

Original Article

An Intelligent Epidemic Prevention Desk Based on Daily Public Health Protection

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Abstract - Since the outbreak, many public places have been taking artificial temperature disinfection measures to guarantee health and safety, and considering the current epidemic situation and pneumonia virus possible for a long time, we can design the intelligent automatic temperature measurement, automatic disinfection of the table, make daily epidemic prevention and control and intelligent, and improve the accuracy of monitoring, is helpful for epidemic prevention, It's also good for public health as a whole. The table adopts STM32 single-chip microcomputer as the control board to control the relevant mechanical structure. The additional Internet module can also control the start command and the feedback collection of relevant functional information more intelligently, which is a positive innovation in public health protection. The full automatic non-contact infrared induction characterizes the table itself, and its own low cost and wide range of audience is also the advantage of its subsequent promotion. The team members are divided into mechanical, electronic control, hardware, and publicity groups. The first version of this product participated in the 2021 Shanghai Machinery Innovation Competition and won the first prize in the city. The subsequent product optimization team also has a clear goal and will continue to combine the intelligence of the work with the Internet information function.

Keywords - Epidemic prevention, Control intelligent automatic epidemic prevention desk.

I. INTRODUCTION

At the beginning of 2020, the NOVEL coronavirus epidemic hit our quiet life and made us more aware of the importance of public health protection. After the epidemic stabilized, we entered the normal epidemic prevention and control. How to better carry out daily public health protection has become the focus of our thinking.

The focus of regular epidemic prevention and control is public prevention and control, while hospitals, classrooms, meeting rooms, and other public areas are prone to virus transmission. Therefore, if a smart epidemic prevention desk can be used in hospitals, classrooms, conference rooms, and other public areas, it can better normalize epidemic prevention and control.

Considering China's huge population, the hospital's consulting room, various enterprises' offices, and meeting rooms are also many. We made this smart table of energy production and popularity, which will have a good prospect for development and important practical significance.

But now the actual scene, there are few applications of the intelligent table. It is largely applied to information intelligent office desks. Expensive, such as in the United States to launch a smart table with a USB interface, Bluetooth, and wireless networks that can be combined with other fitness applications, intelligent high. Still, the price is close to twenty-five thousand yuan. Similar problems exist with smart desks, which are expensive and have little penetration. In the health and epidemic prevention table for the epidemic environment, the intelligent function is reflected in the instant intelligent measurement and disinfection so that the product has a clear and practical function, unlike other products that require high network information technology, which can reduce the production cost is conducive to physical promotion.

The importance of public health issues under the epidemic is self-evident. The functions of instant disinfection and temperature detection brought by smart desks can also play the greatest value in extremely densely populated hospitals, schools, office buildings, and offices.

From this, we began the concrete design scheme. For the sustainability and accuracy of intelligent temperature measurement and automatic disinfection of the two functions of physical design, there are basic mechanical structure design and electric control ideas.

II. OVERALL SCHEME DESIGN AND WORKING PRINCIPLE

A. Overall Scheme Design

After learning a lot of materials and sorting out and analyzing user feedback and evaluation articles collected in the early stage, the following design schemes and research and development directions were obtained.

B. Temperature measurement

The real-time temperature measurement function is designed for the error and unnecessary trouble caused by artificial temperature measurement: the specific parts of the



human body are measured by mechanical equipment many times, saving human resources and in the case of not disturbing the user's office, and writing display its physical condition, and according to the possible situation of the report.

C. Abnormal Alarm

When the user with abnormal body temperature is detected, it will automatically prompt and upload to the system and issue an alarm when necessary.

D. Environmental disinfection

Set a fixed time, such as commuting, and automatically sterilize the environment after school: block the spread of possible pathogens, achieve reasonable and timely cleaning, and achieve the normalization of epidemic prevention and control.

E. Disinfection of Pen Holder

Considering the frequent use of pens in hospital outpatient service, banking, and students' homework, an intelligent rotating disinfection pen holder is designed. After using the pen once and putting it back, the pen holder automatically rotates for disinfection. The previously

sterilized pen will be put up for the next user to use without waiting.

F. Hand Disinfection

Considering that the epidemic prevention table is used in public places and the automatic overall environmental disinfection, the automatic extrusion device of hand sanitizer is added to reduce human labor and avoid cross-infection at the mouth of the disinfection bottle, and ensure the personal cleanliness of users' hands.

