT11 is available by means of Wiring Pi library. The time of one communication handling between DHT11 and Raspberry PI is about 4 ms, once Raspberry PI sends out a start signal to DHT11, the DHT11 converted from low-power state to high speed state. After the ending of starting signal, the DHT 11 will sends out a response signal and 40 bits information of data and trigger a letter collection. The signal is sent as shown in Fig.4.Then the part of data information will be read and checked, If the data transmission is valid, the check-sum should be the last 8 bits of "8 bits integral RH data + 8 bits decimal RH data + 8 bits integral T data + 8 bits decimal

T data". Otherwise the data transmission is invalid. In our design, the transmission will be restarted after 3 s if the data transmission is invalid. The system will report an error, if the times of continuous invalid data transmission are five.

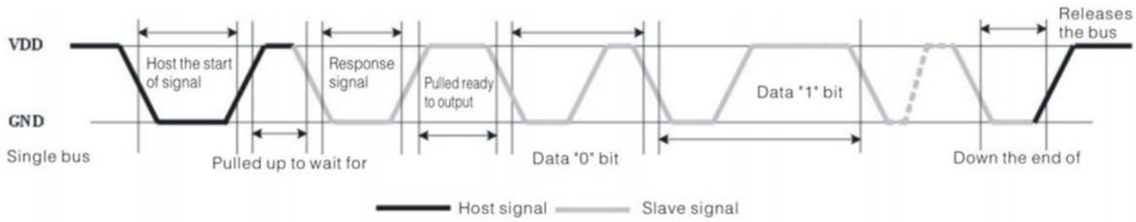

FIGURE 4. Data timing diagram

The Program process of reading data from DHT11 as follow:

```
uint8 readSensorData(void)
{
    uint8 crc;
    uint8 i;

    pinMode(pinNumber, OUTPUT); // set mode to output
    digitalWrite(pinNumber, 0); // output a high level
    delay(25);
    digitalWrite(pinNumber, 1); // output a low level
    pinMode(pinNumber, INPUT); // set mode to input
    pullUpDnControl(pinNumber, PUD_UP);

    delayMicroseconds(27);
     if(digitalRead(pinNumber)==0) //SENSOR ANS
        {
          while(!digitalRead(pinNumber)); //wait to high

        for(i=0;i¡32;i++)
        {
        while(digitalRead(pinNumber)); //data clock start
        while(!digitalRead(pinNumber)); //data start
          delayMicroseconds(HIGH_TIME);
          databuf*=2;
            if(digitalRead(pinNumber)==1) //1
            {
                databuf++;
            }
        }
```

The operating system of the Raspberry PI model B broad is Debian. Python was chosen as the primary programming language because it is easy to learn and suitable for real word application. The visualization of the measured data obtained from given Sensors DS18B20 and DHT11 was created by Matplotlib, a powerful two-dimensional and open-source Python plotting library. Since the data from the sensors is observed in real-time, the main goal is to set a time frame in which the measurements are performed, as well as an explanation and elaboration of the measurement range and sampling interval [25].

3.3. **Design of Sina Weibo API.** Sina Weibo provides Software Development Kit (SDK) including OAuth2.0 and API interface, and the Authorization was implemented though three parameters: userId, passwd, auth_url. APIClient of SDK can be called by information of Client and three parameters, furthermore, the access_token can be obtained, so that application that the account of Sina Weibo can be controlled by third-party App can be passed.

When the Authorization was passed, the interface was accessible each time by the application of access_token. Access_token is unique and would be used many times After return of OAuth2.0 certification, it can be stored in file so that the file can be directly read by the next call.

All kinds of Sina Weibo interface such as read-write comment, read-write micro-blog publication of Text micro-blog, publication of figure micro-blog can be found in link http://open.weibo.com/wiki/%E5%BE%AE%E5%8D%9AAPI. For example, a chart comes from measured data of developed system was published in Sina Weibo. The post of interface is shown in Table.3. The function statuses .upload.post() of SDK was called, the server of Sina Weibo would response a data of json form when the post is successful. The data could be read for identifying the chart was whether or not published.

Table 2. Interface parameter of uploading

Interface	Required	Type	Explanation
source	false	string	The parameter would be not need if the authorization is OAuth
access_token	false	string	The parameter would be need if the authorization is OAuth
status	true	string	Content of micro-blog
visible	false	int	Visibility,0: visible for everyone, 1: visible for myself, 2: visible for friends, 3: visible for appointed group.
list_id	false	string	It is useful when the parameter of visible is 3
pic	true	binary	Picture upload
lat	false	float	latitude
long	false	float	longitude
annotations	false	string	Metadata is convenient for third-party app to record the information that they used
rip	false	string	IP of owner

4. **Tests and Results.** The system has been deployed at the school of Information science and Engineering office area of the Fujian University of Technology for development and testing purposes. The accuracy of sensors and the overall functionality of the design under real-life conditions were verified for some months.

