Intelligent Infusion Service Based on Open MV

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Abstract

This paper presents an intelligent infusion service system designed to reduce the workload of doctors and nurses and for the health of patients. The system is applied to the drip stand to create a "new type of drip stand" that will effectively solve a number of problems. It is dedicated to: "intelligent infusion process, improving the efficiency of health care workers and reducing their work stress and psychological burden". It embodies the concept of economy and structural rationality.
Keywords: intelligent infusion service system, new type of drip stand, economy, structural rationality

1. Introduction

Intravenous infusions are not only fast-acting, but they are also a widespread and effective medical treatment as they can be administered intravenously to reach the whole body quickly through the blood circulation. It is a widespread and effective method of medical treatment.

However, sometimes there are too many patients for the doctor or nurse to change the fluid or tube in time. When the pressure in the infusion line is lower than the pressure in the blood vessels, the blood will flow out of the infusion line, which is often referred to as "bleeding back". If the bleeding is prolonged, the blood will coagulate, causing clotting of the needle, which can lead to medical accidents and disputes between doctors and patients [1].

This can lead to medical malpractice and disputes between doctors and patients, or even death in severe cases!

Moreover, most of today's young people are only children, so they have to go to the hospital alone when they are sick and have no one to accompany them. When they get a transfusion, it can be very difficult to move around. The tall and bulky IV stand is seen by the patients as a jackal, blocking their access to toilets, water, food and so on.

2. Design Bbrief

Based on the idea of "reducing the work pressure of doctors and nurses, and for the sake of patients' health", we have designed an intelligent infusion service system, which will be applied to the drip stand to create a "new type of drip stand", which will effectively solve a series of problems, as shown in Figure 1

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2.1. *Highly accurate feedback on fluid levels*

The intelligent infusion service system, which is applied to the IV stand, enables real-time image acquisition of the height of the medicine in the IV bottle via the camera on top of the stand and combines it with an algorithm to calculate whether the bottle has run out of medicine and needs to be changed [2]. If it needs to be changed, the system connects to the hospital's nursing station via a remote WIFI module via a local area network, allowing the nurses to change it at the first opportunity.This allows the nurses to receive the information in time to change the medication for the patient, ensuring that every patient is attended to. This ensures that every patient is attended to.

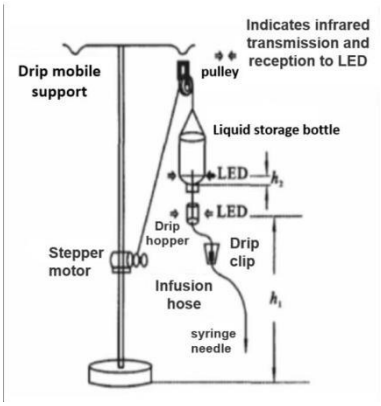

Figure 1. A conceptual model for smart drip

2.2. *drip rack mobile system*

The intelligent infusion service system also allows for patient monitoring via a pan-tilt camera mounted on the vertical bar of the drip stand. Facial recognition" is used to identify and bind the patient through facial analysis. The camera can rotate 360 degrees to see where the patient is The camera can be rotated 360 degrees to observe the patient's position and follow him/her, with the aid of a PID algorithm to set the following distance by means of feedback and negative feedback. The PID algorithm assists in the adjustment of feedback and negative feedback to set the following distance, so that the drip holder can follow the patient's walking and move to achieve "freeing the patient's hands" and realising the true "one person, one lever". This allows the patient to follow the patient's movement, freeing up the patient's hands and enabling true "one person, one lever" auto-following.

2.3. *Privacy security system*

When a patient finishes using the drip stand, the healthcare provider simply restarts the system and the previous patient's information is automatically erased. This not only allows for repeated and efficient use of the 'intelligent' drip rack, but also ensures that the privacy of the previous patient is not compromised. This not only allows for repeated and efficient use of the 'intelligent' drip rack, but also ensures that the privacy of the previous patient is not compromised.