G. Electronic Control

It mainly aims to control movement, lift, and start of measuring temperature disinfection device, including induction device, etc. The temperature measurement function collects the temperature data from the sensor. The voltage signal is amplified to the working voltage range of the single-chip microcomputer by the amplifier circuit. The voltage signal is converted into a digital signal by an A/D converter. The temperature measurement results will be connected with the mobile network client using a single chip as the processor in future research and development.

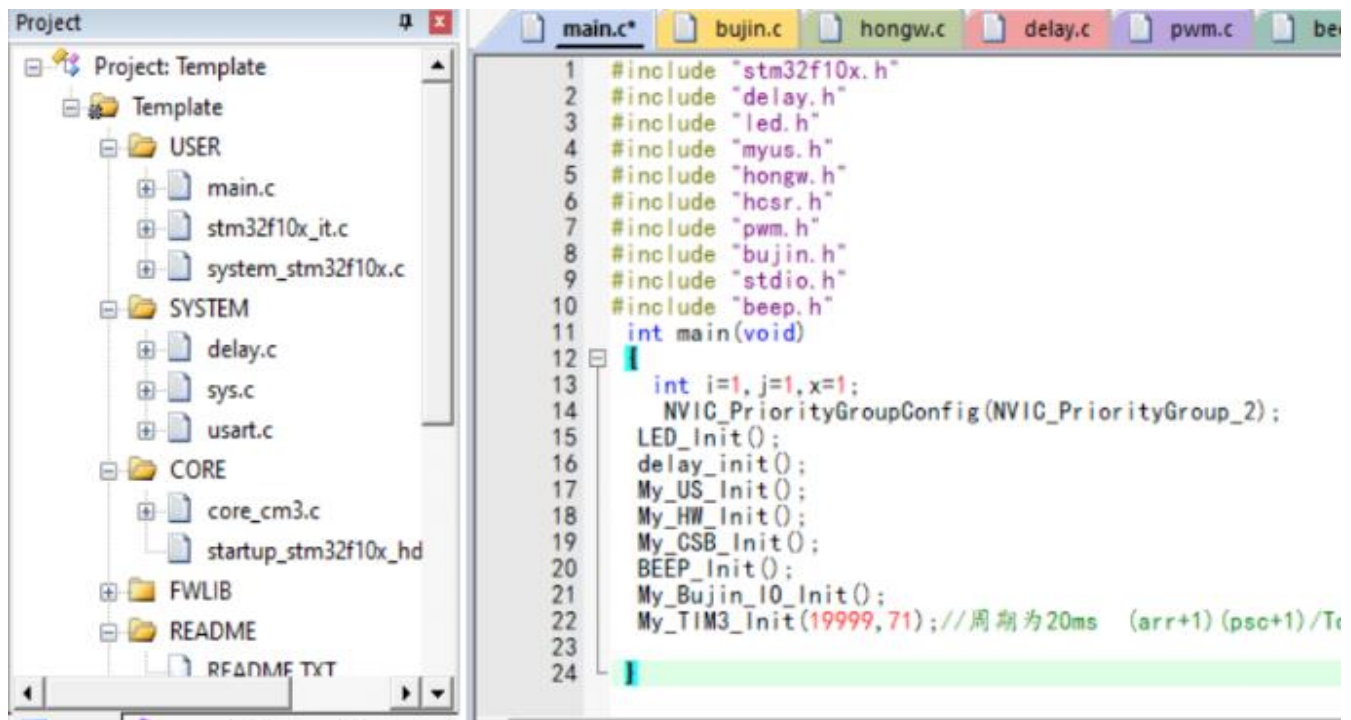


Fig. 1 Main functions of electronic control of intelligent epidemic prevention desk

C. Mechanical aspects

The whole research in the production process of reference to the actual desk, using solid Works to complete the modeling, and then using a variety of mechanical structures have been designed to complete the function of intelligent epidemic prevention desk, finally through testing and experiments to make the physical object and continuous optimization.

