Design and Research of Infusion Monitoring System Based on OneNET Platform

Le Zhang\textsuperscript{a}, Zhongwen Wang\textsuperscript{b}, Xiang Xiu\textsuperscript{c}, Quanqiang Li\textsuperscript{d}

Rongcheng College, Harbin university of science and technology, Weihai, China

\textsuperscript{a}maxwe1118@163.com, \textsuperscript{b}WangZhongwen@163.com, \textsuperscript{c}Xiu xiang@163.com, \\
\textsuperscript{d}Li Quanqiang@163.com

Abstract. This paper proposes an infusion monitoring system based on OneNET platform, with Arduino as the core control device, infrared tube to detect the drop rate and number of drops of infusion, non-contact liquid level sensor to detect residual liquid level, load cell detection drug The weight of the liquid, OneNET as the host computer cloud platform, upload data through the ESP8266 module and parse the issuing command, drive the step-by-click to control the drop rate of the drug, and when the value exceeds the standard, the message will be automatically pushed, and the medical staff can grasp the patient infusion in time. The real-time situation ensures the safety and reliability of the infusion process.

1. Introduction

With the development of computer IoT technology, the degree of intelligence of medical devices is getting higher and higher, and the concept of cloud is gradually becoming familiar. People hope to control the medical process anytime and anywhere, and create more intelligent, humanized and accurate medical treatment. device. In view of the shortcomings of traditional intravenous infusion control device in the process of injection, such as low precision of drip rate control, untimely change of liquid or sudden situation, and large workload of medical staff, this paper designs a new infusion system and existing infusion. Compared with the control system, the system has increased infusion status monitoring, infusion status control and remote monitoring applications, making the system more user-friendly.

2. Overall system design

The system uses the Arduino pro mini controller as the core, and connects the drip drop number detection module, the remaining liquid level detection module, the WIFI communication module, the HMI serial screen module, the drip speed control module, etc. to form the whole new infusion system. The main realization functions are: monitoring and reminding the dripping speed, the number of drops, the remaining liquid level, and the control of the drip speed through the mobile phone APP or the computer webpage. The overall framework of the infusion system is shown in Figure 1.
3. Hardware design

The hardware part of the system mainly includes the minimum system of Arduino Pro mini; the input end has drip speed, drop number detection module and residual liquid level detection module; the communication part has ESP8266 module; the output end has drip speed control module, infusion system application and HMI Serial screen display module.

The system uses Arduino Pro mini MCU, the processor core is ATmega328, with 14 digital IO ports (6 of which can be used as PWM output), 8 analog inputs, one crystal oscillator, no USB port, one reset button, low cost and fulfill requirements as shown in picture 2.

The input end uses an infrared pair tube with a diameter of 3 mm, and the drop nozzle is placed in the middle of the infrared pair tube. The output signal of the detection circuit is the falling edge signal detected when the droplet drops, and the drop speed and the number of drops are detected based on the falling edge signal. The mass sensor is used to obtain the quality of the liquid in the liquid storage bottle in real time. Use a non-contact level sensor to detect the remaining level of the reservoir.

The communication part adopts Lexin's ESP8266 low-power WIFI chip. It has a built-in 32-bit CPU and can run independently. It can also be used as a slave to run on other host MCUs. The module supports the standard IEEE802.11 b/g/n protocol. You can add networking functions to existing
devices, send AT commands to connect to the LAN, connect to the OneNET platform TCP server, and set the module to transparent mode to upload data and receive commands.

The output uses the hmi enhanced serial port screen of Taojingchi to display the current drop speed, the number of drops, the remaining liquid level and the estimated time consumption. The drip speed control module uses a 5v stepping motor to squeeze the dropper. After parsing the target drip rate of the issued command, it compares with the actual drip rate, and combines the pid algorithm to drive the stepper motor to control the infusion state more accurately.