2.4. *Design Advantageization*

1. Intelligent infusion process [3].
2 . Improve the work efficiency of medical and nursing staff.
3 . Reduce the work pressure and psychological burden of health care workers
4. Reduces the risk of blood return and air entering the infusion
5. Automatic sound and light alarm when the infusion is about to be completed, no need to "keep an eye on the bottle", reflecting the concept of humanization.
6. Suitable for all colours of medicine.
7. Simple structure, small size, light weight, reflecting the concept of simplicity;
8. Low price, can be used repeatedly;
9. Sensitive response, safe and reliable;
10. No electromagnetic radiation interference;
11. Mechanical monitoring, no contact with the liquid, safe and hygienic;
12. It is possible to infuse each bottle of medicine as much as possible without wasting the medicine, reflecting the concept of saving;
13. The infusion control device effectively ensures that the working schedule of the medical staff is reasonable.

3. Design process

3.1. *Total design solution*

The intelligent infusion service system, which is applied to the IV stand, enables real-time image capture of the height of the medicine in the IV bottle via the Open MV camera on top of the stand and combines it with an algorithm to calculate whether the bottle has run out of medicine and needs to be replaced. This is shown in Figure 2 below [4].

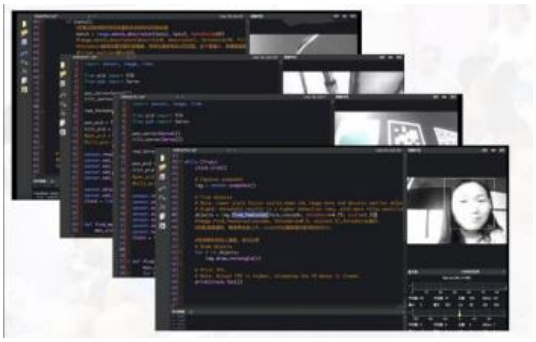

Figure 2. Open MV identifies the persona

If it needs to be changed, the system connects to the hospital's nurses' station via a remote WIFI module via a local area network, allowing nurses to receive the information in time to change the medication for the patient, ensuring that every patient is attended to.The Intelligent Infusion Service system also allows the patient to be identified and bound to the patient through facial analysis by means of a pan-tilt camera mounted on the vertical pole of the drip stand, while the distance between the patient and the infusion pole is determined through a PID

algorithm, as shown in Figure 3 below, and followed in real time to fully address the problem of patient movement.

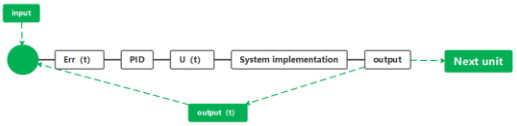

Figure 3. PID unit cycle once process

The intelligent infusion service structure includes various functions such as camera acquisition, wireless remote control alarm, vision and other sensors reading information, automatic following, Bluetooth control, IOT management system, etc. as shown in Figure 4.

In summary, we designed the original idea to free nurses and caregivers to the maximum extent possible and to facilitate the development of the medical profession. To achieve technological intelligence + medical treatment.

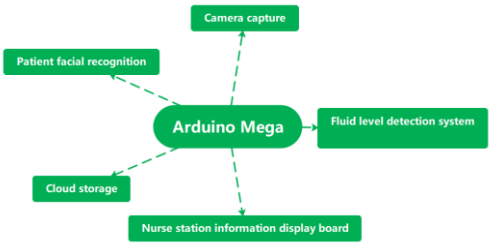

Figure 4. Operating applications of the control panel

3.2. *Introduction to PID*

Next we look at the basic PID equation, as shown in equation (1) below [5].

$$u(t) = Kp[e(t) + \frac{1}{Ti}\int_0^t e(t)dt + Td\frac{de(t)}{dt}] \quad (1)$$

There are two general expressions for PID, a positional PID and an incremental PID, which calculates the change in value of the output of the system in the current control system.

At present, the intelligent infusion system we have designed uses incremental PID, which calculates the difference between the current position and the last position and the expected position, so that the system can quickly and accurately track the patient (patient) in order not to rip off the infusion tube or bottle. Safety problems are thus avoided to a great extent.