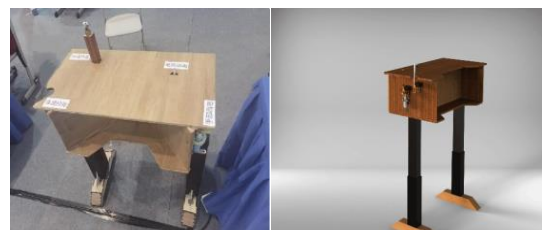


Fig. 2 Overall design of intelligent epidemic prevention desk

III. WORKING PRINCIPLES

A. Temperature Measurement

Mechanical part: the device uses 1 steering gear and 1 infrared temperature measurement module, under the condition of not disturbing the user, to achieve intelligent and accurate temperature measurement. When sensing that people are seated, the steering gear replaced by the connecting rod drives the device to rotate so that it rotates to the top of the table, and the temperature measurement module will measure the hand's temperature in the area.

Electric control part: mainly use infrared temperature sensor module, STM32. When temperature measurement is required, the mechanism is operated by an electric motor and rotates from the right side of the table. The infrared temperature sensor module on the top is connected by DuPont wire, and the Arduino hardware is connected to STM32 through serial communication to realize the reception of temperature data. Through the judgment statement, combined with the temperature corresponding curve obtained from the experiment, the user's temperature is in an effective and normal range.

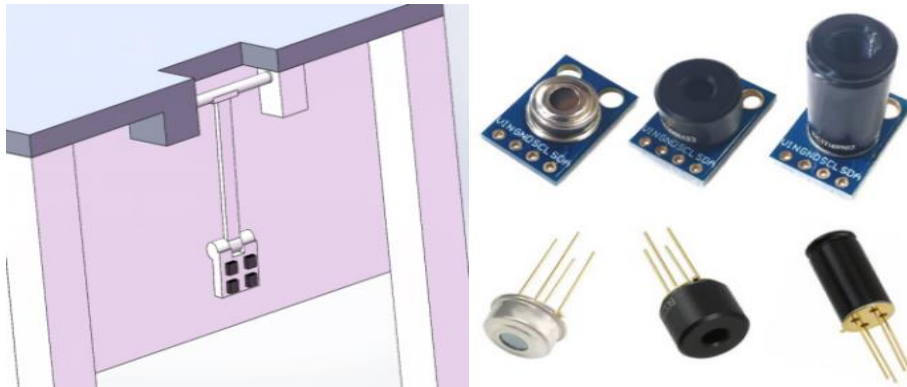


Fig. 3 Temperature measuring mechanical model and sensor

```

1  #include "bujin.h"
2  #include "delay.h"
3
4  void My_Bujin_IO_Init(void)
5  {
6      GPIO_InitTypeDef GPIO_InitStructure;
7      RCC_APB2PeriphClockCmd(RCC_APB2Periph_GPIOB, ENABLE);
8      GPIO_InitStructure.GPIO_Mode=GPIO_Mode_Out_PP;
9      GPIO_InitStructure.GPIO_Pin=GPIO_Pin_0|GPIO_Pin_5;
10     GPIO_InitStructure.GPIO_Speed=GPIO_Speed_50MHz;
11     GPIO_Init(GPIOB, &GPIO_InitStructure);
12 }
13
14 void Bujin_Move(u16 model,u16 turn)
15 {
16     int delayT=50;
17     int i=0;
18
19     if(model==0)
20     {
21         GPIO_ResetBits(GPIOB, GPIO_Pin_5);
22         for(i=0; i<turn*3900; i++)
23         {
24             GPIO_SetBits(GPIOB, GPIO_Pin_0);
25             delay_us(delayT);
26             GPIO_ResetBits(GPIOB, GPIO_Pin_0);
27             delay_us(delayT);
28         }
29     }
30 }

```

Fig. 4 Temperature control procedure

B. Abnormal Alarm

Electric control part: Temperature measurement function in the use of the sensor for temperature data collection, voltage is amplified by amplifying circuit and single-chip microcomputer working voltage range, the A/D converter, the voltage signal into a digital signal, when the temperature measuring device to detect continuous abnormal temperature, a small table on the side of the red light will light up to alert (according to usage scenarios also can be used open buzzer alarm). At the same time, the WiFi module can be used to timely report abnormal data to the supervisor's computer and mobile phone system, or the app can be specially used to receive and process temperature information.