4.1. **Comparison with htc-1 hygromete.** Table.2 show a comparison of Temperature and humidity with htc-1 hygromete and DB18S20, DHT11. The test was performed in May and the results demonstrate that there are almost no difference between the measured data from system and the Field Test Data for htc-1 hygromete.

TABLE 3. Temperature and humidity of HTC-1 and DB18S20, DHT11

Time		8:00	9:00	11:00	11:30	12:00	13:00	14:00	15:00
Time °C	HTC-1	27.9	28.2	32.2	29.7	30.5	30.7	30.6	30.6
	DB18S20	27.875	28.187	32.187	29.75	30.437	30.75	30.625	30.562
Hum %	HTC-1	65	70	85	80	83	75	75	76
	DHT11	65	72	85	83	85	79	77	76

4.2. **Measurement.** Fig.5.comed from Sina Weibo platform presents data regarding temperature, humidity and time. The measured data was displayed in form of chat in Sina Weibo platform and the remote management will be carried out by owners comments of Sina Weibo.

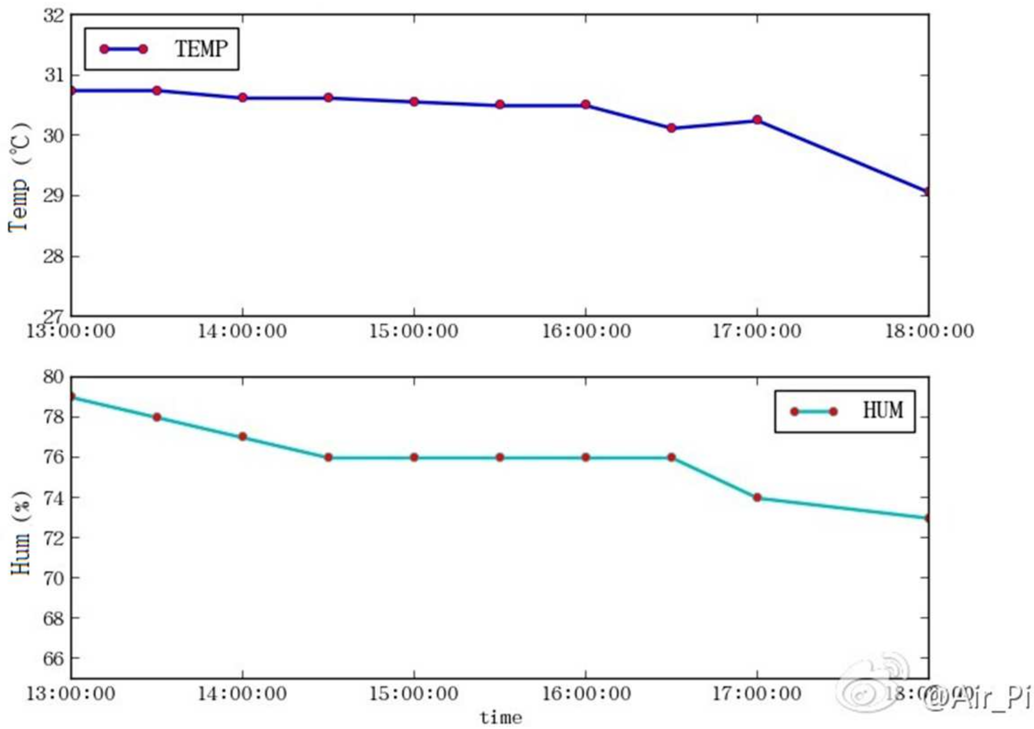

FIGURE 5. Measured data were displayed in Sina Weibo platform

5. **Conclusions.** In this paper, a prototype of An Integrated System for Regional Environmental parameters business data distribution Based on Internet of Things has been proposed. The detailed design was presented, and the results obtained from the system clearly indicate the attractive features of such a system. The system has a number of advantages, such as easy to share data, low cost, high accuracy, visualization of display, and It is suitable for many environmental monitoring and data collection workplaces such as greenhouse, workshop. Besides, this system is capable enough to monitor any gas, be it poisonous or flammable while connects with gas sensor. The approach of data sharing and remote management by Sina Weibo platform introduced in this design would serve as a paradigm for resource and environment real time monitoring in the near future.

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