The above formulae are collated and deformed to give the following equation, as in equation (2).

$$u(t) = Kp \times e(t) + Kp \times \frac{1}{Ti}\int_0^t e(t)dt + Kp \times Td \times Td \times \frac{de(t)}{dt} \quad (2)$$

4. Example of operation

4.1. *Method of use*

We have simplified the use into the following steps：

Step 1: After the infusion is normal, clip the upper end of the infusion tube into the detection slot.

Step 2: Press the S/R (Start/Reset) key, the alarm will sound "Bi-Bi" twice and the alarm will turn on.

Step 3: Press the S/R key again, the alarm will sound "Bi" and the green light will flash, entering the initialisation state.

Step 4: After about 15s, the alarm will give a long "Bi" sound and the green light will flash slowly to enter the working state.

Step 5: When the infusion is completed, a continuous "Bi-Bi" beep will sound and the green light will flash rapidly, and the infusion tube will be blocked.

Step 6: Press the S/R key, the alarm will sound "Bi-Bi" twice and the pressure wheel will release the infusion tube.

Step 7: Switch off: Press and hold the S/R key, the green light will turn off after about 3s and the alarm will switch off.

Step 8: Charging: Plug in the charging transformer in the off state and press and hold the S/R key for 5 seconds, then release the key when the green light comes on for the second time. After about 4 to 8 hours the red light goes out, indicating that charging is complete. The alarm can be used normally in the charged state.

Step 9: When the alarm is working, a short "Bi" tone is emitted every 30 seconds, indicating that the battery is low and needs to be charged. Plug in the charging transformer to recharge immediately. If the alarm is not recharged after approximately 10 minutes, the alarm will automatically switch off after the "Bi" tone and the infusion will be blocked.

4.2. *Illustrated overview*

To make it easier to understand, we give a picture to explain, which shows the components of the system, the interconnection between the various positions [6], in layman's terms and easy to understand as follows in Figure 5.

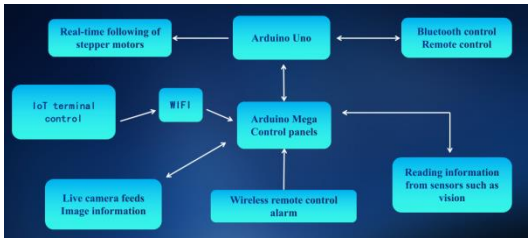

Figure 5. Single system linkage map for each service

5. Concluding remarks

The rapid development of modern technology today has made life faster and medical care + smart technology has become the mainstream of society. In the future, most of the traditional medical treatments will be replaced by modern medical treatments and the information age will usher in a "revolutionary upgrade" of modern medical treatments. This not only reflects a comprehensive upgrade in the medical field, but also gives rise to many more applications. Technology for good, high technology can create even better conditions for the general public.

We have every reason to believe that in the near future we will be able to fit in medical technology that will help patients to overcome their difficulties and be widely appreciated by them [7]. We have greater confidence in this, because it is the country's hope for the future of human healthcare and a satisfactory answer to a major problem such as human health.

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Authors Introduction

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He participated in the American College Mathematical Contest in Modeling as a modeler and data analyst in early 2022 and won the s Award. During his freshman year, he published one international CPCI paper. In 2022, he attended the "Hi cool" Global Entrepreneur Summit with his mentor.

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He is a current undergraduate student of Tianjin University of Science and Technology, majoring in Robotics Engineering, Class of 2021. He won a scholarship at the university level. In 2022, he won the second prize in the North China Robotics Competition and the third prize at the municipal level.

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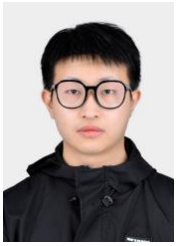
Mr. Feiyang Qu



He is an undergraduate student of Robotics Engineering in the School of Electronic Information and Automation of Tianjin University of Science and Technology. He has a good command of C++, Python and other languages, CAD, UG, PrAe and other software, and has participated in mathematical modeling competitions.

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