3rd International Conference on Mechatronics and Intelligent Robotics (ICMIR-2019)

Design of Office Intelligent Lighting System Based on Arduino

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Abstract.

In view of the current problems of energy waste in China's office lighting, lack of intelligent lighting control and single adjustment mode, based on the domestic intelligent control system, development status, current stage technology, etc., this paper proposes to adopt arduino as the main controller, combine with the infrared inductive sensor and the light sensor , the wifi network is used as the communication mode, and the delay, turn-off control and dimming functions can be automatically realized according to the detection condition of the sensor, thereby realizing the detection of the office lighting environment and the control and adjustment of the office lighting fixture. The purpose of this system is that it has the characteristics of low cost and low carbon green, which is very suitable for office environment.

1 Introduction

At present, there are many problems in traditional office lighting system,among which the waste of energy and the suitability of indoor illumination are the most significant.Therefore,in the design of the lighting system,on the basis of the realization of convenient lighting,to minimize the waste of resources,make full use of natural light sources,and combine the indoor and outdoor natural light to adjust the illuminance of the lamps.Based on arduino's intelligent office lighting system,it uses advanced electromagnetic voltage regulation and electronic sensing technology to monitor and track power supply in real time, automatically and smoothly adjust the voltage and current amplitude of the circuit,and reduce the additional power consumption caused by unbalanced load in the

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lighting circuit.Improve the power factor,reduce the working temperature of the lamps and lines,and achieve the lighting control system for optimizing the power supply.On this basis,a series of programs are designed to automatically control the opening and closing of the lamp,adjust the brightness of the lamp,and set the scene function for the office staff.The most satisfying visual effect.The intelligent lighting control system based on arduino can provide us with the most comfortable lighting through reasonable management.It can reduce the energy consumption of the office with the most economical energy consumption in work and life. In addition,it provides research ideas for electronic sensing technology and sensor detection technology,and broadens the application field.

2 Overall System Design

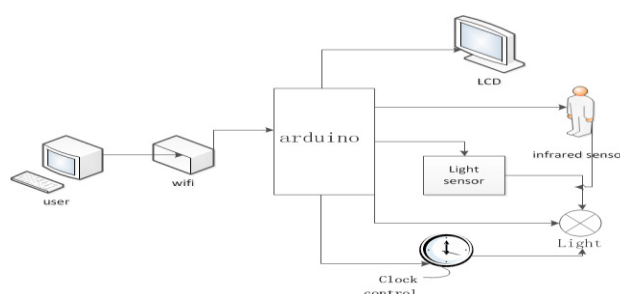Office intelligent lighting system structure shown in Figure 1.

Figure 1. system structure.

Different sensors in the system are placed together with the controller in the room,the indoor parameters detected by different detection devices are transmitted to the user through the arduino controller.The arduino microcontroller is not responsible for collecting data.It is only responsible for transmitting the data collected by each node to the system through the communication network.Arduino is responsible for the acceptance and processing of data,and transmits it to the LCD for display according to the relevant attributes of the data,and then uploads it to the client data center through the communication network.The intelligent lighting system has an automatic brightness adjustment function,which helps the user to adjust the brightness of the indoor light at any time to achieve the most comfortable lighting effect.At the same time,people can remotely operate the mobile phone,remotely control the indoor lighting switch,brightness adjustment,and scene presets.This kind of instant feedback mode can avoid the waste of resources of indoor lamps when people go out,has strong efficiency,and can provide people with the most comfortable illumination in real time.

3 System hardware design

3.1 Communication Network

In order to make the system more convenient to connect with PC or mobile devices and avoid trivial wiring,the WiFi network is selected as the carrier for transmitting and receiving data. The Esp8266 is an ultra-low power UART-WiFi chip designed for mobile devices and IoT applications.This module provides users with a highly integrated WiFiSoc solution that can be used as a slave to run on other host MCUs.In the development environment of Esp8266,a small wireless LAN can be set up through corresponding configuration. The Esp8266 has a rich hardware interface that supports UART, I^2C,PWM,GPIO and ADC,and is a very suitable module for IoT applications.