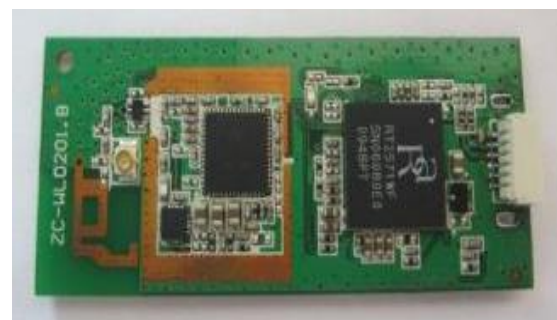


Fig. 5 WIFI module

```

#include "beep.h"
void BEEP_Init(void)

GPIO_InitTypeDef GPIO_InitStructure;

RCC_APB2PeriphClockCmd(RCC_APB2Periph_GPIOB, ENABLE); //使能GPIOB端口时钟

GPIO_InitStructure.GPIO_Pin = GPIO_Pin_8; //BEEP-->PB.8 端口配置
GPIO_InitStructure.GPIO_Mode = GPIO_Mode_Out_PP; //推挽输出
GPIO_InitStructure.GPIO_Speed = GPIO_Speed_50MHz; //速度为50MHz
GPIO_Init(GPIOB, &GPIO_InitStructure); //根据参数初始化GPIOB.8

GPIO_ResetBits(GPIOB, GPIO_Pin_8); //输出0, 关闭蜂鸣器输出
    
```

Fig. 6 Buzzer program Settings

C. Environmental disinfection

Mechanical part: The automatic disinfection device (as shown in Fig7) is located in the upper left corner of the table. The two sleeve joints of the disinfection lifting device are threaded. When the two cylinders rotate relative to each other, the vertical positions of the two cylinders change, similar to screws and nuts. The outer sleeve is like a nut, which is relatively fixed with the rotating part of the steering gear. Through the rotation of the steering gear, the outer sleeve (nut) is driven to rotate, forcing the inner cylinder (like a screw) to rise and fall. When the nozzle reaches the highest point, the disinfection device spits out disinfectant (as shown in Fig8). The ejection principle uses a miniature water pump to connect the blue disinfection bottle and the mist nozzle with an infusion tube, as shown in Fig8 (the infusion tube is omitted).

Electric control: steering gear, small water pump, mist nozzle, and two power supplies. Micropump and steering gear or push rod connecting the power supply respectively, two single-chip microcomputer serial port connection of two power supply, set a fixed time (hospital working hours) and motor operation by the single-chip microcomputer control pump source is turned on, the lifting gear up and spray mist disinfectant disinfection (as shown in Fig9), after some time MCU instruction shut down the pump power, and make the device lowered, Complete automatic disinfection. Will also set the button on duty working hours, but when not used for a long time, the relevant personnel can press the button for disinfection timely to ensure the health situation.

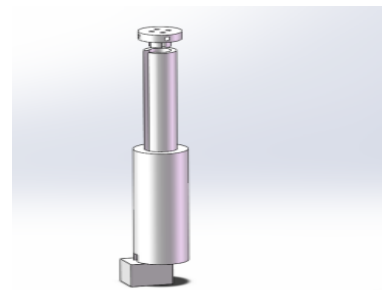


Fig. 7 Pushrod of Disinfection Device



Fig. 8 Disinfection spraying

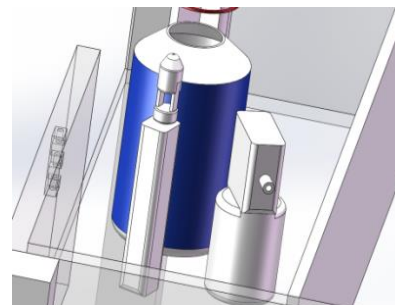


Fig. 9 Disinfection connection principle

D. Pen Holder Disinfection

Mechanical part: sterilized pen holder (as shown in Fig10), consisting of a simple cylindrical pen holder, motor, steering gear, and lever. The penholder is divided into four parts, and the base can be moved up and down. Initial state

lever instead of steering wheel position for making a pen container base through the desktop round hole out of desktop users takes arch. When the pen by circular Kong Fang back, motor and steering gear can alternate, spin makes use pen to disinfection spray area, and rising part has been done disinfection pen instead of a lever to lift the arch used next time. Disinfect the connection (see Figure11).