4. Software design
The software design of this system is mainly divided into three parts: OneNET equipment cloud platform deployment, HMI serial screen interface design and programming of Arduino pro mini.

4.1. OneNET platform deployment
Before accessing OneNET, users must register their user account with OneNET, create a product under the Developer Center, get the Master-APIkey of the product information, and create a device in the product. The device will correspond to a device ID, Master-APIkey and device. The ID we use in the program is also the key information for our successful access to the platform. Then add data streams to the device, design the application, and set up triggers. According to the characteristics of the infusion system, we need to upload data and issue commands. The device access protocol selects the most suitable EDP protocol. The protocol is based on TCP. In the transparent transmission mode of ESP8266, the reported data and the issued command can be completed.

4.2. Serial screen interface and function design
The serial port screen is responsible for displaying the values measured by the sensor. Designed with usart hmi software, the interface design of the serial screen is very simple, while the design of the function requires programming. The system can display time, drip rate, number of drops, remaining liquid level and estimated time in real time, and can modify the capacity of the current vial.

4.3. Programming the Arduino pro mini
(1) Arduino initialization
The macro defines the product Master-APIkey and device ID, which is the Master-APIkey and device ID in 3.1. Initialize the serial port, connect the TX and RX ports to the ESP8266 as the communication terminal; D10 and D11 as the soft serial port (SoftwareSerial hmi (10, 11)) to connect to the serial port screen. Define and initialize the drip rate, the number of drops, and the remaining liquid level, which is expected to take time. Define a pointer to handle the EDP protocol package. Send an AT command to the presence of the WiFi module detection module. The baud rate of the serial port screen module is 9600, and the baud rate of the WIFI module is 115200.

(2) Serial screen display data
The serial screen display data requires a specific format. In order to simplify the program, write the Display function and simply call the function when sending the measured value of the sensor.

(3) Upload data to the OneNET platform
Send an EDP packet to connect to the OneNET platform. If there is no connection or the connection is broken, connect it. If the connection is successful, send the data.

(4) Command analysis
Because the system not only needs to upload data, but also adjusts the speed of infusion according to the commands issued by the user. Therefore, we need to analyze the data bytes that we really want to obtain in the lengthy order, in order to further regulate the infusion state.

5. Conclusion
Researches on infusion systems in clinical medicine at home and abroad have their own strengths. The infusion monitoring system based on the OneNET device cloud platform proposed in this paper can
effectively achieve the purpose of precise control. The “infusion system application” is designed to receive real-time drip rate and liquid level data. Medical staff can monitor patients in real time through computer webpage or mobile APP. Infusion conditions, stepper motor as the system's actuator and combined with PID algorithm to control the liquid drip speed, the study of drip infusion has an important significance.

Acknowledgments
This study was supported by the innovation and entrepreneurship training program for Provincial College Students of Harbin University of Science and Technology: Design and Production of a New Infusion System; Project Number: 201810214139.

References
[1] Nie Xuefang. Research and design of liquid droplet intelligent monitoring system [d]. Chengdu University of Technology, 2010.
[2] Chen Luzhou. Arduino programming basis [M]. Beijing: Aerospace University Press, 2014: 6-10.
[3] Wang Qi. Design of intelligent infusion detection system based on fuzzy theory [d]. East China University of Science and Technology, 2016.
[4] Fan Xinglong. Application of esp8266 in smart home monitoring system [j]. Single Chip Microcomputer and Embedded System Application, 2016, 16 (09): 52-56.
[5] Xu Guangxian, Guo Lin, Lu Wei. Design and implementation of intelligent infusion monitoring system [j]. Laser Journal, 2014, 35 (09): 119-121.
[6] CHEN Baoyuan, YAN Qingwen, SUN Zhongxiang, LUO Zhongming. An Intelligent Hardware Networking Method Based on OneNet Device Cloud[J]. Journal of Harbin University of Science and Technology, 2017, 22 (05): 76-80.