3.2 Intelligent Lighting System

The intelligent lighting system is essentially different from the traditional office lighting.The traditional lighting is controlled by "strong" and "strong".The common wall switch or the disconnect switch in the distribution box is used to control the phase of the control circuit to achieve the control of the loop.The intelligent lighting system is

"weak" and "strong" .The user does not need to touch the strong electricity at all,greatly reducing the incidence of safety accidents,and the control methods are diversified.The switch can control any circuit in the system,thus breaking either set of lights,you can also set other functions.The system is mainly composed of a clock module,a communication module,a light detection module,a human body infrared sensing module,a control module and an execution device,and the execution device has an LED light and an LCD display.The hardware wiring diagram of this system is shown in Figure 2.
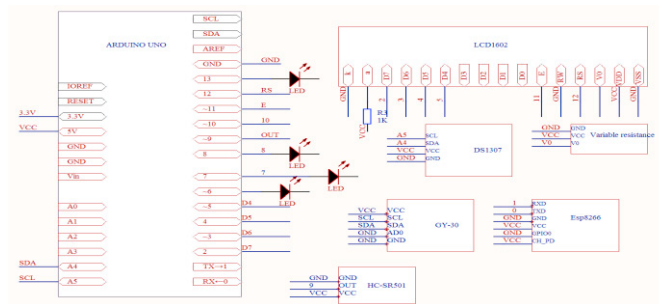
Figure. 2. System wiring diagram

The working principle of the system is on the PC device to write the program to realize the required functions,and then upload the controller main board.The controller is used as the control center and is divided into manual and automatic modes.The pins are connected to the sensors below,and the default level is low.In the automatic mode,when the sensor detects the specific content,the original low level is turned to the high level,the related lamps are lit,or the curtain is turned on;in the manual mode,the control center and the sensor are transmitted and accepted data through the wireless wifi.the user sends an instruction,and then directly turns the low level of the lamp port to a high level,thereby achieving the user's needs.

4 System Software Design

4.1 Software Design for Intelligent Lighting

The software design is divided into clock module,communication module, illumination module,human body infrared module,controller and execution device. The execution device has LED light and LCD display.Each module communicates with each other and interacts to complete the system function.The overall flow chart of the intelligent lighting system is shown in Figure 3.
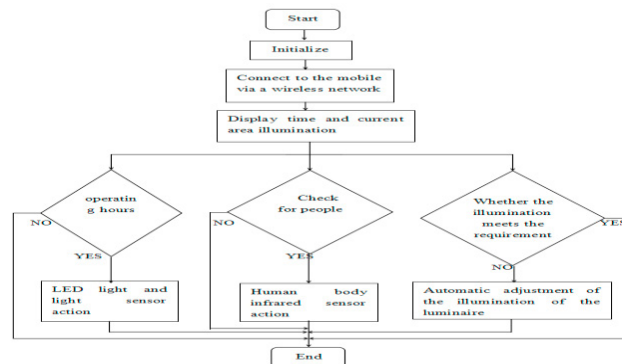
Figure. 3. System flow chart

4.2 Clock Module

This system selects DS1307, DS1307 adopts I2C interface.I2C is a synchronous protocol with a clock signal that allows multiple slave devices to be connected to a single bus.I2C slave devices are distinguished by address,and as long as the addresses do not conflict,many devices can be connected.The I2C speed is 100 kbs,400 kbps and 1 Mbps.The working principle is to initialize the module time,and then call the RTC library function to correct the time between the module and the connected PC. When compiling,the current time value of the PC is written into the module chip,and then the time is displayed on the LCD screen.The subtitles of the LCD screen are made clear by changing the resistance value of the variable resistor.

4.3 GY-30 Lighting Module

The module's illuminance sensor uses the BH1750FVI chip.The module has a 16-bit digital-to-analog converter built in.It can directly output a digital signal without complicated calculations.The illuminance sensor adopts the principle of thermoelectric effect.This sensor mainly uses a detecting component that has high sensitivity to low light. In the linear range,the output signal is proportional to the natural illuminance.In the linear range,the output signal is proportional to the natural illuminance.The visible light transmitted through the filter is irradiated to the imported photodiode,and the illuminance of the visible light is converted into an electrical signal by the photodiode,and then the electrical signal enters the sensor's processing system.Within the system,the binary signal to be obtained is output.

The illumination module obtains valid data by calculating the voltage,and this photosensor can be measured directly by a photometer.The communication method of this module is I2C protocol,which uses two-wire system to transmit serial port data. Its working principle is mainly to transmit and receive data through addresses.First define its first address in arduino,introduce an interface as the transmit and receive address,and use another pin as the port to transmit data.The module converts the detected electrical data into illuminance by the illumination calculation formula.The formula required to convert an optical signal into a digital signal is:

$$va = (va << 8) + (c \,\&\, 0xFF)$$
$$va = va / 1.2$$

Where va is the illuminance defined by the serial port and c is the electrical signal data received by the system.