Electric control part: infrared ranging or pressure sensing device (as shown in Fig12) is used to measure the taking or putting back of the pen. The steering motor drives the lever to rotate and drop when the pen is taken away. When the pen is put back, the single-chip microcomputer controls the motor to rotate at a certain Angle to transfer the pen to the disinfection area. Then the steering motor is delayed to start the lever lifting to lift the new pen.

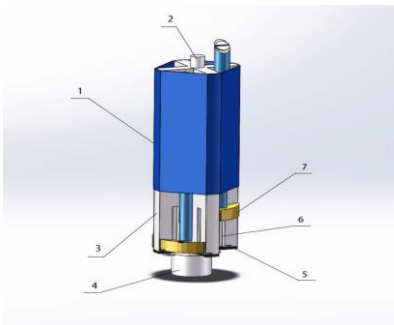


Fig. 10 Rotating pen holder

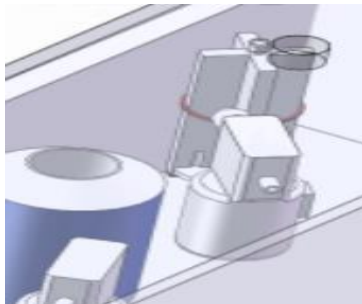


Fig. 11 Disinfection area of the pen holder

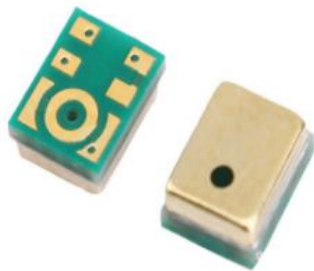


Fig. 12 Pressure sensing module

```
void TIM2_IRQHandler(void)
{
    if(TIM_GetITStatus(TIM2, TIM_IT_Update) != RESET)
    {
        N += 1;
    }
    TIM_ClearITPendingBit(TIM2, TIM_IT_Update); //清除中断标志位
}

int count=0;
float Distance(void)
{
    GPIO_ResetBits(GPIOB, GPIO_Pin_6); //预先拉低Trig引脚
    GPIO_SetBits(GPIOB, GPIO_Pin_6);
    delay_us(20);
    GPIO_ResetBits(GPIOB, GPIO_Pin_6); //发出10us的脉冲
    while(GPIO_ReadInputDataBit(GPIOB, GPIO_Pin_7) == 0); //等待
    //N=0;
    TIM2->CNT=0; //us级别读取
    while(GPIO_ReadInputDataBit(GPIOB, GPIO_Pin_7) == 1); //等待
    count=TIM2->CNT;
    //count=N;
    //单位cm
    //v = 340m/s = 34000cm/s = 34000cm/10^6us = 0.034cm/us
    //s = vt/2 = t*0.034/2 = t*0.017 ≈ t/58
    distance=(float)count/58;
    return distance;
}
```

Fig. 13 Pressure sensing module program configuration

E. Hand disinfection

Mechanical part: Hand disinfection device, as shown in Fig14. This device only needs to use one steering gear, generally composed of the grippers on both sides and the middle plate. The grippers on both sides can ensure the stable grasp of most bottled disinfectants on the market by restricting the one-way gear on the top of the rotating gripper shaft. The elastic top plate is adopted at the top, which is in contact with the top, pressing the head of the bottled disinfectant. When the steering wheel rotates counterclockwise, the pressure rod of the steering wheel squeezes the elastic top plate downward, thus squeezing the pressing head of the bottled disinfectant to realize the automatic pressing of the disinfectant once.