According to relevant research,the most suitable light intensity in the office is 300lx,but according to the actual situation,the illumination of 250lx is the most comfortable for the human body.

4.4 Communication Network

The ESP8266 is an ultra-low-power UART-WiFi pass-through module with industry-leading package size and ultra-low power technology designed for mobile devices and Io T applications that connect users' physical devices to Wi - On the wireless network, perform Internet or LAN communication to achieve networking.ESP8266 has various packaging methods,The antenna can support on-board PCB antenna,IPEX interface and stamp hole interface.ESP8266 can be widely used in smart grid,intelligent transportation,smart furniture,handheld equipment,industrial control and other fields.

4.5 Human Body Infrared Sensor Module

This system uses the HC-SR501 module.This module is inexpensive,and the biggest advantage of the HC-SR501 is that there are two detection modes.There are two knobs to adjust the sensitivity and delay.The three pins next to the knob are used as the detection mode select the jumper.If the jumper cap is inserted in the upper two pins,it is in the single detection mode,and the lower two pins are in the continuous detection mode.

Single detection mode:When the sensor detects the movement of the human body,the system outputs a high level.After a period of time delay,the high level changes to a low level,and the number of detections is only one time;

Continuous detection mode:When the sensor detects the movement of the human body,the system outputs a high level,but if the human body continues to move within the sensor range,the high level of the sensor remains valid until the human body leaves the sensor detection range,and the high level becomes Low level.

4.6 Scene Setting Module

This module sets the scene in advance.When it is used,the user can obtain the corresponding scene by simply sending commands through the network.The scenes designed by the system are:

Light up a different number of lights.If there is someone in a certain area,you can just light the lights in this area,such as the switch of the conference room and office lights.

Light up the lights of different colors.If people work for a long time,the eyes feel sour,then you can light up the green light to relieve eye fatigue;if you are at school time,the fluorescent light used in normal times is too strong,you can choose the warm light now;if you want To dreamlike scenes,just turn on the blue phantom light to make people feel like a fairy tale,giving people great pleasure.

Entertainment mode:If people have worked hard for a certain period of time to complete a project or work,then you can choose the entertainment mode,the lights flash and alternately,and enjoy yourself.

5 Conclusion

In general,the system designed this time focuses on energy conservation, cost reduction,safety improvement, and easier maintenance for the future system.It also basically completes the initial verification and feasibility of the office lighting system,and from the hardware.The overall function of the software has also been realized.This system will have very important significance and reference value for the field research and industrial actualization of the future office intelligent control lighting.

6 References

1. M Mediawan,M Yusro and J Bintoro.Arduino.Automatic Watering System in Plant House -Using Arduino.[J].IOP Conference Series: Materials Science and Engineering;2018.Vol.434,012220.
2. Zoltan Gingl, Robert Mingesz, Gergely Makan and Janos Mellar.Driving with an Arduino? Keep the lane![J].Physics Education;2019.Vol.54,025010.
3. Al Mubarok Abdul Goffar,Djatmiko Wisnu, Yusro Muhammad.Design of Arduino-based small wind power generation system.[J].E3S Web of Conferences;2018.Vol.67,01006.
4. N N Mahzan, N I M Enzai, N M Zin and K S S K M Noh.Design of an Arduino-based home fire alarm system with GSM module.[J].Journal of Physics: Conference Series;2018.Vol.1019,012079.
5. A V Kudryashov,E S Galishheva and A S Kalinina.Arduino.Adaptive lighting system.[J].IOP Conference Series: Materials Science and Engineering;2018.Vol.451,012206.
6. Lisa A Ostrin.Arduino.Ocular and systemic melatonin and the influence of light exposure.[J].Clinical and Experimental Optometry;2019.Vol.102,99-108.
7. Jie Chen,Ben M.Chen,Jian Sun.Complex system and intelligent control:theories and applications.[J].Frontiers of Information Technology & Electronic Engineering;2019.Vol.20,1-3.
8.   Stefan.M.Abelin.Intelliget monitoring &   control capability.[J].World Pumps;2017.Vol.2017,30-32.
9. Jagannathan, S (Jagannathan, Sarangapani).Intelligent Control.[J].IEEE CONTROL SYSTEMS MAGAZINE;2015.Vol.35,19-20.
10. Safwan Hafeedh Younus,Aubida A.Al-Hameed,Ahmed Taha Hussein,Mohammed Thamer Alresheedi,Jaafar M. H. Elmirghani.Parallel Data Transmission in Indoor Visible Light Communication Systems.[J].IEEE.