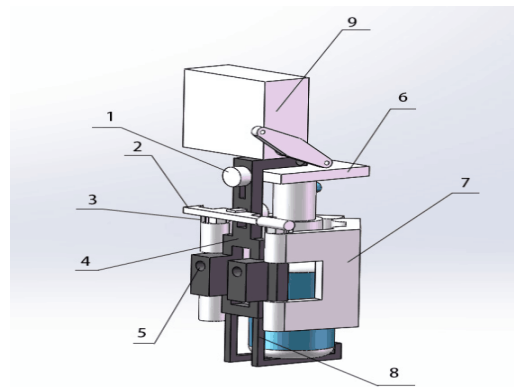


Fig. 14 Smart hand disinfection model diagram

```

#include "pwm.h"
#include "led.h"
//PA6,PA7 TIM3CH12
void My_TIM3_Init(u16 arr,u16 psc)
{
    GPIO_InitTypeDef GPIO_InitStructure;
    TIM_TimeBaseInitTypeDef TIM_TimeBaseInitStruct;
    TIM_OCInitTypeDef TIM_OCInitStruct;

    RCC_APB2PeriphClockCmd(RCC_APB2Periph_GPIOA, ENABLE);
    RCC_APB1PeriphClockCmd(RCC_APB1Periph_TIM3, ENABLE);
    RCC_APB2PeriphClockCmd(RCC_APB2Periph_AFIO, ENABLE);

    GPIO_InitStructure.GPIO_Mode=GPIO_Mode_AF_PP;//复用推挽
    GPIO_InitStructure.GPIO_Pin=GPIO_Pin_6|GPIO_Pin_7;
    GPIO_InitStructure.GPIO_Speed=GPIO_Speed_50MHz;

    TIM_TimeBaseInitStruct.TIM_ClockDivision=TIM_CKD_DIV1;//分频因子
    TIM_TimeBaseInitStruct.TIM_CounterMode=TIM_CounterMode_Up;//向上计数
    TIM_TimeBaseInitStruct.TIM_Period=arr;//自动重装载值
    TIM_TimeBaseInitStruct.TIM_Prescaler=psc;//预分频系数

    TIM_OCInitStruct.TIM_OCMode=TIM_OCMode_PWM1;
    TIM_OCInitStruct.TIM_OCNPolarity=TIM_OCNPolarity_High;
    TIM_OCInitStruct.TIM_OutputState=TIM_OutputState_Enable;
    GPIO_Init(GPIOA, &GPIO_InitStructure);
    TIM_TimeBaseInit(TIM3, &TIM_TimeBaseInitStruct);
    TIM_OC1Init(TIM3, &TIM_OCInitStruct);//通道1
    TIM_OC2Init(TIM3, &TIM_OCInitStruct);//通道2

    TIM_OC1PreloadConfig(TIM3, TIM_OCPreload_Enable); //使能预装载寄存器
    TIM_OC2PreloadConfig(TIM3, TIM_OCPreload_Enable);
    TIM_Cmd(TIM3, ENABLE); //使能TIM2
}

```

Fig. 15 Smart hand disinfection program configuration

IV. MARKET ANALYSIS

Now, there are few practical application scenarios for smart desks and is largely applied to information intelligent office desk and are expensive; such as; in the United States to launch a smart table with a USB interface, Bluetooth, and wireless networks can be combined with other fitness applications, intelligent high. Still, the price is close to twenty-five thousand yuan. A similar problem is the situation of the existing smart desk, making it expensive, low popularity coverage. in the health and epidemic prevention table for the epidemic environment, the intelligent function is reflected in the instant intelligent measurement and disinfection so that the product has a clear and practical function; unlike other products that require high network information technology and expensive hardware, can reduce the production cost is conducive to physical promotion. Its unique intelligence is aimed at public health, so it has no direct competition with the product; the competitive pressure is small. The following Fig 16 shows our online and offline market survey before design.



Fig. 16 Market survey chart

V. OUTLOOK AND SUMMARY

A. Future Outlook

Since the new crown outbreak in 2020, our country and around the world within the scope of the various countries and regions are subjected to a different extent will be coronavirus. Large crowds gather in public places such as hospitals, Banks, schools; epidemic prevention and control is an important link of the epidemic prevention and control, and in the public places are a lot of contact with people for a long time table, The instant disinfection, and temperature detection functions brought by the product can also play the greatest value, reducing the heavy tasks of the daily staff in these places, while ensuring the fast, efficient and reliable health and epidemic prevention work. Therefore, this product has a wide market, which hospitals, companies, and schools can use. Moreover, its health function in the epidemic environment also makes this product of extremely important safety value. Its market value is very considerable, and its low cost is conducive to the actual promotion of the market in the later period.

B. Summarize

The intelligent table for epidemic prevention overall structure is simple, the cost is relatively low, geared to the needs of user groups widely, through the preliminary test, can further play the role of epidemic put control, can satisfy the user's daily work and study at home, we will follow-up to debug through the APP, a key to achieve convenient user disinfection, even if I wasn't at home can also remote disinfection. and our current design works have applied for the national patent certificate, with two core technologies of mechanical parts and electronic control. We believe that we can also develop this technology more widely in the future.

ACKNOWLEDGMENT

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